“For some must watch, while some must sleep”

(Shakespeare, Hamlet - Act. III, Sc. ii)
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EDITORIAL

UNUSUAL RESPONSE TO MUSCLE RELAXANTS IN THE PREGNANT WOMAN UNDERGOING CESAREAN SECTION

Succinylcholine is usually recommended for tracheal intubation in the pregnant woman scheduled for Cesarean section under general anesthesia, while nondepolarising relaxant is used to maintain muscular relaxation throughout surgery. However, the use of both muscle relaxants may be complicated by the physiological and/or the pathological changes associated with pregnancy.

Because the parturient should be always considered as a patient with a full stomach and a possible difficult airway, succinylcholine is considered the muscle relaxant of choice for rapid sequence induction of general anesthesia. During pregnancy, the level of plasma cholinesterase which hydrolyses succinylcholine is moderately decreased, and hence hydrolysis of succinylcholine remains within the normal range. Also, the duration of action of succinylcholine will be only moderately prolonged in the heterozygote atypical parturient. However, in the parturient inheriting homozygote atypical esterase, hydrolysis of the injected succinylcholine is negligible with a consequent very prolonged neuromuscular block, which allows the transmission of the unhydrolysed succinylcholine across the placenta to the fetal circulation. This can be complicated by neuromuscular block in the fetus who may have inherited a homozygote atypical plasma cholinesterase if the father is homozygote or heterozygote carrier of the enzyme.

In addition to the possible prolonged neuromuscular block, succinylcholine administration may result in rare but very serious complications such as anaphylactic reactions. Also, it can trigger excessive potassium release in the parturients suffering from denervation conditions such as the quadriplegic patient or patients suffering from neurologic diseases such as guillain Barré syndrome.

The abnormal response to muscle relaxants during pregnancy is not limited to succinylcholine, but can also complicate nondepolarising muscle relaxants. Administration of nondepolarising relaxants during repeated Cesarean section can result in serious IgE-mediated anaphylactic reaction which may culminate in maternal cardiac arrest. Fortunately, the placenta plays an important role in protecting the fetus against drug-induced anaphylactic reaction in the parturient. The placental barrier will prevent crossing of the high molecules-weight IgE antibodies to the fetus. Also, the high diamine oxidase of the maternal decidua will catalyze the oxidative deamination of histamine and other related endogenous amines released during anaphylaxis. Several case reports document the successful resuscitation of pregnant women in cardiac arrest after perimortem Cesarean delivery. The time interval from cardiac arrest to delivery is probably the single most important factor for fetal survival. If the fetus is delivered within 5 minutes, intact neurological survival is increased for both the mother and the newborn.

Abnormal response to nondepolarizing muscle relaxants during pregnancy can also occur in the undiagnosed myasthenia gravis parturient. Myasthenia gravis is easily missed during pregnancy. Misdiagnosis might lead to serious complications affecting both the mother and the neonate. The mother given the normal dose of nondepolarizing muscle relaxant can develop a prolonged and profound neuromuscular block which cannot be adequately reversed by neostigmine. Also, the neonate may develop transient myasthenia gravis symptoms. The onset of neonatal myasthenic
symptoms occur within the first two hours following delivery in 75% of the cases for a mean duration of 18 days.

Whenever nondepolarising relaxants are used in eclamptic patients receiving magnesium sulphate therapy, its dose should be carefully titrated. The anticonvulsant effect of magnesium is usually attributed to both its central depressant action and its peripheral depressant effect on neuromuscular transmission. At the neuromuscular junction, magnesium decreases the presynaptic release of acetylcholine, as well as reduces the sensitivity of the post-junctional membrane to the liberated acetylcholine, and decreases the excitability of the muscle fibers membrane. These effects will potentiate the action of the neuromuscular blocking drugs, particularly the neuromuscular block of nondepolarising relaxants. Also, whenever magnesium is administered postoperatively to toxemic patients recovering from general anesthesia including muscle relaxants, its dose should be carefully titrated to avoid post operative recurarization.

Pheochromocytoma during pregnancy may mimic the usual symptoms and signs of preeclampsia. Paroxysmal attacks may be precipitated by postural changes, the mechanical effect of the gravid uterus in the last trimester, uterine contractions during labor and increased fetal movements. These signs and symptoms may mimic that of preeclampsia and is therefore often missed, and misdiagnosed as preeclampsia. However, hypertension associated with pheochromocytoma is seldom accompanied by oedema or proteinuria, while glycosuria is often present. Fortunately, the use of intravenous labetalol or hydralazine as well established in preeclampsia, and its use in combination with magnesium sulphate has been recommended in patients with pheochromocytoma. In this situation, the interaction of magnesium sulphate with muscle relaxants must be considered.

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References

Background: Post-thoracotomy pain is the most severe types of postoperative pain. This study compares the effects of intrapleural bupivacaine and morphine on post-thoracotomy pain.

Methods: In a double blind clinical trial study, 30 patients candidate for unilateral thoracotomy were randomly divided into bupivacaine and morphine groups. Patients in the morphine group received 0.2 mg/kg morphine and those in the bupivacaine group received 1 mg/kg bupivacaine by an intrapleural catheter placed at the end of surgery by direct vision. Intrarpleural morphine and bupivacaine continued every 4 hours for the next 24 hours. If required, systemic analgesia with morphine (patient-controlled analgesia, PCA) also used as a postoperative analgesic. The amount of morphine consumption and level of postoperative pain at 2, 6, 12 and 24 hours after surgery were recorded.

Results: Patients did not differ significantly in terms of age, gender and duration of surgery. There were no significant differences between the two groups with regard to their mean score of pain at 2 and 6 hours of the surgery; however, the level of pain was significantly lower in the bupivacaine group compared to the morphine group at 12 and 24 hours of the surgery. In the bupivacaine group, the mean level of intravenous opioid used over the 24 hours following surgery was significantly lower than in the morphine group.

Discussion: Intrapleural injection of bupivacaine can be more effective in reducing post-thoracotomy pain compared to intrapleural morphine.

Introduction

Post-thoracotomy pain is the most severe types of post-operative pain and occurs in more than 70% of patients. Pain control and restoration of proper lung function is a primary objective in the post-thoracic surgery period. By creating a vicious cycle of hypoventilation, discharge accumulation and atelectasis the pain causes hypoxia, hypercapnia and, consequently, progressive intrapulmonary shunt, and ultimately exacerbates the patient’s problems. In addition, the failure to properly improve pain leads to stressful postoperative responses and endocrine and metabolic...
disorders. Given that most patients undergoing thoracotomy have underlying cardiopulmonary problems and are usually ASA (American Society of Anesthesiologists) III and IV, pain control becomes even more important. Accordingly, some surgeons tend to use less harmful techniques such as muscle-sparing posterolateral thoracotomy or video-assisted thoracoscopy, while others focus on improving pain management techniques, such as the use of regional anesthesia, epidural anesthesia, and intravenous patient-controlled analgesia. Another pain management technique used is the intrapleural anesthesia - an effective simple technique with few side-effects. In this technique a catheter is placed between the visceral and parietal pleura, which then exits through the skin and thus a permanent or intermittent anesthetic infusion is performed. Numerous studies have confirmed the effects of intrapleural bupivacaine and morphine on post-thoracotomy pain as well as their minimal side-effects. Considering the different mechanisms of these two drugs and the potential side-effects of each, this study aims to compare the effects of intrapleural bupivacaine and morphine on post-thoracotomy pain.

**Methods**

In a double-blind and random manner, 30 patients of ASA of class I-III aged between 18 and 80 years admitted to Shahid Beheshti hospital of Kashan for elective unilateral thoracotomy were selected. Patients with allergic reactions to local anesthetics, obesity (Body Mass Index greater than 40), significant central nervous system disease, who have pneumonia, empyema, or known pleuritic, with a history of alcohol, drugs, anticonvulsants, antidepressants, benzodiazepines, antihistamines consumption, as well as patients with liver and kidney failure were excluded.

Following the approval of the university’s Ethics Committee and after obtaining the patients’ informed consent, they were admitted to the operating theater and received 10 mg/kg Ringer’s lactate solution intravenously. Premedication was performed with 0.05 mg/kg midazolam in addition to 2 μg/kg fentanyl. General anesthesia was induced using 5 mg/kg thiopental while 0.5 mg/kg atracurium was used for facilitating intubation. Anesthesia was maintained with 0.5%-1% isoflurane and 100% oxygen. Atracurium was repeated according to neuromuscular monitoring of the patient while fentanyl dosage was repeated every hour with the last does given 30 minutes before the end of surgery. Surgery was performed with a posterolateral incision on the 5th and 6th intercostal space. At the end of the surgery, an 18G epidural needle was inserted through the 1st intercostal space right above the incision line and a 20 G catheter was inserted into the pleural space at approximately 15 cm insertion level, the catheter was fixed to the parietal pleural while sutured to the skin. Two posterior or anterior chest tubes were then inserted. At this stage, the patients were divided into either morphine or bupivacaine group using the random number table. Prior to extubating the patient, the chest tube was blocked for about 15 minutes and the initial dose of both drugs were administered interpleurally. Patients in the morphine group received 0.2 mg/kg morphine sulfate while patients in the bupivacaine group received 1 mg/kg bupivacaine. After reversal of the muscle relaxant with 0.04 mg/kg atropine and 0.07 mg/kg neostigmine and ensuring proper ventilation, the patients were extubated and then transferred to the recovery room followed by admission to the ICU. Patients who required tracheal intubation after surgery were excluded from the study.

After 4 hours from first intrapleural injection, patients in the morphine group received 0.1 mg/kg morphine sulfate, while patients in the bupivacaine group received 1 mg/kg bupivacaine and continued to receive the drugs every 4 hours for 24 hours. In both groups, the chest tube was closed for 30 minutes prior to the administration of the drugs. Syringes containing equal volumes (40 ml) of drugs were prepared by trained nurse not involved in the study and then the questionnaires were completed.

Patients in both groups received intravenous patient-controlled analgesia (PCA) with morphine (0.2mg/ml, 4 ml /hour background infusion, 1ml / 15 min bolus dose, lockout 15 minutes) with a PCA device for 24 hours postoperatively. Pain scores were calculated at 2, 6, 12 and 24 hours of the surgery (from hour zero of recovery) during the rest and deep breathing, using the Visual Analogue Score (VAS). Fifteen five patients per group was calculated
with a power of 80% for detecting a 50% difference in pain scores between the 2 study groups at a significance level of 0.05.

Demographic characteristics of patients, duration of surgery, the amount of morphine consumption, pain at 2, 6, 12 and 24 hours after surgery during the rest and the deep breathing were recorded and analyzed by SPSS software. Statistical tests of the T-test, and chi-square test was used. Data are presented as mean± standard deviation(Mean±SD). A p-value 0.05 was considered significant.

Results

Patients demographics for both group were not statistically different (Table 1).

There was no significant difference between the bupivacaine and the morphine group with respect to the mean scores of pain at rest and deep breathing at 2 and 6 hours after the surgery; however, the level of pain at rest and deep breathing was significantly lower in the bupivacaine group at 12 and 24 hours after surgery compared to the morphine group (Table 2) (Table 3).

Discussion

Effective postoperative pain management is an integral part of the treatment procedure of patients undergoing thoracic surgery. Several methods are used to relief pain after thoracotomy. In this study we used intrapleural bupivacaine and morphine on post-thoracotomy pain. The mean scores of pain at rest and deep breathing at 2 and 6 hours after the surgery in two groups were equal; however, the level of pain was significantly lower in the bupivacaine group compared to the morphine group during the 24 hours period after surgery (Figure 1).
at rest and deep breathing was significantly lower in the bupivacaine group at 12 and 24 hours after surgery compared to the morphine group. Morphine consumption was significantly lower in the bupivacaine group compared to the morphine group during 24 hours after surgery. In a study, Mann et al. used a 50 mg/kg of intrapleural bupivacaine every 4 hours for post-thoracotomy pain and succeeded in significantly reducing postoperative pain compared to the negative control group. In another study conducted by Mansuri et al. in order to control post coronary artery bypass pain, 20 ml 2.5% intrapleural bupivacaine (50 mg) was used prior to the surgery, which led to a lower postoperative pain in the bupivacaine group compared to the control group. In Kadkhodaie et al. study, patients received 2 mg/kg bupivacaine through the thoracic catheter post-thoracotomy and were compared the group that received intravenous pethidine. Results showed the same level of pain in both groups but greater complications in the pethidine group. On the other hand, other studies have investigated the effects of intrapleural opioids. Dabir et al. compared 0.2 mg/kg intrapleural morphine against intravenous morphine and showed that intrapleural morphine is more effective. Few studies have compared the effects of intrapleural opioids and bupivacaine. Esem et al. evaluated the effects of intermittent paravertebral intrapleural bupivacaine and morphine on pain management in patients undergoing thoracotomy and compared with intermittent systemic analgesia over a period of 72 hours. Pain score was lower in the morphine and bupivacaine groups compared with control group at all postoperative time points. After 6 and 24 hours, the level of pain was lower in the morphine group compared to the bupivacaine group. In a study by Dabir et al. intrapleural morphine resulted in greater pain reduction compared to the bupivacaine group. In the present study, however, no significant difference was observed in the analgesic effects of morphine and bupivacaine in the first 6 hours after surgery, but after 12 and 24 hours of the surgery, the level of pain was significantly lower in the bupivacaine group compared to the morphine group. For understanding the differences between the results of the present study compared to results of other studies, two major. First, a lower dose of morphine was used in the present study compared to other studies. The initial dose of intrapleural morphine used was 0.2 mg/kg, which was repeated at a dose of 0.1 mg/kg every 4 hours; however, in the studies by Dabir et al. and Esem et al., a 0.2 mg/kg dose of intrapleural morphine was used and repeated every 4 hours so that their maintenance dose of morphine was twice as in the current study. In the aforementioned studies, the higher dose of opioids used can justify the lower degree of pain in the morphine group compared to the bupivacaine group. Second, difference can also be attributed to the direct effects of opioids on pain terminals in the

Fig. 1
Morphine consumption with the PCA (Mean±SD) in the two groups during 24 hours after surgery

![Morphine consumption with the PCA](image)

*p < 0.05
pleural space. Many human and animal studies have shown that in addition to their central effects, opioids can also develop analgesia in surgery-damaged tissues by affecting the peripheral pain receptors at nerve endings. Another point that has been proved in human and animal studies is that the topical and systemic use of d, k and m receptor agonists and the endogenous opioids affect the damaged tissues more than the healthy tissues22,23. These opioid receptors are placed on the sensory neurons of small, medium and large diameters. Inflammation of peripheral tissues broadly acts as a regulator of opioid receptors in the sensory neurons, which increases the analgesic effects of opioids on the inflamed tissues. Therefore, in the first hours of neuron damaging, both the peripheral and central opioid receptors play a role in the management of postoperative pain24.

As such, it seems that in the present study, during the first hours within surgery, morphine reduced the level of pain in the patients through both peripheral and central mechanisms. In the later hours, by reducing inflammation and eliminating the peripheral effects of intrapleural morphine, only its central effects remained involved in pain control. As a result, within 6 hours, the analgesic effect of intrapleural bupivacaine was greater than morphine’s. This also supported is borne true by the lower amount of PCA opioid used by patients in the bupivacaine group.

Conclusion

Results of the present study thus showed that the injection of intrapleural bupivacaine can be more effective in reducing post-thoracotomy pain compared to intrapleural morphine. Given that intrapleural bupivacaine does not increase the respiratory depression risk that is often associated with opioids, it can be a suitable pain management option for thoracic surgeries.

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References


RAPID FLUID ADMINISTRATION AND THE INCIDENCE OF HYPOTENSION INDUCED BY SPINAL ANESTHESIA AND EPHEDRINE REQUIREMENT: THE EFFECT OF CRYSTALLOID VERSUS COLLOID COLOADING

HAKKI UNlugenc*, MEHIDA TURKAN*, ISMAIL CUNeyT EVErUKe**, MURAT GUNDUz*, REFIK BURGUT***, HACER YAPICIOGLU-YILDIZDAS**** and GEYLAN ISIK*

Purpose: Spinal anesthesia for caesarean delivery is often associated with hypotension. This study was conducted to evaluate the effects of rapid crystalloid (Lactated Ringer’s solution; LRS) or colloid (hydroxyethyl starch; HES) cohydration with a second intravenous access line on the incidence of hypotension and ephedrine requirement during spinal anesthesia for cesarean section.

Methods: We studied 90 women with uncomplicated pregnancies undergoing elective cesarean section under spinal anesthesia. Intravenous access was established in all patients with two peripheral intravenous lines, the first being used for the baseline volume infusion. Immediately after induction of spinal anesthesia, LRS (Group L) or HES (Group C) infusions were started at the maximal possible rate via the second line in groups L and C respectively. In the third group (Group E), patients received lactated Ringer’s solution at a ‘keep vein open’ rate to maintain the double-blind nature. The incidence of hypotension, ephedrine requirements, total amount of volume and side effects were recorded.

Results: The incidence of hypotension was significantly greater in group E than in groups L and C, and greater in group L than in group C (p<0.03 and p<0.01 respectively). The total dose of ephedrine used to treat hypotension was significantly less in groups L and C than in group E (p<0.001 and p<0.001 respectively). Groups L and C received similar infusion volumes and doses of ephedrine.

Conclusions: Giving either LR or HES coloading via a second IV line caused less hypotension and required less use of ephedrine compared to no coloading. There were no maternal or neonatal side effects.

Keywords: Anesthetic techniques-subarachnoid, Pharmacology-agonists adrenergic, Fluid Therapy, Fluids iv.

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Introduction

Spinal anesthesia for cesarean delivery often causes hypotension, which requires rapid and aggressive treatment to prevent maternal and neonatal side effects. Lateral uterine displacement, the use of IV fluid preload or coload, vasopressors, and compression devices on the legs, have all been used to restore venous return and arterial blood pressure during spinal anesthesia. Phenylephrine and ephedrine are used to treat and prevent hypotension induced by spinal anesthesia; a prophylactic phenylephrine infusion together with fluid cohydration can effectively eliminate hypotension, but maternal reactive hypertension and bradycardia, may be a problem, even at slow infusion rates. Unlike phenylephrine, ephedrine can cause fetal acidosis, and large doses are associated with maternal nausea and vomiting. Rapid fluid administration on initiation of spinal anesthesia offers an alternative technique, but it can cause hypervolemia, risking pulmonary edema, decreased oxygen-carrying capacity and poor wound healing. Thus far, no method has proved entirely satisfactory.

In this study, we aimed to evaluate the effects of rapid crystalloid (Lactated Ringer’s solution; LR) or colloid (hydroxyethyl starch; HES) cohydration via the second intravenous access line during spinal anesthesia for cesarean section. The hypothesis was that cohydration with LR or HES, beginning at the time of spinal injection, will reduce hypotension and ephedrine use.

Method

Faculty Ethics Committee approval and informed parturient consent was obtained. This trial was registered at Clinical Trials.gov with trial registration number: NCT01741610.

90 ASA physical status I or II, with a singleton uncomplicated pregnancy at full-term gestation, undergoing elective cesarean section under spinal anesthesia were included in this prospective, randomized, controlled study. Exclusion criteria included significant coexisting disease such as pre-eclampsia and hepato-renal disease, pregnancy preinduced hypertension, being in active labor or requiring emergency cesarean section, and any contraindication to regional anesthesia such as local infection or bleeding disorders.

Parturient were instructed preoperatively on the use of the verbal rating scale (VRS) for pain assessment. All were fasted for 6 hours pre-operatively and no premedication was given. Intraoperative monitoring included lead II electrocardiogram (ECG), pulse oximetry and automated blood pressure cuff. Systolic blood pressure (SBP), heart rate (HR), and oxygen saturation (SpO2) were monitored before spinal anesthesia and throughout the operation. Intravenous access was established with two peripheral intravenous lines (20 Gauge). The first was used for the baseline volume infusion; all parturient received iv 10 ml/kg/h of lactated Ringer’s solution while the block was being performed.

Using a computer generated sequence patients were randomly allocated to one of three groups of 30 patients each. Group L received 1000 mL of lactated Ringer’s solution via the second peripheral intravenous line with the flow-control clamp fully open. The Colloid group (Group C), similarly received 1000 mL of 6% hydroxyethyl starch (HES) (Voluven®). Group E received lactated Ringer’s solution at a ‘keep vein open’ rate as control group. All study solutions were covered by a non-transparent plastic bag to maintain the double-blind nature of the study.

The spinal blocks were performed by experienced, qualified anesthetists using a standard spinal anesthetic technique. A 26 gauge Pencil Point spinal needle was inserted at the L3-4 or L4-5 intervertebral level via a midline approach. Following skin preparation and local infiltration with 1% lidocaine, the subarachnoid space was then punctured with the parturient in the sitting position. After return of clear cerebrospinal fluid a standard spinal anesthetic consisting of 0.5% heavy bupivacaine 10 mg combined with 25 mcg fentanyl was given. After intrathecal injection, the parturient were placed supine with a 15°-20° left uterine tilt for the prevention of aortocaval compression. Immediately after induction of spinal anesthesia, lactated Ringer’s or colloid infusions were launched at the maximal possible rate in groups L and C. It was planned that if this 1000
mL coloading was complete before the end of surgery, lactated Ringer’s solution would be launched at a ‘keep vein open’ rate in groups L and C. Oxygen 2–4 L/min was delivered routinely via nasal cannula until delivery. No additional analgesic was administered unless requested by the patients.

A T₃ sensory dermatome level was obtained before surgical incision in all parturient. After delivery, umbilical artery blood gas samples (pH, PO₂, PCO₂ and HCO₃⁻) were taken and neonatal Apgar scores were recorded at 1 and 5 min by an attending pediatrician. Demographic data (age, height, weight, parity and gravity) and duration of surgery were noted by an observer blinded to the treatment group. Systolic and diastolic blood pressures (SBP, DBP), heart rate (HR) and peripheral oxygen saturation (SpO₂) were recorded by an anesthetist blinded to the patient group, preoperatively and at 1, 3, 5, 10, 15, 20, 30, 45 and 60 min after the IT injection and at 5, 15, 30 min and 1, 2, 6, 12, 24 hours postoperatively.

Sensory and motor block levels were assessed and recorded at 1, 5, 15, 30 and 60 min after IT injection. Sensory block was assessed by pinprick test. Motor block was assessed by modified Bromage score (0, no motor loss; 1, inability to flex the hip; 2, inability to flex the knee; 3, inability to flex the ankle). The duration of total sensory block (defined as the time for regression of two segments from the maximum block height evaluated by pinprick) and of spinal anesthesia (defined as the period from spinal injection to the

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Fig. 1
Flowchart of the patients
bradycardia (heart rate <50 beats/min), hypoxemia (SpO₂ <95 %), excessive sedation, pruritus, dizziness, nausea and vomiting were recorded. Discharge criteria for the ward were resolved motor block, stable vital signs, and absence of nausea, vomiting and pain.

**Data Analysis**

The primary study endpoint was the ephedrine requirement (incidence of hypotension). We calculated that 90 women, 30 for each group would be required to
Table 1
Demographic data, patient characteristics, duration of surgery, sensory and spinal block in groups

<table>
<thead>
<tr>
<th></th>
<th>Group L (n=30)</th>
<th>Group C (n=30)</th>
<th>Group E (n=30)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (year)</td>
<td>30.8 ±5.8</td>
<td>31.8±5.2</td>
<td>29.8±4.2</td>
<td>0.3</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>162.7±5</td>
<td>163.7±5.5</td>
<td>161±5.8</td>
<td>0.2</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>84.5±11.4</td>
<td>85.7±14.4</td>
<td>79.5±10</td>
<td>0.1</td>
</tr>
<tr>
<td>Parity</td>
<td>2.6±1.4</td>
<td>2.5±1.1</td>
<td>2.7±1.5</td>
<td>0.8</td>
</tr>
<tr>
<td>Gravidity</td>
<td>2.9±1.7</td>
<td>2.8±1.1</td>
<td>3.1±1.6</td>
<td>0.7</td>
</tr>
<tr>
<td>Duration of surgery (min); median (range)</td>
<td>52 (30-120)</td>
<td>47 (25-120)</td>
<td>46 (25-105)</td>
<td>0.1</td>
</tr>
<tr>
<td>Duration of sensory block (min); median (range)</td>
<td>58 (25-120)</td>
<td>63 (24-120)</td>
<td>57 (28-120)</td>
<td>0.1</td>
</tr>
<tr>
<td>Duration of spinal block (min); median (range)</td>
<td>124 (45-180)</td>
<td>134 (50-200)</td>
<td>133 (45-220)</td>
<td>0.6</td>
</tr>
</tbody>
</table>

Data are presented as mean ± SD or median (range).

Table 2
Neonatal Apgar scores and umbilical artery gas values

<table>
<thead>
<tr>
<th></th>
<th>Group L (n=30)</th>
<th>Group C (n=30)</th>
<th>Group E (n=30)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apgar score 1. min median (range)</td>
<td>8 (4-9)</td>
<td>8 (3-9)</td>
<td>8 (5-9)</td>
<td>0.4</td>
</tr>
<tr>
<td>Apgar score 5. min median (range)</td>
<td>9 (7-10)</td>
<td>9 (7-10)</td>
<td>9 (8-10)</td>
<td>0.5</td>
</tr>
<tr>
<td>Umbilical artery blood gases</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td>7.32±0</td>
<td>7.32±0</td>
<td>7.34±0</td>
<td>0.5</td>
</tr>
<tr>
<td>pO2 (mmHg)</td>
<td>23.5±9</td>
<td>23.1±9.1</td>
<td>26.9±16</td>
<td>0.4</td>
</tr>
<tr>
<td>pCO2 (mmHg)</td>
<td>44.3±9</td>
<td>46.5±9.4</td>
<td>43±8.2</td>
<td>0.3</td>
</tr>
<tr>
<td>HCO3</td>
<td>22.1±2.8</td>
<td>23.1±4.8</td>
<td>22.5±2</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Data are presented as mean±SD or median (range).

Table 3
Sensory and motor blockade levels

<table>
<thead>
<tr>
<th></th>
<th>Group L (n=30)</th>
<th>Group C (n=30)</th>
<th>Group E (n=30)</th>
<th>P K-Wallis test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensory block level</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 min</td>
<td>T6 (T3 T12)</td>
<td>T6 (T3 T12)</td>
<td>T6 (T3 T10)</td>
<td>0.3</td>
</tr>
<tr>
<td>5 min</td>
<td>T4 (T2 T6)</td>
<td>T4 (T3 T10)</td>
<td>T4 (T2 T8)</td>
<td>0.4</td>
</tr>
<tr>
<td>15 min</td>
<td>T4 (T2 T6)</td>
<td>T3 (T3 T10)</td>
<td>T4 (T3 T8)</td>
<td>0.4</td>
</tr>
<tr>
<td>30 min</td>
<td>T4 (T2 T6)</td>
<td>T4 (T3 T8)</td>
<td>T4 (T2 T8)</td>
<td>0.1</td>
</tr>
<tr>
<td>60 min</td>
<td>T4 (T2 T10)</td>
<td>T4 (T3 T6)</td>
<td>T5 (T3 T6)</td>
<td>0.8</td>
</tr>
<tr>
<td>Motor block level (Bomage)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 min</td>
<td>2 (0 3)</td>
<td>2 (1 3)</td>
<td>3 (0 3)</td>
<td>0.2</td>
</tr>
<tr>
<td>5 min</td>
<td>3 (1 3)</td>
<td>3 (3 3)</td>
<td>3 (2 3)</td>
<td>0.2</td>
</tr>
<tr>
<td>15 min</td>
<td>3 (3 3)</td>
<td>3 (3 3)</td>
<td>3 (3 3)</td>
<td>0.3</td>
</tr>
<tr>
<td>30 min</td>
<td>3 (2 3)</td>
<td>3 (3 3)</td>
<td>3 (2 3)</td>
<td>0.1</td>
</tr>
<tr>
<td>60 min</td>
<td>3 (2 3)</td>
<td>3 (3 3)</td>
<td>3 (1 3)</td>
<td>0.3</td>
</tr>
</tbody>
</table>

Data are presented as median (range).
After 1 and 5 min and umbilical artery gas samples were also similar (Table 2). Maternal SpO₂ values remained within the normal range throughout the perioperative and postoperative study period. Sensory blockade achieved T5 and above within 10 min in all parturient, with no significant differences in the level of sensory or motor blockade between groups (Table 3). Perioperative SBP and HR variables are shown in Figure 2-3. There were no significant differences in perioperative and postoperative hemodynamic variables (SBP and HR) between groups.

Transient hypotension occurred in each group despite volume coloading. The incidence of hypotension after spinal anesthesia was 43% (13/30) in Group L and 20% (6/30) in group C. It was 66% (20/30) in Group E and significantly greater than in groups L and C (p<0.03, p<0.01, respectively). There was less hypotension in Group C than in group L (p<0.05), (Table 4). The total amount of volume infused was significantly greater in groups L and C than in group E (p<0.001, p<0.001). Significantly less ephedrine was used in the coloading groups than in group E (p<0.001). Groups L and group C received similar total fluid volumes and ephedrine doses (Table 4).

Nausea was experienced by 10 patients (33%) in group L, by 7 patients in group C (23%) and by seventeen patients in group E (56%); which was successfully treated by correcting hypotension. There was more nausea in group E than in groups L and C (p<0.01, p<0.03) (Table 4). No major side effects or

<table>
<thead>
<tr>
<th>Table 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Incidence of hypotension and nausea, total amount of volume infused and vasopressor requirements</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Group L (n=30)</th>
<th>Group C (n=30)</th>
<th>Group E (n=30)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total volume infused (mL)</td>
<td>2552±572*</td>
<td>2233±479*</td>
<td>1617±297</td>
<td>0.001</td>
</tr>
<tr>
<td>First IV Line</td>
<td>1478±490</td>
<td>1336±341</td>
<td>1541±296</td>
<td>0.1</td>
</tr>
<tr>
<td>Second IV Line</td>
<td>1074±290*</td>
<td>930±185*</td>
<td>86±40</td>
<td>0.001</td>
</tr>
<tr>
<td>Total ephedrine dose (mg)</td>
<td>8±14&quot;</td>
<td>3.6±9.2&quot;*</td>
<td>15.3±17.4</td>
<td>0.003</td>
</tr>
<tr>
<td>(2.6 13.3)</td>
<td>3.6(0.2 7.1)</td>
<td>15.3 (8.7 22)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incidence of hypotension; n (%)</td>
<td>13/30(43%)*</td>
<td>6/30(20%)*</td>
<td>20/30 (66%)</td>
<td>0.001</td>
</tr>
<tr>
<td>Incidence of nausea; n (%)</td>
<td>10 (33%)*</td>
<td>7 (23%)*</td>
<td>17 (56%)</td>
<td>0.03</td>
</tr>
</tbody>
</table>

Data are presented as mean±SD, mean (95% CI) or n (%).
* p<0.05 compared with group E.
† p<0.05 compared with group L.

Results

Ninety patients were enrolled and completed the study. A flowchart of the patients was shown in Figure 1. There were no significant differences between groups in demographic data, patient characteristics and the duration of surgery (Table 1). Neonatal Apgar scores

**Statistical analyses**

Normality was checked for each continuous variable, and normally distributed values were expressed as mean (SD) or (95% CI), number (%), others as median (range) where appropriate. Demographic (gestational age, maternal age, height and weight) data were analyzed using one way ANOVA. Clinical data were analyzed using the Kruskal-Wallis test. If there were significant differences among the three groups, the analysis was continued with posthoc comparisons of differences between pairs of groups by using Mann-Whitney’s U-test. The incidence of hypotension in the groups was compared by Chi-square test. If there were significant differences between multiple groups, a multiple comparison was applied with Bonferroni’s correction (p<0.05/n; where n= number of comparisons) and p<0.017 considered statistically significant. Hemodynamic data were analyzed by repeated measure analyses. The incidence of intra- and postoperative adverse events were analyzed using Chi-square tests. Values of p < 0.05 were considered statistically significant. Statistical analyses were performed using the statistical package SPSS v 19.0 (Inc, Chicago, USA).
complications related with spinal anesthesia were recorded.

Discussion

Depending on the definition used, the incidence of hypotension caused by spinal block in pregnant females has been reported as 90%8,9. Current strategy for avoiding hypotension following spinal anesthesia would appear to be fluid therapy combined with the appropriate vasopressor, dependent on patient status10. However, there is no reliable way to determine how much volume or vasopressor is required to compensate for the decrease in systemic vascular resistance caused by sympathetic blockade. In routine clinical practice, generally single peripheral intravenous line (18-20 Gauge) is used to treat hypotension during cesarean section surgery and this frequently cannot compensate for the decrease in systemic vascular resistance caused by sympathetic blockade (at T4), even at the flow-control clamp fully open rate. Therefore, giving rapid fluid coloading via second IV line can be an alternative approach to increase stroke volume while decreasing vasopressor need. In the present study, regardless of the fluid used, rapid coloading via second IV line caused less hypotension and required less use of ephedrine compared to no coloading.

Rapid and generous fluid administration may expand the intravascular space and lead to activation of atrial natriuretic peptide, thereby counteracting the desired volume-expanding effects11,12. However, debate has been going on not only as to the optimal fluid volume and type (crystalloid versus colloid), and timing of fluid administration but also as to type and dose of vasopressors used (phenylephrine versus ephedrine)1,2.

In a recent Cochrane analysis, Cyna et al13 investigated 75 trials to assess the effect of prophylactic interventions for hypotension following spinal anesthesia for cesarean section and found that no single or combined prophylactic intervention avoids the need to treat a proportion of women for hypotension following spinal anesthesia for cesarean section. However, no conclusion has been drawn from the above analysis with respect to the optimum volume and the infusion rate of fluids needed to restore hemodynamic function during spinal anesthesia. In the present study, fluid infusion was given more rapidly with the use of two peripheral intravenous lines to achieve optimum and acute peak expansion of intravascular volume.

Block height determines the extent of sympathetic blockade and thus the degree of volume expansion to be replaced after spinal anesthesia. Sensory block levels were similar between groups, but the incidence of hypotension and ephedrine requirements were significantly greater in group E. The fluid coloading in groups L and C was probably adequate to compensate for the decrease in systemic vascular resistance caused by sympathetic block.

Most studies have attempted to restore venous return using crystalloids, but colloids remain within the intravascular space for longer and less is needed to restore hemodynamic function14. Thus, our parturient receiving 6% HES experienced less hypotension than those receiving crystalloid or only ephedrine. It may not be possible to infuse crystalloids fast enough to maintain intravascular volume and avoid hypotension during spinal anesthesia because of the short intravascular half-life15. Sharma et al16 reported that patients given 500 mL of hetastarch had a 21% incidence of hypotension after spinal anesthesia compared to a 55% incidence in patients given 1000 mL of LR. Zorko et al17 found that hydroxyethyl starch increased cardiac output during development of sympathetic block after spinal anesthesia.

Volume kinetic studies suggest that giving fluids as a coload at the time of onset of spinal anesthesia might be better than using a preload8. In the present study, fluid coloading from the second iv access was started immediately after induction of spinal anesthesia rather than before. Rapid administration of crystalloid preload before spinal anesthesia does not decrease the incidence or severity of hypotension after spinal anesthesia15. Dyer et al reported that rapid crystalloid administration after, rather than before the induction of spinal anesthesia for elective cesarean section, provides better maternal hemodynamic control and lower ephedrine requirement prior to delivery4. Kamenik et al18 found that cardiac output remained elevated above baseline in patients given coload (11.3%) 30 min after induction of anesthesia, whereas it returned to baseline
30 min after spinal anesthesia in those given preload (20%).

Many clinicians recommend the avoidance or severe limitation of the use of vasopressors in parturient, because of their untoward side effects, but treat the hypotension aggressively after spinal anesthesia\textsuperscript{19}. A recent review article states that hemodynamic stability after spinal anesthesia may be best restored by a low-dose phenylephrine infusion\textsuperscript{1}. This was confirmed in the last European survey and phenylephrine administration has been recommended as the fastest and most effective way of restoring mean arterial pressure\textsuperscript{20}. Although use of a prophylactic phenylephrine infusion concurrently with a fluid coloading can virtually eliminate hypotension associated with spinal anesthesia, maternal reactive hypertension and bradycardia still occur\textsuperscript{2,3}. Ephedrine has a long history of use in obstetrics, and is still used\textsuperscript{21}. It may be that obstetric anesthetists may feel more comfortable with it than with phenylephrine\textsuperscript{1}. We found the incidence of hypotension and total dose of ephedrine used to treat hypotension after spinal anesthesia were greater in group E than in groups L and C.

Spinal hypotension often causes nausea and vomiting, which can be largely avoided by maintenance of maternal blood pressure. Kee et al found that maintaining maternal systolic blood pressure at 100\% of baseline was the best way to avoid nausea and vomiting\textsuperscript{22}. However, we found an incidence of hypotension after spinal anesthesia of 43\% (13/30) in Group L, 20\% (6/30) in Group C, and 66\% (13/30) in Group E. The incidence of nausea was 33\% (10/30) in group L, 23\% (7/30) in group C and 56\% (17/30) in group E. There was a positive correlation between hypotension and nausea. Most nausea episodes coincided with episodes of hypotension and were successfully treated by correcting this.

The main limitation of this study is that a non-invasive hemodynamic monitoring (ie. echocardiography) has not been used to document cardiac output during the fluid therapy. Non-invasive cardiac output monitoring in patients undergoing cesarean section with spinal anesthesia might provide more accurate determination of fluid responsiveness.

Our study supports the idea that maintaining homeostasis by infusing rapid volume coloading and minimizing the use of vasopressors in pregnant patients is an acceptable strategy because of the possible adverse consequences of vasoconstrictors. Thereby, fluid coloading via a second IV line might be an alternative approach to compensate for the decrease in systemic vascular resistance caused by sympathetic blockade while avoiding untoward side effects of vasopressors and indicated in parturients for whom ephedrine or phenylephrine are contraindicated.

In conclusion we found that parturient given either LR or HES coloading via second IV line experienced a lower incidence of hypotension and required smaller doses of ephedrine, without causing maternal or neonatal side effects compared to parturient given no coloading. 6\% HES was associated with a lower incidence of hypotension after spinal anesthesia than crystalloid, although the volumes given were similar in the two groups.

**Acknowledgement**

The authors gratefully acknowledge the routine assistance of nursing staff and surgical colleagues.
FLUID COLOADING AND INCIDENCE OF HYPOTENSION

References


OPIOID ADMINISTRATION AS PREDICTOR OF PEDIATRIC EPIDURAL FAILURE

JAMES J. MOONEY* AND ASHLEY MC DONELL**

Background: Increasing use of regional analgesia in pediatric populations requires a better understanding of when analgesic techniques need revising or supplementation. This study was conducted to examine intra-operative opioid use as a predictor of post-operative epidural failure.

Methods: Retrospective chart review of patients having epidurals placed intra-operatively. 229 epidurals were placed during the study, with 75 excluded. Dosing and quantity of opioids used intra-operatively were compared to the primary outcome of epidural failure, as well as duration of infusions and pain scores.

Results: Opioid use was associated with increased epidural failure, particularly in less than 12 hours. However, no distinct point of certain epidural failure was found.

Conclusions: Opioid use after epidural loading correlates with increasing risk for epidural failure. Anesthesia providers should consider replacing or supplementing epidurals with increasing use of opioids.

Keywords: Epidural Analgesia, Epidural Anesthesia, Opioid Analgesics, Outcomes Assessment, Pediatrics.

Introduction

Reliable prediction of epidural failure in pediatric anesthesia is difficult, and testing of block adequacy is generally prohibited by placement after induction of general anesthesia. Changing physiologic parameters, such as blood pressure and heart rate, are used as substitute indicators of inadequate analgesia.

Unfortunately, there are multiple factors contributing to variation in vital signs during surgery, including stimuli outside of the surgical area, changing anesthetic levels, and tourniquet related discomfort. Many of these stimuli may lead to the use of intravenous opioids during anesthesia. However, this makes it difficult at times to determine the effectiveness of an epidural.

This uncertainty can lead to a patient emerging from anesthesia with an inadequately functioning epidural and inadequate intravenous analgesia. Additional information that might improve the ability to predict a failed block would improve patient care. The purpose of this study was to evaluate the hypothesis that opioid use after initiation (or ‘loading’) of an epidural block may correlate with the success or failure of an epidural.

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Corresponding author: James Mooney, MD. Penn State Milton S. Hershey Medical Center, Penn State College of Medicine, Department of Anesthesiology, Mail Code H187, 500 University Drive, P.O. Box: 850, Hershey, PA 17033-0850. Phone: (717)531-4264, Fax: (717)531-4110. E-mail: mooney.kiddoc@gmail.com.
Methods

This was a prospective observational study of routine anesthetic care, without randomization or control groups. All anesthesia patients between 7/20/2010 and 5/20/2011 were screened for epidural placement as part of a pre-existing billing/review process within the Department of Anesthesiology & Pain Medicine at Seattle Children’s Hospital after IRB approval and waiver of consent. In patients receiving epidurals both paper (anesthesia records) and electronic (Clinical Information System [CIS] and Pain service database) records were reviewed for information on epidural loading, intra-operative opioid use, pain scores and possible failure of epidurals.

Patients were excluded if they were admitted to the Neonatal ICU or under 6 months old, remained intubated at the end of procedure, underwent procedures expected to require more than an epidural for analgesia or when an epidural could not be evaluated during or after surgery. Examples of this last group would include epidurals being placed or removed at the end of a surgical procedure or unexpected changes in post-operative care unrelated to the epidural. Other exclusion criteria included being over 18 years of age, catheter dislodgement, and if an alternative pain scoring system was used.

The primary outcome variable epidural catheter failure was defined as epidural removal due to inadequate analgesia or the regular use of intravenous/enteral opioids in addition to the epidural infusion. Determination of inadequate analgesia was made by the acute pain service per their routine clinical practice on a case-by-case basis.

Quantity of opioid doses used intra-operatively was measured as either absolute number delivered, or doses per hour. The dose of opioids administered was measured as mcg/kg or mcg/kg/hour. All measures of opioid administration ignored opioids used prior to epidural loading, under the assumption that these were associated with induction of anesthesia. Secondary outcome measures included the first 24 hours of pain scores, and the duration of epidural infusion without removal or supplementation.

Spearman’s rho was used for correlations between intra-operative opioid use and the outcome measures of epidural failure, pain scores and infusion duration. A p value < 0.05 was considered statistically significant.

Results

After IRB approval and waiver of consent, 229 patients who had epidurals placed were identified. After exclusion criteria, patient ages ranged from 6 months to 18 years, with a mean of 8.3 years. Patient weights ranged from 4.49 to 108.2 kg, with a mean of 33.96 kg (Std Dev 23.9).

A total of 75 patients were excluded, most frequently for being under six months of age or postoperative care in the NICU (33 patients). Twenty two patients could not have their epidurals evaluated due to being placed or removed at the end of the procedure. Less common reasons for exclusion included being over 18 years of age (6 patients), catheter dislodgement (5 patients), remaining intubated (4 patients), procedures requiring more than an epidural for analgesia (3 patients) and post-operative seizures in a patient with a seizure disorder requiring a highly sedating regimen (1 patient). Due to the low use of opioids besides fentanyl, all comparisons using opioid dosing are based exclusively on those patients receiving only intra-operative fentanyl. The exception to this is binary state comparison of opioids used/ no opioids used.

For the primary outcome measure of epidural failure there were a significant number of measures that showed significant correlations. No use of opioids after epidural loading was negatively associated with epidural failure in less than 12 hours (-0.239 p=0.005), and epidural failure at any time (-0.221 p=0.009). The hazard curve for opioid use is illustrated in Figure 1. Opioid use measured as the number of doses administered during the procedure (number of doses) correlated with epidural failure in less than 12 hours (0.244 p=0.006) and at any time (0.306 p=0.001), while opioid use measured as number of doses/hour correlated with epidural failure in less than 12 hours (0.272 p=0.002) and at any time (0.207 p=0.02). The hazard curve for number of doses/hour is illustrated in Figure 2. Opioid use measured as mcg/Kg correlated with epidural failure in less than 12 hours (0.324
Fig. 1
Showing the cumulative hazard of epidural failure by groups of patients who received intra-operative opioids and those who did not.

Fig. 2
Showing the cumulative hazard of epidural failure grouped by fentanyl doses per hour.

Fig. 3
Showing the cumulative hazard of epidural failure grouped by fentanyl dosing in micrograms/kilogram/hour.

Fig. 4
Showing the distribution of failed and successful epidurals distributed by patient age and weight in kilograms.

p<0.001), between 12 and 24 hours (0.191 p=0.035) and at any time (0.282 p=0.001). When measured as mcg/Kg/Hr, opioid use correlated with epidural failure in less than 12 hours (0.284 p=0.002) and at any time (0.232 p=0.009). The hazard curve for opioids measured in mcg/Kg/Hr is illustrated in Figure 3.

The secondary outcome of pain scores had fewer correlations. The first post-operative pain score correlated only with opioid use measured as mcg/Kg (0.185, p=0.035), but the third post-operative pain score correlated with opioids measured in mcg/kg, mcg/kg/Hr, and number of doses administered (0.205 p=0.022, 0.180 p=0.043, and 0.186 p=0.038 respectively). Age only correlated with the 5th and
6th pain scores (0.214 p=0.013 and 0.201p=0.019 respectively). Similarly, weight correlated with the 5th and 6th pain scores (0.219 p=0.01 and 0.195 p=0.024 respectively). Figure 4 illustrates the age and weight distribution, with epidural failures and successes.

Discussion

Intra-operative opioid use did correlate with epidural failure, particularly within the first 12 hours. Post-operative pain scores were not as well correlated with opioid use. The failure of epidurals in the first 12 hours supports the idea that opioid use intra-operatively is often masking the sympathetic response to surgical stimulation, i.e. pain.

Perhaps the strongest statistical predictor is opioids measured as mcg/Kg, with correlations to epidural failure in less than 12 hours, between 12 and 24 hours and at any time. The cumulative hazard of 1 before 16 hours at a fentanyl dose of 1 mcg/kg/hour suggests this may be the clearest indicator of epidural failure for clinical practice.

The relative lack of correlation between post-operative pain scores and opioid use is not surprising. Strong correlation would seem surprising to the authors, given the inherent variability in pain score in and between individuals, as well as the fact that rarely are epidurals used without adjuncts (acetaminophen, or non-steroidal) at Seattle Children’s. Additional variability in pain scores of ‘working’ epidurals can come from insufficient infusion rates and changes in activity.

No report was found in the literature of using opioid administration to predict success or failure of regional analgesia. There have been prior attempts, with limited success, using other techniques. Non-invasive attempts have included changes in baseline heart rate ¹, monitoring skin temperature², and plethysmography³. Unfortunately, these techniques do not report successful coverage of the surgical area specifically¹-³, or require special equipment⁴. More invasive measures have included evaluation of anal sphincter tone⁵ and papillary response to electrical stimulation⁶. These techniques require special equipment⁷ or were only evaluated at the end of surgery⁸.

The findings of this study demonstrate another avenue for evaluating epidural success and failure, but do not provide definitive criteria for predicting epidural failure. No opioid administration was negatively associated with failure, but even in that group there were epidural failures. How many of these failures were due to factors within anesthesia staff control (poor placement choices, unrealistic expectation of epidural coverage, etc.) or generally out of their control (patchy blocks, one sided blocks, catheter migration) cannot be evaluated. Given the variable nature of surgical interventions and anesthetics administered to the subjects of this study, we believe these results are broadly applicable to other pediatric populations.

This study had several potential limitations, including the observational design. Lack of information on patient gender, specific surgical procedures and epidural placement locations limited some avenues of analysis, while variations in anesthetic practice were not controlled for. These data points may have provided further analysis, but that is uncertain given the subject group size. The limited data set was chosen with the intention to maximize applicability to general pediatric anesthesia practice.

Not requiring systemic opioids for management during anesthesia is a predictor of a successful epidural. Each use of systemic opioids adds to the risk of a failed epidural as well. Unfortunately, only the relatively high dose of 1mcg/kg/hour fentanyl produced a clear indication of failure. Future studies can examine this issue with specific surgical types, such as orthopedic procedures and abdominal procedures (with the contribution of visceral responses being examined) or specific epidural regimens (such as thoracic placement). Perhaps a larger study population will be able to identify a specific point of significantly increased risk for failure, directing anesthesia care providers to address analgesic inadequacy before the patient leaves the operating suites.

Acknowledgements

The authors would like to thank Dr. Nathalia Jimenez for her advice on statistical analysis in this project.
OPIOIDS AS PREDICTOR OF EPIDURAL FAILURE

References


COMPARISON OF PRE-EMPTIVE EFFECT OF MELOXICAM AND CELECOXIB ON POST-OPERATIVE ANALGESIA: A DOUBLE-BLIND, RANDOMIZED CLINICAL TRIAL

OMID AGHADAVOUDI*, HAMID HAJIGHOLAM SARYAZDI*, AMIR SHAFA** AND ALIREZA RAMEZANI***

Introduction: Pre-emptive analgesia may reduce pain, accelerate recovery and shorten the duration of hospitalization. The present study aims to compare the preemptive analgesic effects of meloxicam and celecoxib in patients undergoing lower limb surgery.

Method: In this double blind randomized clinical trial, 70 patients, undergoing lower extremity surgery, entered the study; thirty five patients were randomly allocated to either group using random allocation software. Meloxicam (15mg) was administered orally to one group two hours before the surgical onset. The other group was treated with oral celecoxib (400 mg) two hours before the operation. Pain severity was compared between the two groups.

Results: Upon admission to Recovery Room, the mean pain severity was not significantly different between the two groups. At one and two hours following surgery the mean pain severity was significantly higher in celecoxib group. However, 6 hours following surgery mean pain severity was higher with meloxicam administration. Pain severity was not significantly different in the two groups, 12 and 24 hours following surgery.

Conclusion: The analgesic effect of celecoxib seems to cover longer duration than meloxicam; but, meloxicam appears to be a stronger analgesic in shorter time interval.

Keywords: postoperative pain, preemptive analgesia, celecoxib, meloxicam.

Introduction

Pain can deeply influence the level of satisfaction and quality of life. Diverse measures have been taken to reduce pain through quick, cheap, accessible and safe methods1.

Post-operative uncontrolled pain has different acute and chronic adverse effects on patients. Pre-emptive analgesia may reduce pain, accelerate recovery and shorten the duration of hospitalization which eventually diminishes the overall cost and burden, and increases the level of satisfaction2-5. One aim is to decrease the need for analgesic medications, and therefore, to lower analgesic induced side effects6.

Preemptive analgesia requires pre-operative administration of analgesic medication, which yields reduced post-operative pain and less need for post-operative analgesic administration7-9. There is growing tendency towards the use of new agents without narcotic properties resulting in respiratory depression, cardiac and urinary side effects10,11. Some studies have shown that

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efficacy of such agents are similar to that of narcotics. Moreover, combination of these agents with narcotic analgesics is far more effective than narcotic analgesics alone.\textsuperscript{12,13}

Surgical procedures damage the tissue which leads to prostaglandin secretion by means of cyclooxygenase enzyme (COX), and increases inflammation and the sensitivity of nociceptors. By blocking COX activity, non-steroid anti-inflammatory drugs (NSAIDs) inhibit the production of prostaglandins.\textsuperscript{14} Specific COX-2 inhibitors can also lead to same effect while causing fewer side effects.\textsuperscript{15} Celecoxib is a COX-2 inhibitor agent that has been shown to be effective in post-operative analgesia.\textsuperscript{16,17} Meloxicam is an NSAID which selectively inhibits COX-2 over COX-1 at low therapeutic doses and has been used to manage pain in human and animals.\textsuperscript{18,19} Meloxicam and robenacoxib, which have similar pharmacologic profiles, have been used in veterinary medicine to reduce pain in cats, and robenacoxib has been shown to be more effective.\textsuperscript{20} The aim of the current study is to compare the pre-operative analgesic effects of meloxicam and celecoxib in patients undergoing lower limb surgeries.

**Materials and Methods**

This is a double blind randomized clinical trial, conducted in 2014 at Alzahra Hospital, Isfahan, Iran. It was approved by the ethics committee of Isfahan University of Medical Sciences (IUMS). Written informed consents were obtained from all patients.

The sample was randomly selected among patients undergoing lower limb surgery under general anesthesia.

Inclusion criteria were patients of age 18-65 years, ASA-I and II, candidates of lower extremity surgery, with absence of coagulopathy, not having any history of peptic ulcer disease, gastrointestinal bleeding, substance dependence or seizure disorder. Patients were excluded from the study if there were deviations in their surgical or anesthetic plan or they received treatment for dysrhythmias, or had an un expected decline in blood pressure. Using a random allocation software 70 patients were randomly allocated to receive either meloxicam (n=35) or celecoxib (n=35). Meloxicam (15mg) in water (5cc) was administered orally to one group two hours before the operation. The other group received oral celecoxib (400 mg) in water (5cc) two hours before the operation. To ensure the blinding process, both celecoxib and meloxicam were identically packed and alphabetically labeled by the pharmaceutical laboratory. Neither the patients nor the clinician who evaluated the patients and collected the data was aware of the patient group allocation. Standard monitoring, including blood pressure, electrocardiogram, pulse rate and O2 saturation, was performed for all patient before, during and after the surgery. Following pre-oxygenation, induction of anesthesia was similarly performed in groups using identical doses of intravenous sodium thiopental (6mg/kg), atracurium0.6 mg/kg, and fentanyl (100 µg). Maintenance of anesthesia was achieved with isoflurane (1.2%), O2 50% and N2O 50%. After induction, intravenous morphine (0.15 mg/kg) was administered to provide analgesia. Exutamation and recovery time was registered for each patient. Patients were discharged from recovery room based on Aldrete score and assessment of consciousness level.

Pain severity was assessed and registered, using Visual Analogue Scale (VAS), on admission to recovery, and at 1, 2, 6, 12 and 24 hours post-operatively. In case of VAS score ≥4, intravenous pethidine (0.5 mg/kg) was administered. Consciousness was evaluated and registered at 1, 2, 6, 12 and 24 hours following surgery. The dosage of medication and side effects were registered for each patient. Time and dosage of first additional analgesic were also registered.

A power analysis considering a confident interval (CI) of 0.95, a power of 80%, a standard deviation of 1.17 for post-operative pain score and a minimum significant clinical difference of 0.8 in the VAS showed that 70 patients will be needed (35 patients in each group). Data were analyzed with Chi-square, Student t-test and repeated measure ANOVA by SPSS 16.0.2. (SPSS Inc. Released 2007. SPSS for Windows, Version 16.0.2 Chicago, SPSS Inc.). Level of significance was considered at p <0.05.

**Results**

Baseline data are presented in table 1 and showed no significant differences between the two groups.
Comparison of mean intra-operative hemodynamic parameters revealed that mean systolic and diastolic blood pressure in both groups was not significantly different. However, pulse rate was significantly higher in patients receiving meloxicam ($p = 0.01$). Also, O2 saturation was significantly higher in patients receiving celecoxib ($p = 0.035$) (Table 2).

There was no difference in the mean extubation time between the two groups (Table 2). Frequency of confusion, vomiting, and additional analgesic administration in recovery room and in the first postoperative 24 hours are presented in Table 3. There was no significant difference in incidence of confusion between the two groups in the 1st hour following surgery. However, in patients receiving meloxicam the incidence of confusion was significantly higher two hours post-operatively. All patients in both groups were completely oriented six to 24 hours following surgery (Table 3).

Frequency of vomiting was not significantly different between the two groups in the recovery room and in the 1st, 2nd, 6th, 12th and 24th hours following the operation (Table 3). During the study, two patients in the celecoxib group and none of the patients in the meloxicam required intravenous metoclopramide.

Frequency of additional analgesic administration in the first two hours after the operation was significantly higher in participants receiving celecoxib.

### Table 1
Demographic data presented as mean±SD

<table>
<thead>
<tr>
<th></th>
<th>Meloxicam (n=33)</th>
<th>Celecoxib (n=35)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yrs)</td>
<td>37.8±14.0</td>
<td>36.9±10.5</td>
<td>0.76</td>
</tr>
<tr>
<td>Body weight (kg)</td>
<td>71.7±6.7</td>
<td>69.3±8.3</td>
<td>0.2</td>
</tr>
<tr>
<td>Gender (M/F)</td>
<td>27/8</td>
<td>26/9</td>
<td>0.78</td>
</tr>
</tbody>
</table>

SD: Standard Deviation.

### Table 2
Comparison of intra-operative hemodynamic parameters as mean±SD

<table>
<thead>
<tr>
<th></th>
<th>Meloxicam (n=35)</th>
<th>Celecoxib (n=35)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart rate (beats/min)</td>
<td>79.4±4.2</td>
<td>76.3±6.4</td>
<td>0.01</td>
</tr>
<tr>
<td>Systolic blood pressure (mmHg)</td>
<td>115.7±5.6</td>
<td>116.1±5.6</td>
<td>0.75</td>
</tr>
<tr>
<td>Diastolic blood pressure (mmHg)</td>
<td>78.9±3.2</td>
<td>77.7±6.1</td>
<td>0.33</td>
</tr>
<tr>
<td>SPO2 (%)</td>
<td>97.1±1.5</td>
<td>97.8±1.1</td>
<td>0.035</td>
</tr>
<tr>
<td>Mean Extubation Time (minutes)</td>
<td>7.83±3.4</td>
<td>7.53±8±</td>
<td>0.16</td>
</tr>
</tbody>
</table>

SD: Standard Deviation.

### Table 3
Frequency of postoperative confusion, vomiting and additional analgesic administration during the first 24 hours following surgery

<table>
<thead>
<tr>
<th></th>
<th>Confusion</th>
<th>Vomiting</th>
<th>Additional Analgesic Administration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>meloxicam</td>
<td>celecoxib</td>
<td>p-value</td>
</tr>
<tr>
<td>On admission to recovery</td>
<td>0(0)</td>
<td>0(0)</td>
<td>1</td>
</tr>
<tr>
<td>1h after surgery</td>
<td>7(20)</td>
<td>5(14.3)</td>
<td>0.53</td>
</tr>
<tr>
<td>2h after surgery</td>
<td>6(17.1)</td>
<td>0(0)</td>
<td>0.025</td>
</tr>
<tr>
<td>6h after surgery</td>
<td>0(0)</td>
<td>0(0)</td>
<td>1</td>
</tr>
<tr>
<td>12h after surgery</td>
<td>0(0)</td>
<td>0(0)</td>
<td>1</td>
</tr>
<tr>
<td>24h after surgery</td>
<td>0(0)</td>
<td>0(0)</td>
<td>1</td>
</tr>
</tbody>
</table>

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(Table 3). However the frequency of additional analgesic administration was higher in patients receiving meloxicam during 24 hours postoperatively (Table 3).

Mean severity of pain was approximately similar in both groups on admission to recovery room. (Table 4). The severity of pain was higher in participants receiving celecoxib at the 1st and 2nd hour following the operation; however, the severity of pain was higher in patients receiving meloxicam at the 6th hour postoperatively. There was no significant difference in the severity of pain, between the two groups, at the 12th and 24th hours following surgery (Table 4).

Discussion

In the present study, we found that both groups had similar levels of blood pressure, although patients receiving meloxicam had significantly higher heart rates. Blood O2 saturation was significantly higher in patients receiving celecoxib. However, both differences do not seem to be of clinical significance. Adverse hemodynamic effect including hypotension and bradycardia were not detected in either group. Therefore, both medications seem to be safe in this regard. Patients receiving celecoxib had better consciousness states. Celecoxib administration was associated with decreased post-operative nausea and vomiting, during the first two hours after the operation, in comparison to meloxicam. Hawkey et al in their study concluded that meloxicam was significantly better tolerated in terms of dyspepsia, nausea and vomiting, abdominal pain and diarrhea comparing with diclofenac in investigating tolerability of the two drugs in a setting of over a 28-day period oral administration\(^{16}\). However we could not find any study comparing the gastrointestinal tolerability of meloxicam and celecoxib in perioperative period.

Meloxicam was associated with decreased severity of pain in the first two postoperative hours. This may be due to the fact that celecoxib reaches peak plasma concentrations after approximately 2-3 hours but meloxicam reaches maximum plasma concentration \((C_{\text{max}})\) at 2.5-7 hours after a 15mg dose\(^{17, 18}\) and our patients had their administration two hours before surgery. The total mean severity score of pain in both groups was not significantly different during the whole 24 hours post-operatively. Although the mean VAS scores had been nearly the same at 24th hour, the additional analgesic administration has been more in meloxicam group statistically. This might be based on the violence of nurses from following the current survey protocol in administering analgesic in the ward.

Al-Sukhun et al indicated that preemptive administration of low dose celecoxib was associated with significant postoperative analgesia in minor oral surgery\(^{19}\). They administered a standard oral dose of 200 mg celecoxib, preemptively 1 h before surgery and this may explain the efficacy of celecoxib in recovery

| Table 4 |

*Comparison of pain severity between meloxicam and celecoxib receiving groups during the first 24 hours following surgery as mean±SD*

<table>
<thead>
<tr>
<th>VAS score</th>
<th>Meloxicam (n=35)</th>
<th>Celecoxib (n=35)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>On admission to recovery</td>
<td>1.03±1.3</td>
<td>1.03±1.2</td>
<td>1</td>
</tr>
<tr>
<td>1h after surgery</td>
<td>2.1±1.2</td>
<td>3.1±1.7</td>
<td>0.007</td>
</tr>
<tr>
<td>2h after surgery</td>
<td>2.3±1.2</td>
<td>3.2±1.7</td>
<td>0.008</td>
</tr>
<tr>
<td>6h after surgery</td>
<td>4.5±2.0</td>
<td>3.4±1.7</td>
<td>0.022</td>
</tr>
<tr>
<td>12h after surgery</td>
<td>4.9±2.0</td>
<td>4.0±2.2</td>
<td>0.07</td>
</tr>
<tr>
<td>24h after surgery</td>
<td>3±1.5</td>
<td>2.6±1.6</td>
<td>0.29</td>
</tr>
</tbody>
</table>
period according to peak plasma concentrations and surgery duration. Boonriong et al concluded in their study that celecoxib showed no significantly difference from placebo at any time points in reducing postoperative pain. Aoki et al concluded that in the setting of surgery with local anesthesia, premedication with meloxicam was effective in reducing postoperative pain in oral outpatient surgery.

Our study was limited in some aspects. In the current study, small sample size and restriction of population to candidates of lower extremity surgery can interfere with generalizability. Also, capability of participants to understand and follow the instruction of VAS may confound the observation.

It is concluded that celecoxib and meloxicam have similar effects on postoperative pain in lower extremity surgery. However, because of more rapid Cmax of celecoxib, it should be administered more closely to the surgery. Both medications are well-tolerated and can be selected based on clinical indications and surgery duration. Further studies comparing the gastrointestinal tolerability of meloxicam and celecoxib in perioperative period is recommended.
References


CLINICAL RESEARCH REGARDING PREEMPTIVE ANALGESIC EFFECT OF PREOPERATIVE KETAMINE AFTER TRANSURETHRAL RESECTION OF PROSTATE

Na Wang*, Yaowen Fu**, Haichun Ma*** and Jinguo Wang****

Objective: To investigate whether a single intravenous dose of ketamine before transurethral resection of prostate (TURP) led to reduced postoperative pain and tramadol consumption.

Methodology: Sixty patients undergoing elective TURP were randomized into one of two groups: the ketamine group (Group K, n=30) received intravenous 0.5 mg/kg ketamine 10 min before surgery, and the control group (Group C, n=30) received an equivalent volume of normal saline 30 min before surgery. A standardized general anesthesia method was used with a laryngeal mask airway device in all patients. Data on pain intensity, incidence of lower urinary tract discomfort, time to the first analgesic requirement, tramadol analgesia and consumption, overall patient satisfaction and side effects were recorded for 24 h after extubation of the patients.

Results: Group K had significantly decreased postoperative pain scores at 1, 2, 6, and 12 h. The number of patients who required postoperative analgesia was fewer and postoperative tramadol consumption was significantly less in Group K as compared with Group C. There was no significant difference in the incidence of lower urinary tract discomfort or any of side effects. The patients in Group K were more satisfied.

Conclusion: Preemptive 0.5 mg/kg ketamine has a definitive role of preemptive analgesia for TURP without influence of LUT discomfort or an increase of adverse effects.

Keywords: Ketamine, Transurethral resection of prostate, Preemptive analgesia.

Introduction

Preemptive analgesia is a pretreatment that prevents the establishment of central sensitization, which amplifies upcoming pain. Various drugs have been used for this analgesic method, but treatments that can prevent the development of central sensitization may have the greatest benefit. It has been shown that central sensitization could be attenuated by 4, 9 N-methyl d-aspartate receptor antagonists. Ketamine, a NMDA receptor antagonist, is an interesting choice for preemptive analgesia. Previous studies indicated that a single small dose of preoperative ketamine can decrease postoperative pain and analgesic requirement in minor surgeries such as outpatient...
surgery, knee arthroscopy, gynecological laparoscopic surgery and laparoscopic cholecystectomy, which cause less tissue trauma. Conceivably, small dose ketamine can’t lead to obvious hemodynamic variation and additional psychotomimetic effects. Transurethral resection of prostate (TURP) is associated with less pain and disability; nonetheless several components contribute to pain after TURP such as tissue trauma at the surgical site, pelvic organ nociception, stimulation due to irrigation and low urinary tract (LUT) discomfort. Most patients scheduled for TURP are elderly, frequently presented with cardiopulmonary comorbidities, increased pain threshold and decreased pain tolerance; as such the improvement in pain control is necessary.

The aim of this study is to evaluate preemptive analgesic efficacy of preoperative intravenous 0.5 mg/kg ketamine after TURP under general anesthesia.

**Materials and Methods**

After obtaining the approval from the local Ethics Committee and written informed consent from the patients, the present study was conducted in a randomized and double-blinded manner on a total of 60 patients with American society of anesthesiologists (ASA) physical status I - II, scheduled for elective TURP using a standardized general anesthesia technique with a laryngeal mask airway (LMA) device.

Patients who were allergic to tramadol or ketamine, with a history of drug abuse, with psychiatric illness and communication difficulties and morbidly obese patients were excluded from the trial.

Randomization was performed with a computer-generated sequence of numbers and sealed envelopes were used to allocate patients into two groups. Group K patients received 0.5 mg/kg ketamine (Jiangsu Hengrui Medicine CO., LTD, Lianyungang, China) 10 min before the surgery, and Group C received an equivalent volume of normal saline. The study drugs were drawn and diluted to a fixed volume of 10 ml by an anesthesiologist who was not involved in the management of anesthesia. The other researchers and patients were blinded to the grouping allocation. All the patients were instructed on the visual analog scale (VAS) preoperatively and instructed of its use as a tool for measuring postoperative pain.

After shifting the patients to the operating theatre, electrocardiogram (ECG), heart rate (HR), blood pressure (BP), Narcotrend index (NI), end-tidal CO₂ (ETCO₂) and oxygen saturation (SpO₂) were monitored throughout the surgical procedure. All patients received 5 ml/kg normal saline over 20 min before anesthetic induction. The intravenous infusion was minimally maintained during the surgical procedure to avoid fluid overload. Anesthesia was induced with 0.3 mg/kg etomidate, 3 µg/kg fentanyl and 0.15 mg/kg cisatracurium. After preoxygenation for 3 min, intubation using a proper-sized LMA was performed.

Anesthesia was maintained with 6 to 8 mg/kg/h propofol and 0.008 mg/kg/h remifentanil, and intermittent administration of cisatracurium as needed. Intravenous 1 µg/kg fentanyl was given to all patients about 10 min before the completion of the surgery.

After extubation, the patients were shifted to the recovery room where the continuing observations were made and recorded by an independent anesthesia registrar who was unaware of the group situation. The pain intensity was evaluated and recorded at 0.5, 1, 2, 6, 12 and 24 h after extubation of the patients at rest. The time 0 h was taken as the time of extubation of the patient. Postoperative analgesia consisted of 1.5 mg/kg intravenous tramadol, which was administered intravenously when the patient complained of pain and the VAS score was more than 3. The time to the first analgesic request, the number of tramadol doses given and patients who required tramadol analgesia were recorded.

The pain intensity was assessed by a linear 10 cm VAS (0- no pain; 1, 2, 3- mild pain; 4, 5, 6- moderate pain; 7, 8, 9- severe pain; 10- worst imaginable pain) and the sedation score was evaluated with Ramsay sedation scale (RSS: 1- anxious and agitated; 2- cooperative and tranquil; 3- drowsy but responds to command; 4- asleep but responds to tactile stimulation; and 5- asleep and no response). The incidence of lower urinary tract (LUT) discomfort was recorded. The overall satisfaction degree for postoperative analgesia was also measured at the end of the study. The overall satisfaction degree was divided as follow: poor, moderate, good, excellent.
Adverse effects associated with ketamine, such as nausea, vomiting, and hallucinations were evaluated with a “yes” or “no” survey. Hallucination was defined as a false sensory experience in which the patients reported they saw, heard, smelled, tasted, or felt something that was non-existent. The study ended at the 24th hour after extubation of the patient.

The time to the first analgesic request was the primary endpoint of this study. According to clinical experiences and previous studies, we assumed that preoperative intravenous ketamine would prolong time to the first analgesic request by 30 min, 23 subjects were required in each group with two-sided $\alpha$ of 5% and $\beta$ of 10%. We decided to enroll 30 patients per group for possible dropouts.

Data were analyzed with the SPSS 17.0 (SPSS Inc, Chicago, IL, USA). Data of the two groups were compared by unpaired Student’s t-test for normally distributed data, Mann–Whitney U-test for nonnormally distributed data (the number of tramadol doses, VAS and RSS scores), and Chi-square or Fisher’s exact test for qualitative data. A value of $P<0.05$ was considered as a statistically significant.

Results

The demographic data and surgical characteristics were comparable with no significant differences between the two groups (Table 1).

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Demographic data and surgical characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group K (n=30)</td>
<td>Group C (n=30)</td>
</tr>
<tr>
<td>Age (years)</td>
<td>67.2±9.5</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>63.2±11.1</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>168.4±9.4</td>
</tr>
<tr>
<td>ASA I / II (n)</td>
<td>15/15</td>
</tr>
<tr>
<td>Duration of operation (min)</td>
<td>45.9±13.7</td>
</tr>
<tr>
<td>Prostate volume (g)</td>
<td>55.6±12.1</td>
</tr>
</tbody>
</table>

ASA: American Society of Anesthesiologists. Values are presented as mean±standard deviation.

The VAS scores at 1, 2, 6 and 12 h were significantly higher in Group C as compared with the VAS scores at the same time point in Group K. At 0.5 and 24 h the VAS scores were comparable between the two groups (Fig. 1).

Table 2 summarizes the use of postoperative tramadol.

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Postoperative tramadol use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group K (n=30)</td>
<td>Group C (n=30)</td>
</tr>
<tr>
<td>Time to the first tramadol request (min)</td>
<td>114.6±32.2</td>
</tr>
<tr>
<td>Number of doses of tramadol (n)</td>
<td>1.8±0.7</td>
</tr>
<tr>
<td>Number of patients requiring tramadol analgesia: n (%)</td>
<td>18(60%)</td>
</tr>
</tbody>
</table>

Values are presented as mean±standard deviation and number of patients (%).

Table 3 summarizes patient satisfaction.

<table>
<thead>
<tr>
<th>Table 3</th>
<th>Patient satisfaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group K (n=30)</td>
<td>Group C (n=30)</td>
</tr>
<tr>
<td>Poor</td>
<td>1(3.3%)</td>
</tr>
<tr>
<td>Moderate</td>
<td>6(20.0%)</td>
</tr>
<tr>
<td>Good</td>
<td>10(33.3%)</td>
</tr>
<tr>
<td>Excellent</td>
<td>13(43.3%)</td>
</tr>
<tr>
<td>P-value</td>
<td>0.037</td>
</tr>
</tbody>
</table>

Values are presented as number of patients (%).

Table 4 summarizes the incidence of lower urinary tract (LUT) discomfort and adverse effects.

<table>
<thead>
<tr>
<th>Table 4</th>
<th>The incidence of lower urinary tract (LUT) discomfort and adverse effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group K (n=30)</td>
<td>Group C (n=30)</td>
</tr>
<tr>
<td>LUT discomfort</td>
<td>8 (26.7%)</td>
</tr>
<tr>
<td>Nausea</td>
<td>5 (16.7%)</td>
</tr>
<tr>
<td>Vomiting</td>
<td>2 (6.7%)</td>
</tr>
<tr>
<td>Hallucination</td>
<td>0 (0.0%)</td>
</tr>
</tbody>
</table>

Values are presented as number of patients (%).
tramadol analgesia. In Group K, the time to the first tramadol request was significantly longer, and the patients who required tramadol analgesia and the number of tramadol doses given were significantly fewer.

The overall patients’ satisfaction degree is shown in Table 3. Patients in Group K were more satisfied compared to patients in Group C.

No statistically significant difference was noted on RSS scores between the two groups at all time points during the study (Fig. 2).

There were no significant differences between the two groups for the incidence of LUT discomfort or any of the adverse events (Table 4). All data of SpO₂ and respiration rate were within the normal range during the study period (93-100% for SpO₂ and 12-16 breath/min for respiration rate) in both groups.

**Discussion**

Surgical stimulation leads to release of glutamate which can activate postsynaptic NMDA receptors in the central nervous system. Activation of NMDA receptor is involved in development and exacerbation of hyperalgesia. Analgesic intervention before surgical stimuli, for example, preoperative administration of ketamine which is an NMDA receptor antagonist may attenuate or block sensitization and hence reduce acute pain.

The role of preoperative intravenous ketamine has been previously reported in outpatient surgeries,
gynecological laparoscopic surgery and laparoscopic cholecystectomy which are all minor surgeries with less tissue damage compared with other types of surgeries\textsuperscript{4,5,6}. Singh et al have reported that VAS scores in the three groups receiving different doses of ketamine were comparable and 0.5 mg/kg ketamine had similar effect to 1.00 mg/kg. According to their study, 1.00 mg/kg ketamine was associated with higher incidence of side effects\textsuperscript{6}. Therefore, the lowest dose of 0.5 mg/kg ketamine was chosen as the study dose in our study.

Our study demonstrated that the patients in Group K had significantly less postoperative pain. The result was consistent with the published researches mentioned above. Whereas some studies have demonstrated no beneficial effect of preoperative ketamine\textsuperscript{9,10,11}. These negative findings could be ascribed to major surgeries in those studies. Major surgeries were usually associated with severe postoperative pain and maybe preoperative ketamine was not potent enough to block central sensitization in this kind of surgeries.

In the present study, intravenous administration of fentanyl 10 min before completion of the surgery might contribute to the comparable VAS scores at the time point of 0.5 h between the two groups. No significant difference was found on the incidence of LUT discomfort between the two groups. It might be associated with the result that ketamine had no function on muscarinic receptor.

The RSS scores were assessed as an indirect reflection of the adverse effect of ketamine. Patients in the two groups had comparable RSS scores at various time points. It implied that preoperative ketamine did not affect sedation status which should be attached attention to in the elder patients after general anesthesia.

In our study, no patients experienced hallucination in Group K. It corresponded to the incidence reported in the literature with the same dosage of ketamine\textsuperscript{6}. The incidence of nausea and vomiting was comparable between the two groups and similar to the previous research\textsuperscript{6}. It was not noted in this clinical trial that a small dose of ketamine could decrease postoperative nausea and vomiting\textsuperscript{12}.

There are limitations about this study. Ketamine is known to alter the neuroplasticity and reduce the development of chronic pain\textsuperscript{13}. We didn’t follow up the patients or evaluate whether chronic pain was reduced with 0.5 mg/kg ketamine. Further studies in this area are suggested.

We conclude that preoperative 0.5 mg/kg ketamine can reduce postoperative pain in patients undergoing TURP without an increase of side effects.
References


“ANESTHETIC SPARING EFFECT OF INTRAOPERATIVE LIGNOCAINE OR DEXMEDETOMIDINE INFUSION ON SEVOFLURANE DURING GENERAL ANESTHESIA”

Siddarameshwar S. Harsoor*, Devika Rani D**, Roopa M.N***, Lathashree S****, Sudheesh K***** and Nethra S.S******

**Background:** Lidocaine and Dexmedetomidine are known to blunt the stress response to surgery, and have anesthetic sparing activity. This study was designed to evaluate and compare the anesthetic sparing effect of intravenous lidocaine with Dexmedetomidine infusion during sevoflurane based general anesthesia and also to assess their effects on hemodynamic parameters.

**Methods:** Forty-eight ASA I–II patients aged between 18–55 yr, scheduled for abdominal surgery lasting less than 2 h, performed under general anesthesia were enrolled and they were randomly allocated to Lido(L), Dexmedetomidine (D) and Saline (S) groups of 16 each. Group L received Inj. Lidocaine at 1.5 mg/kg bolus over 10 min followed by infusion at 1.5 mg/kg/hr, and Group D received Inj. Dexmedetomidine at 1 µg/kg over 10 min, followed by 0.5 µg/kg/hr infusion till the end of surgery. Group S received similar volume of normal saline. Anesthesia was induced with Inj. Propofol and maintained with N₂O in O₂ and sevoflurane, keeping entropy between 40–60. The hourly sevoflurane requirements and hemodynamic parameters were recorded.

**Results:** Demographic parameters, entropy and duration of surgery were comparable. Mean sevoflurane requirement at 1st h in group L and D were 11.6 ± 1.5 ml, and 10.2 ± 1.3 ml respectively, while it was 16.7 ± 4.1 ml in Saline group (P < 0.001). Sevoflurane requirements were significantly lesser in group D compared to group L (P = 0.009). The Mean ETₙₐ values in Group L, D and S were 0.8 ± 0.3, 0.8 ± 0.4 and 1.2 ± 0.5 (P = 0.021), respectively.

**Conclusions:** Both drugs produce significant anesthetic sparing effect during sevoflurane based general anesthesia, but dexmedetomidine has better sparing effect than lignocaine.

**Keywords:** Dexmedetomidine, Intraoperative, Lidocaine, Sevoflurane.

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Introduction

Intravenous (IV) Lidocaine can be used to provide symptomatic relief from cancer pain\(^1\), diabetic neuropathies\(^2,3\), and chronic pain\(^4,5\) without producing any toxic side effects. This analgesic efficacy was attributed to selective depression of pain transmission in the spinal cord\(^4,4\), and a reduction in tonic neural discharge of active peripheral nerve fibers\(^6,7\). Because of its NMDA receptor antagonist activity, lidocaine can reduce volatile anesthetic requirements during general anesthesia. Dexmedetomedine, a highly selective \(\alpha\)-2 adrenergic receptor agonist has sedative, analgesic, anesthetic-sparing properties without any respiratory depression\(^8\). The hypnotic and supraspinal analgesic effects are mediated by the hyperpolarization of noradrenergic neurons, which suppresses neuronal firing in the locus ceruleus due to decreased norepinephrine and histamine release\(^9\).

There are very few studies that compare intravenous lidocaine and dexmedetomedine with regard to anesthetic sparing effect, specially when objective tools like BIS or entropy were used to guide the depth of anesthesia.

Hence this clinical study was designed to compare the effects of IV lidocaine and dexmedetomedine on sevoflurane requirements during entropy guided general anesthesia.

Materials and Methods

After obtaining approval from institutional ethical committee, a randomized, prospective, double blind, controlled, clinical study was formulated, and conducted at our hospital from March 2013 to October 2013.

Forty eight patients were randomly allocated into three groups as Group L (Lidocaine group), Group D (Dexmedetomedine) and Group S (Saline group) using computer based random number generation technique.

Informed written consent was obtained from all patients. The patients with American society of Anesthesiologists (ASA) physical status I and II, aged 18-55 yr, scheduled for elective open abdominal surgery expected to last less than 2 hours, under general anesthesia were included in the study. Hypertensive patients, patients on psychoactive medication, and those allergic to local anesthetics were excluded from the study.

A minimum fasting state of 6-8 hours before anesthesia was ensured in all patients. In the operating theatre IV access was obtained and the standard monitoring consisted of electrocardiography, pulse oximetry, noninvasive blood pressure, entropy sensor, neuromuscular transmission indicator (NMT) and capnography. Midazolam 0.05 mg/kg IV, glycopyrrolate 0.005 mg/kg IV, Fentanyl 2 μg/kg IV were used for premedication. The response entropy was measured with Datex Ohmeda entropy S/5 module. All patients were pre-oxygenated with 100% oxygen for 3 minutes.

Group L received a loading dose of lidocaine1.5 mg/kg IV made to 20 ml with normal saline, over 10 minutes followed by similar volume every hour till the end of surgery. In group D, patients received 1 μg/kg of dexmedetomidine, made to 20 ml, in 10 minutes followed by an infusion of dexmedetomidine 0.5 μg/kg made up to 20 ml, every hour. Group S received similar volume of normal saline. The drug solutions were prepared by anesthesiologists who were not involved in the management of the case. Anesthesia was induced with Propofol until RE reached 50, and confirmed with loss of response to verbal commands. Atracurium 0.5 mg/kg IV was used to facilitate tracheal intubation. Anesthesia was continued with 60% nitrous oxide in oxygen and sevoflurane, and ventilated to maintain ETCO\(_{2}\) between 35-40 mmHg. Sevoflurane concentration was adjusted to ensure adequate depth of general anesthesia as guided by entropy (40-60) and also by clinical variables like HR, systolic and diastolic blood pressures (SBP & DBP), and mean arterial pressure (MAP). Adequate muscle relaxation was guided by NMT monitor. The monitored data were recorded continually at baseline, before induction, after induction, 1 minute after intubation and every 5 minutes thereafter, till the end of surgery. Initially fresh gas flow (FGF) of 6 L/min was used until the difference between end inspiratory and end expiratory sevoflurane concentration was nearly equal and later the FGF was reduced to 2 L/min. Infusion of test drug and sevoflurane administration
was cut off on the beginning of skin closure and the fresh gas flow was increased to 6 L/min oxygen. At the end of the skin closure, residual neuromuscular blockade was reversed with neostigmine 0.5 mg/kg and glycopyrrolate 0.01 mg/kg and trachea was extubated after satisfactory recovery. The duration of sevoflurane usage and duration of anesthesia (min) were recorded. The hourly sevoflurane requirements and total consumption of sevoflurane at the end of the procedure were recorded directly from anesthetic agent monitoring module of Datex Ohmeda Avance S5™ anesthesia workstation. The Minimum alveolar anesthetic concentration (MAC) was derived from end tidal concentration of sevoflurane using a nomogram by Nickalls and Mapleson11.

Intraoperatively, occurrence of bradycardia and hypotension episodes were noted. Bradycardia was defined as heart rate less than 50 beats/ min and hypotension was defined as more than 25% decrease in mean arterial pressure from the baseline. Bradycardia and hypotension if noticed, were treated with atropine 0.5 mg i.v, and fluid boluses and ephedrine 6 mg i.v boluses respectively. Tachycardia was defined as heart rate (HR) more than 110 beats/ min and hypertension defined as increase in mean arterial pressure greater than 25% from the baseline and treated with esmolol infusion. If time from discontinuation of anesthetic to spontaneous eye opening exceeded 30 min, it was considered as delayed recovery and recorded.

**Statistical Analysis**

Sample size was calculated based on the pilot study done on 10 patients. We hypothesized that dexmedetomidine would have greater anesthetic sparing effect compared to Lidocaine. By keeping the confidence limits at 95% and power at 80%, to detect a 15% reduction in sevoflurane consumption assuming an equal standard deviation and normal distribution of values, the required sample size was 13 patients in each group. However for better validation of results we increased the sample size to 16 in each group. All parametric data were presented as mean ± SD, and nominal data were tabulated. One way ANOVA and post hoc analysis with Benferroni’s correction and Dunell’s correction was applied for all parametric data, chi-square test and Fisher exact test applied for nominal data. Furthermore, independent t-test was applied for intergroup comparison of mean values. P value of less than 0.05 was considered statistically significant. Statistical analysis was conducted with SPSS (Version 17) for windows statistical package.

**Results**

Demographic parameters such as age, gender, weight, duration and type of surgery and anesthesia, basal vital parameters and entropy values were similar in all the groups (Table 1). Sevoflurane was used for slightly longer time in group D patients (P = 0.04).

**Table 1**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Lidocaine (n = 16)</th>
<th>Dexmedetomidine (n = 16)</th>
<th>Saline (n = 16)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yrs)</td>
<td>41.2 ± 12.5</td>
<td>48 ± 9.01</td>
<td>46.68 ± 12.48</td>
<td>0.21</td>
</tr>
<tr>
<td>Sex (M:F)</td>
<td>7:9</td>
<td>6:10</td>
<td>7:9</td>
<td></td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>55.60 ± 9.08</td>
<td>51.40 ± 5.08</td>
<td>53.87 ± 6.55</td>
<td>0.25</td>
</tr>
<tr>
<td>Duration of surgery (min)</td>
<td>76.88 ± 15.15</td>
<td>89.33 ± 30.93</td>
<td>74.38 ± 18.52</td>
<td>0.14</td>
</tr>
<tr>
<td>Duration of Anesthesia (min)</td>
<td>92.18 ± 14.94</td>
<td>111.67 ± 38.44</td>
<td>91.88 ± 18.79</td>
<td>0.06</td>
</tr>
<tr>
<td>Duration of Sevoflurane Usage (min)</td>
<td>72.8 ± 15.2</td>
<td>93.67 ± 33.57*</td>
<td>77.19 ± 19.15</td>
<td>0.043</td>
</tr>
<tr>
<td>Types of surgeries</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open cholecystectomy</td>
<td>12</td>
<td>9</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Open cholecystectomy with common bile duct exploration</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>0.7</td>
</tr>
<tr>
<td>Gastric surgeries</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

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Intraoperatively adequate depth of anesthesia was maintained in all the patients with the help of entropy (Fig. 1) and clinical parameters such as heart rate and blood pressure (Figs. 2 and 3).

Mean Sevoflurane requirement at 1st hour in Group S was 16.75 ± 4.07 ml compared to 11.63 ± 1.58 ml in Group L (30.5% reduction), and 10.20 ± 1.32 ml in Group D (39% reduction)(P < 0.01). Post hoc analysis showed significantly lower consumption of sevoflurane in group D compared to group L (P < 0.01) in the first hour. The end tidal concentration of sevoflurane (Et_Sev) was significantly lower in groups L and D compared to group S (P = 0.02). The intergroup comparison indicates that there was no statistically significant difference between Group L and Group D with respect to mean end tidal sevoflurane concentration, although duration of sevoflurane usage was significantly longer in group D (Table 2).

The average MAC was 1.02 ± 0.2, 1.05 ± 0.1, and 1.16 ± 0.2 in Group L, D and group S respectively(P =

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Group L</th>
<th>Group D</th>
<th>Group S</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Et_Sev</td>
<td>0.78 ± 0.3</td>
<td>0.83 ± 0.42</td>
<td>1.18 ± 0.53*</td>
<td>0.021</td>
</tr>
<tr>
<td>Mean Sevoflurane Consumption in 1st hour</td>
<td>11.63 ± 1.58</td>
<td>10.20 ± 1.32*</td>
<td>16.75 ± 4.07*</td>
<td>&lt; 0.0001</td>
</tr>
</tbody>
</table>

Fig. 1
Response Entropy values mean±SD in 3 groups

Fig. 2
The trend in heart rate
During first hour of anesthesia, the heart rates were significantly lower in Group D compared to other two groups. The mean heart rates in group D were comparable to groups L and S after 1st hour. The systolic and diastolic blood pressure was comparable in all the three groups initially, but was significantly higher in group S compared to other two groups after 1st hour. None of the patients in any of the three groups had heart rate or blood pressure instability requiring intervention. There was no incidence of delayed recovery in any of the three groups.

**Discussion**

The present study shows that intraoperative infusions of lidocaine and dexmedetomidine reduces the sevoflurane consumption during entropy guided general anesthesia. Dexmedetomidine caused greater decreases in sevoflurane consumption compared to lidocaine infusion. Degree of surgical stimulus may influence anesthetic consumption and all attempts were made to maintain uniformity in surgical stimulus in the present study, by recruiting patients undergoing upper abdominal surgeries of duration less than 2 hours.

Following systemic administration, lidocaine, a sodium channel blocker, attenuates skin pain in response to mechanical or chemical stimuli through peripheral and central mechanisms in preclinical human volunteer tests. It was observed that IV lidocaine infusion reduced BIS guided propofol requirement. The BIS read zero when lidocaine was inadvertently administered at a dose of 100 mg per minute for 7-8 min indicating that cerebral cortical activity was decreased by systemic lidocaine administration. During the study conducted to explore the effect of lidocaine on MAC, Hodgson and Liru found that during general anesthesia with BIS less than 50, epidural lidocaine reduced sevoflurane requirement by 34%, probably due to rostral migration of lidocaine to the brain cerebrospinal fluid. It was observed that, intraoperative lidocaine infusion reduced sevoflurane requirement by 5% during BIS monitored general anesthesia. During 60% nitrous oxide in oxygen anesthesia, in the current study, it was observed that there was 30.5% reduction in sevoflurane requirement during 1st hour of anesthesia when lidocaine was infused. The greater reduction in consumption noticed in the present study compared to previous ones may be attributed to the use of nitrous oxide.

Edno Magalhaes and others observed that dexmedetomidine infusion at a rate of 0.5 µg/kg over 10 min before the induction of anesthesia and when later maintained with 0.2-0.7 µg/kg/hr until skin closure attenuated sympatho-adrenal response to tracheal intubation. Uyar et al observed that administration of single IV bolus dose of dexmedetomedine 1 µg/kg over 10 minutes before induction of anesthesia resulted in attenuation of hemodynamic and neuroendocrinal responses to skull pin insertion in patients undergoing...
craniotomy. Keniya et al\textsuperscript{23} showed that 1 µg/kg bolus followed by 0.2-0.7 µg/kg/hr of dexmedetomidine infusion not only blunted the sympathoadrenal response to tracheal intubation but also reduced the consumption of fentanyl and isoflurane; however, their measurement were based on the inspired concentration of isoflurane. Patel et al\textsuperscript{24} reported that dexmedetomidine infusion when given as bolus of 1 µg/kg followed by 0.2-0.8 µg/kg infusion, reduced end-tidal sevoflurane concentration by 21%. In the present study, using bolus IV dexmedetomedine 1 µg/kg combined with infusion of 0.5 µg/kg/hr resulted in 39% reduction in sevoflurane requirements during 1st hour of anesthesia. However, end-tidal concentration of sevoflurane in patients receiving dexmedetomidine, in the current study, were lower compared to those reported by Patel et al which may be attributed to the use of fentanyl in the current study. Action of dexmedetomidine at both supraspinal and spinal levels may have attributed to greater reductions in sevoflurane consumption compared to lidocaine. Though patients receiving dexmedetomidine exhibited significant reduction in heart rate intraoperatively, none of these patients required any treatment.

The main limitations of the study are the fact that the MAC was a derived factor from end-tidal concentration. Also, the serum levels of test drugs were not estimated during this clinical study and hence dose response relationship could not be established.

**Conclusion**

IV lidocaine and dexmedetomedine used for preanesthetic and intraoperative infusions produce 30.5% and 39% anesthetic sparing effect respectively during sevoflurane based general anesthesia when compared to normal saline. However dexmedetomedine was found to be significantly more effective than IV lidocaine.
SUBMUCOSAL DISSECTION OF THE RETROPHARYNGEAL SPACE DURING NASAL INTUBATION

MUMIN HAKIM1, RICHARD S. CARTABUKES1,2, SENTHIL G. KRISHNA1,2, GIORGIO VENEZIANO1,2, AHSAN SYED1,2, MEREDITH N. MERZ LIND3, AND JOSEPH D. TOBIAS1,2,4*

Various complications have been reported with nasal endotracheal intubation including bleeding, epistaxis, bacteremia, damage to intranasal structures, and even intracranial penetration. We present two cases that required general anesthesia for dental surgery. Submucosal dissection of the retropharyngeal tissues occurred during attempted nasal endotracheal intubation. Previous reports of this complication are reviewed, treatment strategies presented, and potential maneuvers to prevent this complication suggested.

Introduction

Endotracheal intubation via the nasal route is performed in various clinical scenarios including intraoperative care of patients undergoing oromaxillary or dental surgery. Although generally safe, nasal endotracheal intubation has a greater potential for trauma to the mucosa of the nasopharynx than does routine oral endotracheal intubation. Various complications have been reported including bleeding, epistaxis, bacteremia, damage to intranasal structures, and even intracranial penetration1,2. We present a pediatric patient presenting for dental surgery in whom submucosal dissection of the retropharyngeal tissues occurred during attempted nasal endotracheal intubation. Previous reports of this complication are reviewed, treatment strategies presented, and potential maneuvers to prevent this complication suggested.

Case Report

Institutional Review Board approval is not required at Nationwide Children’s Hospital (Columbus, Ohio) for the presentation of case reports involving two patients.

Patient #1: The patient was a 4-year-old, 20.5 kg girl who presented for oral rehabilitation under general anesthesia for the treatment of dental caries. Her past medical history was significant for recurrent acute otitis media. Her past surgical history included adenotonsillectomy for tonsillar hypertrophy. There were no associated co-morbid conditions. The patient was not on any home medications. Preoperative physical examination revealed a well-appearing girl in no acute distress and a normal systemic examination with dental caries in the oral cavity. On the day of surgery, the patient was held nil per os for 6 hours. She was transported to the operating room and routine

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American Society of Anesthesiologists’ monitors were applied. Anesthesia was induced with the inhalation of sevoflurane in nitrous oxide and oxygen. After the induction of anesthesia, a 22 gauge peripheral intravenous catheter was placed in the left hand and propofol was administered to deepen the level of anesthesia. Bag-valve-mask ventilation was provided without difficulty. Following lubrication of the right nare, a 4.5 mm cuffed endotracheal tube (ETT) was passed through the nare in preparation of nasal endotracheal intubation. Direct laryngoscopy was performed and blood was noticed in the supraglottic area and the oropharynx. The patient’s oropharynx was suctioned and a submucosal bulging was noted in the retropharyngeal space. Pediatric otolaryngology was consulted as it was thought that the nasal ETT had caused a blind submucosal tract. With the nasal ETT in place, an oral 4.5 mm cuffed ETT was placed into the trachea without difficulty under direct vision using a Miller 2 blade. The patient was kept in the supine position and anesthesia was maintained with sevoflurane in air and oxygen. The pediatric otolaryngologist noted a submucosal dissection of the retropharyngeal space. Based on their recommendation, the ETT was removed and prophylactic antibiotics (clindamycin) administered. The dental procedure was then completed without problems. During the procedure, the patient experienced an episode of bronchospasm and mild hypotension which was attributed to an anaphylactoid reaction to the clindamycin infusion. The bronchospasm was treated with albuterol administered via the ETT using a metered dose inhaler and a single intravenous dose of epinephrine (30 µg). Additional medications during the procedure included dexamethasone (4 mg), ondansetron (2 mg), and fentanyl (35 µg). Following completion of the procedure, the patient’s trachea was extubated when awake. She was transferred to the Post Anesthesia Care Unit (PACU) in a stable condition. The patient was kept for observation in the general pediatric overnight. Postoperative pain control was provided by intermittent, as needed doses of oral ibuprofen. A 7 day course of oral antibiotics (amoxicillin-clavulanate) was completed. Her postoperative period was uneventful and she was discharged the next day. No complications related to the submucosal dissection were noted.

**Patient #2:** The patient was a 6-year-old, 22 kg boy who presented for oral rehabilitation under general anesthesia for the treatment of dental caries at the ambulatory surgery center. There was no past surgical or medical history. There were no associated co-morbid conditions. The patient was not on any home medications. Preoperative physical examination revealed a well-appearing boy in no acute distress and a normal systemic examination with dental caries in the oral cavity. On the day of surgery, the patient was held nil per os for 6 hours. He was transported to the operating room and routine American Society of Anesthesiologists’ monitors were applied. Anesthesia was induced with sevoflurane in oxygen and nitrous oxide. After the induction of general anesthesia, a 22 gauge peripheral intravenous cannula was inserted. After achieving topical vasoconstriction with 4 drops of 0.05% oxymetazoline, a softened and lubricated 5.0 mm cuffed nasal RAE ETT was inserted into the right nostril with minimal resistance. Under direct laryngoscopy, the ETT was advanced further; however, the tip of the ETT was not visualized in the oropharynx. The ETT was noticed advancing under the mucosa of the right posterior pharyngeal wall. The procedure was abandoned, the nasal ETT was left undisturbed and an oral ETT was placed without difficulty. A pediatric otolaryngology consultation was obtained. The nasal ETT was removed under direct visualization of the ENT surgeon; however, a posterior pharyngeal hematoma was noted and a CT scan of the neck was recommended. The dental procedure was cancelled and the subsequent CT scan revealed no vascular injury or posterior pharyngeal hematoma. The patient was admitted for overnight observation. Antibiotic prophylaxis was provided by oral Augmentin (amoxicillin-clavulanate potassium). He was discharged home the next day with instructions to follow up in the otorhinolaryngology clinic in 6 weeks.

**Discussion**

Although required to facilitate various oromaxillary and dental surgical procedures, there is a higher incidence of adverse events related to nasotracheal intubation when compared to standard oral endotracheal intubation. A complication rate of 3% to 16% has reported with nasotracheal intubation
NASAL INTUBATION

with many being noted during prolonged attempts due to a higher failure rate when compared with oral intubation. One way of classifying involves separation into adverse events related to: 1) stimulation of the sympathetic nervous system and physiological changes related to pain; 2) occlusive problems related to the presence of an endotracheal tube in the nasopharynx; and 3) traumatic problems. Physiologic changes related to pain and stimulation of the sympathetic nervous system includes hypertension, tachycardia, arrhythmias, and increased intracranial pressure. Occlusive problems include from long term placement of a nasal endotracheal tube and can result in otitis media secondary to the obstruction of nasal and pharyngeal ostiae and maxillary sinusitis. Problems from direct trauma during passage of the endotracheal tube through the nasopharynx include bleeding, damage to the nasal turbinates, bacteremia, dislodgement of adenoids, or even rare reports of penetration of the cranial vault with intracranial placement of the endotracheal tube. Epistaxis is the most common of the traumatic complications with a reported incidence varying from 10 to 80% based on the technique and definitions used. Posterior epistaxis can result in a significant hemorrhage while anterior epistaxis generally resolves on its own.

As noted in our two patients, another albeit rare yet potential complication of nasal endotracheal intubation is the submucosal passage of the ETT. The first report in the literature regarding this complication appeared in 1975 with the description of 3 cases are of retropharyngeal dissection as a complication of nasal endotracheal intubation. In all three of the cases, after introduction of the ETT through the nare, the tip could not be visualized in the oropharynx during direct laryngoscopy. Palpation revealed that the ETT was in the submucosal plane. As noted from the patients reported herein, the initial report from 1975, and others from the literature, retropharyngeal dissection may occur from trauma to the pharyngeal wall during nasal placement of an ETT (Table 1). Fortunately, this complication is generally benign if recognized early. The literature has reported no long term complications related to the creation of the false passage and no reports of significant bleeding although localized hematomas as noted in our second patient have been reported in the literature. However, there remains a risk of morbidity and even mortality if positive pressure is administered as subcutaneous emphysema, pneumothorax, and pneumomediastinum can develop.

This complication can potentially be prevented or its incidence at least decreased by a systematic approach with appropriate preparation of the nare and the ETT prior to its passage through the nostril. Careful selection of the more patent nare can also be helpful. Comparing the airflow or probing with a swab used to apply a topical vasoconstrictor can help in selecting the most patent naris. Alternatively, the nare can be progressively opened by the passage of progressing larger lubricated nasal trumpets. As the ETT is advanced, excessive force should be avoided and the ETT should never be advanced against resistance. The ETT should be advanced in a plane that is parallel to the floor of the hard palate, generally perpendicular to the bed when the patient is supine. Additionally, trauma can be limited by the use of lubrication of the ETT, the application of topical vasoconstrictors, and thermosoftening or warming of ETT. Although various topical vasoconstrictors such as epinephrine, phenylephrine, oxymetazoline, and cocaine have been shown to effective, they may be associated with life-threatening cardiovascular complications including cardiac arrhythmias as well as systemic and pulmonary hypertension.

The bevel of an ETT is left-facing which may favor its advancement through the left nare along the nasal septum with the bevel facing outward thereby potentially limiting trauma. However, a recent study demonstrated no advantage to either the left or right nare regarding success rates and untoward events. Kihara et al compared a silicone-based wire-reinforced ETT with a hemispherical bevel is superior to a polyvinyl chloride (PVC)-based pre-curved tube with a conventional diagonal bevel for nasotracheal intubation in adults. Although the pharyngeal and tracheal placement phases of nasotracheal intubation required fewer attempts with the silicone ETT than the PVC ETT, the glottic placement phase required more attempts. No difference in intubation times was noted between the two groups. The frequency (32% versus 80%; P<0.0001) and severity of epistaxis were less with the silicone ETT. In a similar study to assess the potential impact of ETT design on trauma...
Table 1
Previous reports of submucosal dissection during nasotracheal intubation

<table>
<thead>
<tr>
<th>Authors and reference</th>
<th>Patient demographics</th>
<th>Intraoperative findings and management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peña MT et al(^{15})</td>
<td>A 6-year-old girl for elective surgery. 8-year-old boy with Noonan syndrome with respiratory failure.</td>
<td>Positive pressure ventilation after attempted nasotracheal intubation resulted in subcutaneous emphysema. Procedure was deferred and clindamycin administered for antibiotic prophylaxis. Computed tomography imaging demonstrated air within retropharyngeal tissues and along the right carotid artery. No long term sequelae. Four centimeter laceration of the posterior trachea, developing pneumomediastinum after nasotracheal intubation.</td>
</tr>
<tr>
<td>Ghaffari S et al(^{16})</td>
<td>7-year-old girl for tonsillectomy.</td>
<td>Uncuffed nasal tube was inserted by the surgeon through the right nare. No problem was noted and endotracheal intubation was completed. During the procedure, it was noted that the nasotracheal tube pierced the posterior pharyngeal mucosa and then re-entered oropharynx.</td>
</tr>
<tr>
<td>Bozdogan N et al(^{17})</td>
<td>67-year-old man for uvulopalatopharyngoplasty.</td>
<td>During the surgery, it was noted that the nasotracheal tube had penetrated the oropharyngeal mucosa in the retropharyngeal space and then re-entered the oropharynx. The ETT was left in place during surgery to prevent bleeding. After surgery, a vertical incision was made through the mucosa surrounding the tube from the inferior pouch up to the nasopharynx to explore the site.</td>
</tr>
<tr>
<td>Krebs MJ et al(^{18})</td>
<td>A 54-year-old, 95-kg woman for excision of a mandibular ossifying fibroma.</td>
<td>After passage of the ETT through the nare, direct laryngoscopy could not identify the tip of the nasotracheal tube in the oropharynx. A longitudinal submucosal bulge was noted in the posterolateral wall of the pharynx. Digital palpation confirmed that the tip of the ETT had made a false passage into the nasopharyngeal submucosa. The nasotracheal tube was removed and a standard orotracheal ETT was placed without difficulty. The right-sided nasopharyngeal cavity was packed with sterile gauze for prophylactic tamponade. Clindamycin was administered for antibiotic prophylaxis.</td>
</tr>
<tr>
<td>Chait DH et al(^{19})</td>
<td>33-year-old woman.</td>
<td>Retropharyngeal dissection during nasotracheal intubation was immediately noted during direct laryngoscopy and digital palpation. There was brief epistaxis, which spontaneously stopped. Penicillin was administered for antibiotic prophylaxis.</td>
</tr>
<tr>
<td>Landess WW,(^{20})</td>
<td>90-year-old woman for repair of femoral fracture.</td>
<td>Nasotracheal intubation attempted when oral intubation and direct laryngoscopy failed. Resistance was noted with passage of the nasotracheal tube.</td>
</tr>
</tbody>
</table>

During nasotracheal intubation, although thermostiffening effectively reduced the severity of epistaxis for both types of conventional types of ETT, there was no difference in the severity of epistaxis and the incidence of nasal injury and pain between the Magill-tipped, non-thermo-softened ETT and Murphy-tipped, thermos-softened ETT\(^{32}\).

What is generally accepted is that gentle warming of the ETT reduces the incidence and severity of trauma. The technique is commonly referred to as “thermosoftening”\(^{23,24}\). However, excessive heating can make the ETT too soft thereby making successful passage of the ETT and endotracheal intubation more difficult. In our practice, the ETT is placed in sterile normal saline which is kept in a warmer with the temperature carefully controlled to prevent overheating.

In a prospective comparison, it has been
demonstrated that trauma can be reduced by placing a red rubber catheter over the ETT prior to advancing it through the nasal passage. The tip of the ETT is passed into the flange of the red rubber catheter and the taper end is then advanced into the nasal passage. Direct laryngoscopy is performed and the red rubber catheter is removed as the ETT is advanced once it is visualized in the oropharynx. Although the intubation process took longer with the red-rubber catheter technique, there was less trauma and less bleeding. Similar findings were reported by Enk et al. A finger cot has also been used to protect the advancing end of the ETT and thereby limit trauma; however, these smaller devices can potentially be lost in the nasopharynx or airway and are therefore not recommended. Alternatively, other items such as suction catheters, gum elastic bougies or nasogastric tubes can be passed through the nasal passage to act as a guide for the ETT.

The suggestions made above for the atraumatic passage of a nasal endotracheal tube intranasally can be divided into 3 categories:

Never advance the ETT with against resistance. The ETT should be passed in a plane that is parallel to the hard palate. As there has been an increased use of cuffed ETTs in infants and children, this allows the use of a smaller ETT which may pass more easily through the nasal passages and limit the incidence of trauma. The cuff can then be inflated to seal the airway.

The nasopharynx should be prepared prior to the procedure with a vasoconstrictor. Although there may be significant hemodynamic effects with excessive dosing, the topical application of a vasoconstrictor such as oxymetazoline is suggested. This should be done with careful attention to recent dosing and administration recommendations. The nasal passage can also be progressively dilated by the passage of progressively larger, well-lubricated nasal trumpets.

The distal end of the endotracheal tube can be covered in order to minimize trauma from the leading edge of the ETT with a red-rubber catheter or advanced over a suction catheter or nasogastric tube that has been placed through the nasal passage.

Should submucosal dissection occur, we would recommend the following treatment algorithm:

1. Leave the ETT in place and secure the airway
2. Obtain otolaryngology consultation for direct inspection of the site
3. Never attempt positive pressure ventilation unless the ETT is in the trachea. An unnoticed retropharyngeal dissection can worsen with an attempt to ventilate with the tube or any additional force resulting pneumomediastinum or pneumothorax
4. If there is a concern for hematoma formation or damage to vital structures, a CT scan should be obtained
5. Postoperative inpatient observation is suggested as late bleeding with hematoma formation may compromise the airway
References


A PROSPECTIVE RANDOMIZED COMPARATIVE STUDY TO COMPARE THE HEMODYNAMIC AND METABOLIC STRESS RESPONSE DUE TO ENDOTRACHEAL INTUBATION AND I-GEL USAGE DURING LAPAROSCOPIC CHOLECYSTECTOMY

SAUMYA BISWAS*, SOUMEN MANDAL**, TAPOBRATA MITRA***, SUPRIO DE RAY****, RANABIR CHANDA***** AND DEBAJYOTI SUR******

Background: Surgery and endotracheal intubation both cause an increase in metabolic stress response. This is further aggravated during laparoscopic surgeries. In this study we aimed at comparing hemodynamic and metabolic parameters which are reflective of intraoperative stress response while using I-GEL against endotracheal tube (ETT) during laparoscopic cholecystectomy.

Material and Methods: This is a prospective randomized comparative study among 64 cases of American Society of Anesthesiologists (ASA) physical status class I and II, undergoing laparoscopic cholecystectomy who were randomly allocated into two groups of 32 each using computer generated random number table. Patients were put under general anesthesia using standard protocol. After anesthesia induction and 20 minutes after induction venous blood samples were obtained for measuring adrenaline, noradrenaline, dopamine and cortisol levels. Hemodynamic and respiratory parameters were recorded at the 1st, 5th, 15th, 30th and 45th minutes after the insertion of airway device.

Results: Although there was no significant difference regarding ventilatory parameters there was significant increase in heart rate at 1st and 45th minutes (p=0.02 and 0.034) respectively and increase in mean arterial pressure at 15th and 30th minutes (p=0.034 and 0.026) respectively in the ETT group compared to I-GEL group. Stress hormone intergroup analysis revealed significant increase in serum cortisol 20 minutes after induction in ETT group as compared to I-GEL group (p=0.03).

Conclusion: I-GEL usage is a suitable, effective and safe alternative to ETT in laparoscopic cholecystectomy patients with lower metabolic stress response.

Keywords: Endotracheal Tube, I-GEL, Hemodynamic Response, Metabolic Response, Laparoscopy.

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Corresponding author: Dr. Saumya Biswas, Address: 815/C Block-A, Laketown. Kolkata, 700089. Phone number: 9433127430. E-mail: saumya.biswas@gmail.com Source(s) of support: NIL, Conflict of Interest: NIL.
Introduction

Endotracheal intubation has been shown to impose the most intense stress response to organism under general anesthesia\(^1,2\). Opioids, inhalational agents fail to prevent release of catecholamines which causes significant hemodynamic response after laryngotracheal manipulation\(^3,4,5\). Surgical stress response further leads to activation of sympathetic nervous system and release of catabolic and hormones\(^6\). Carboperitoneum itself cause significant hemodynamic and metabolic changes. These stress responses may be life threatening in patients with co-morbidities like hypertension, diabetes mellitus, ischemic heart disease. Airway devices which evokes less stress response would be beneficial in these circumstances. This study assess the hemodynamic and metabolic alterations caused with the use of I-GEL and endotracheal tube (ETT) in laparoscopic cholecystectomy where carboperitoneum is created with increase in intraabdominal pressure.

Material and Methods:

After approval of institutional ethics committee of Malda Medical College and obtaining patients informed consents, 70(seventy) ASA (American Physical Status) I and II patients aged between 20-60 yrs scheduled for elective laparoscopic cholecystectomy were included in the study. Exclusion criteria were a known predicted difficult airway, hypertension, diabetes mellitus, chronic obstructive pulmonary disease, cardiac disease, history of allergic reaction and body mass index greater than 35 kg/m\(^2\). Excluding those who failed to satisfy the selection criteria the remaining patients were randomly allocated into two groups of thirty two (n=32) patients each using a computer generated random number table.

Patients were premedicated with diazepam, ranitidine, and metaclopropamide the evening before and in the morning of the day of surgery. Consent and fasting status were confirmed and an intravenous line was obtained. Routine monitoring including electrocardiogram (ECG), noninvasive blood pressure (NIBP), pulse oxymetry (SpO\(_2\)) and end-tidal carbondioxide (EtCO\(_2\)) were applied to each patient in the operating room. Anesthesia was induced in both groups using propofol 2 mg/kg, fentanyl 2 microgram/kg, and airway placement was facilitated by atracurium 0.5 mg/kg.

In the ETT group (Group-E) (n=32) cuffed ETT of internal diameter (I.D.) 7.0 mm for females and 8.0 mm I.D. for males were used. The cuff pressure of ETT was maintained in the range of 25-30 cm of H\(_2\)O using a cuff manometer. In the other group (Group-I) (n=32) I-GEL: size 4.0 were used for both males and females as recommended by the manufacturer. Difficult intubation cases and more than one attempt of airway manipulation were excluded from the study.

Anesthesia was maintained with 1-2% Isoflurane and 50% NO\(_2\) & 50% O\(_2\). Patients were mechanically ventilated with a tidal volume of 8ml/kg and a respiratory rate of 12 breaths/min. SpO\(_2\) and EtCO\(_2\) were maintained >95% and <45mm of Hg respectively. Intra-abdominal pressure was maintained <15mm of Hg during the operation. Mean arterial blood pressure (MAP), heart rate(HR), SpO\(_2\), peak airway pressure, EtCO\(_2\) and tidal volume were recorded at the 1\(^{st}\), 5\(^{th}\), 15\(^{th}\), 30\(^{th}\) and 45\(^{th}\) minutes after insertion of airway devices. Side effects like bronchospasm, laryngospasm, coughing, gagging, hoarseness, aspiration were evaluated. Hemodynamic alterations like hypotension (<25% decrease in MAP from the baseline), hypertension (>25% increase in MAP from the baseline), tachycardia (heart rate >120/min), bradycardia (heart rate<50/min) were recorded and manipulated by titration of inhalational anesthetics at 0.5% concentrations and administration of intravenous 0.5mg atropine sulphate.

After induction of anesthesia and 20 mins after CO\(_2\) insufflation, venous blood samples were obtained for measuring adrenaline, noradrenaline, dopamine and cortisol levels. Blood samples were centrifuged immediately and plasmas were stored at -80°C until hormonal analysis. For analyzing catecholamine levels, high pressure liquid chromatography (HPLC) method was applied using eureka kits (Enrico Fermi 25 60033 Chiaravalle (An) Italy).

Statistical analysis was performed by SPSS\(_{11.5}\) (Statistics Package for Social Sciences) for Windows. Data was presented as mean, median and standard deviation. Comparison between groups were
performed by unpaired student-t-test and Mann-Whitney U-test for continuous variables and chi-square test for intermittent variables. Paired sample t-test and Wilcoxon test were used for comparisons within each group. A p value less than 0.05 was considered as statistically significant.

Results

No statistically significant differences were found in demographic variables between the two groups (Table-1). SpO₂, peak airway pressure, EtCO₂ and minute ventilation were not statistically significantly different when compared between and within groups at all evaluation times (Table-2). Optimal ventilation was maintained in both groups before and after carboperitoneum as indicated by EtCO₂ <45mm of Hg in all patients of both groups.

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>ETT (n=32)</th>
<th>I-GEL (n=32)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGE (yrs)</td>
<td>47.84±10.23</td>
<td>46.02±8.68</td>
<td>0.868</td>
</tr>
<tr>
<td>BMI(kg/m²)</td>
<td>27.89±8.42</td>
<td>28.90±8.42</td>
<td>0.732</td>
</tr>
<tr>
<td>ASA PS(I/II)</td>
<td>28/4</td>
<td>30/2</td>
<td>0.989</td>
</tr>
<tr>
<td>OPEARTION TIME</td>
<td>44.54±10.12</td>
<td>42.13±9.81</td>
<td>0.865</td>
</tr>
</tbody>
</table>

ETT = Endotracheal Tube; ASA PS = American Society of Anesthesiologists.

There was a significant increase in the heart rate at 1st minute and 45th minutes after insertion of airway device respectively in the ETT group. Comparison of mean arterial pressure between the two groups revealed statistically significant differences between the two groups at 15th and 30th minutes after airway insertion (Table-3).

Serum cortisol level 20 minutes after induction of anesthesia was significantly lower in the I-GEL group than the ETT group (Table-4). When serum cortisol levels were compared within groups, cortisol levels 20 minutes after induction of anesthesia were significantly higher than cortisol levels after anesthesia induction in both groups (Table-5).

Discussion

Laparoscopic surgeries present a challenge for the anesthesiologist as there are hemodynamic and ventilatory changes due to pneumoperitonium which may further be aggravated in patients with obesity and chronic systemic illness. Safe airway management remains the principal aim of the anesthesiologist during laparoscopic surgeries as there is increased intra-abdominal pressure which may lead to gastroesophageal and biliary reflux. ETT although commonly used has also some postoperative disadvantages like laryngospasm, hoarseness, and sore throat. In addition laryngoscopy itself induces hemodynamic stress response due to supraglottic manipulation which causes release of chatecholamine and cortisol. Newer second generation supraglottic airway device like I-GEL made of thermoplastic elastomer may be used as an effective and safe alternative to ETT in elective surgeries.

Table-2
ventilator parameters. Data is expressed as mean ± SD.

<table>
<thead>
<tr>
<th>Time</th>
<th>SpO2(%)</th>
<th>Peak Airway Pressure(cm of H₂O)</th>
<th>EtCO2 (mm of Hg)</th>
<th>MV(Lit)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ETT</td>
<td>I-GEL</td>
<td>ETT</td>
<td>ETT</td>
<td>ETT</td>
</tr>
<tr>
<td>1st min</td>
<td>98.16±1.21</td>
<td>98.45±0.97</td>
<td>75±3.75</td>
<td>30.39±3.54</td>
</tr>
<tr>
<td>5th min</td>
<td>99.23±1.45</td>
<td>99.28±0.45</td>
<td>20.21±2.34</td>
<td>31.23±2.43</td>
</tr>
<tr>
<td>15th min</td>
<td>98.14±1.13</td>
<td>97.28±0.34</td>
<td>20.19±3.24</td>
<td>33.23±2.35</td>
</tr>
<tr>
<td>30th min</td>
<td>97.45±1.24</td>
<td>98.23±1.16</td>
<td>22.45±1.34</td>
<td>31.34±3.34</td>
</tr>
<tr>
<td>45th min</td>
<td>98.23±1.17</td>
<td>98.05±0.98</td>
<td>20.76±2.35</td>
<td>32.45±3.56</td>
</tr>
</tbody>
</table>

SpO₂ = Oxygen saturation; EtCO₂ = End tidal carbon di-oxide; MV = Minute Ventilation; ETT = Endotracheal Tube.
Table-3
Haemodynamic Parameters. Data is expressed as mean ± SD.

<table>
<thead>
<tr>
<th>TIME</th>
<th>ETT (Mean ± SD)</th>
<th>I-GEL (Mean ± SD)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st min</td>
<td>90.85±31.23</td>
<td>89.68±23.13</td>
<td>0.867</td>
</tr>
<tr>
<td>5th min</td>
<td>102.36±20.16</td>
<td>100.73±18.68</td>
<td>0.98</td>
</tr>
<tr>
<td>15th min</td>
<td>92.33±16.33</td>
<td>88.23±13.63</td>
<td>0.762</td>
</tr>
<tr>
<td>30th min</td>
<td>90.32±20.56</td>
<td>76.14±15.28</td>
<td>0.026</td>
</tr>
<tr>
<td>45th min</td>
<td>100.23±16.86</td>
<td>89.82±13.68</td>
<td>0.762</td>
</tr>
</tbody>
</table>

ETT = Endotracheal Tube.

Table-4
Comparison of stress hormones between groups. Data is expressed as Mean (range).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>ETT</th>
<th>I-GEL</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adrenaline</td>
<td>73(4-545)</td>
<td>80(4-210)</td>
<td>0.621</td>
</tr>
<tr>
<td>Noradrenaline</td>
<td>261(84-815)</td>
<td>288(89-1056)</td>
<td>0.504</td>
</tr>
<tr>
<td>Dopamine</td>
<td>30(7-345)</td>
<td>35(12-500)</td>
<td>0.435</td>
</tr>
<tr>
<td>Cortisol</td>
<td>11.35(2.84-90.32)</td>
<td>15.23(4-45.30)</td>
<td>0.124</td>
</tr>
</tbody>
</table>

ETT = Endotracheal Tube.

Table-5
Comparison of stress hormones within groups. Data is expressed as mean.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>ETT</th>
<th>I-GEL</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adrenaline</td>
<td>7(3-500)</td>
<td>30(5-484)</td>
<td>0.632</td>
</tr>
<tr>
<td>Noradrenaline</td>
<td>255(82-812)</td>
<td>263(52-918)</td>
<td>0.416</td>
</tr>
<tr>
<td>Dopamine</td>
<td>32(9-316)</td>
<td>36(3-210)</td>
<td>0.826</td>
</tr>
<tr>
<td>Cortisol</td>
<td>10.6(3-94.6)</td>
<td>48.3(8-168)</td>
<td>0.002</td>
</tr>
</tbody>
</table>

ETT = Endotracheal Tube.

Maltby et al compared classic LMA (Laryngeal Mask Airway) and Proseal LMA (PLMA) as alternatives to tracheal intubation in laparoscopic gynaecological procedures with respect to pulmonary ventilation. There was no significant difference with respect to airway pressure, oxygen saturation, and end tidal carbon dioxide before and after peritoneal insufflations. They recommended that tracheal tube could safely be substituted with correctly placed LMA and Proseal LMA during gynaecological laparoscopy8. Sinha et al compared ETT and PLMA in pediatric laparoscopy patients by means of EtCO2, peak inspiratory pressure and SpO2. They did not report any statistically significant difference in SpO2, EtCO2.
HEMODYNAMIC AND METABOLIC STRESS DUE TO ET INTUBATION

and peak inspiratory pressure between the groups. They concluded that the two devices had comparable ventilator efficacy in laparoscopic pediatric surgeries. Won Jung Shin et al made a comparative study among I-GEL, proseal LMA, classic LMA, during general anesthesia and didn’t find any significant difference in ventilator response. Maharjan et al found the I-GEL to be as effective as ETT in laparoscopic surgeries. There was no difference in leak volume, leak fraction and airway pressure between the two study groups. In this study I-GEL was used effectively as ETT during laparoscopic cholecystectomy and ventilator parameters between the two groups were similar.

Jindal P et al compared haemodynamic effects of three supraglottic airway devices I-GEL, LMA and streamlined pharyngeal airway (SLIPA) during general anesthesia with controlled ventilation I-GEL revealed least haemodynamic changes during device use. Ismail SA et al compared intraocular pressure, heart rate, blood pressure before and after I-GEL, LMA, and tracheal tube. Use of LMA and ETT resulted in significant increase in intraocular pressure and haemodynamics compared to I-GEL. Oczenski et al reported that cardiovascular responses induced by laryngoscopy and intubation were more than twice as high as those produced by insertion of an LMA. In the present study I-GEL usages showed significantly less haemodynamic perturbation when compared to ETT (Table-3) as indicated by heart rate and mean arterial pressure.

Walder and Aitkenhead evaluated if pneumoperitoneum affected haemodynamic and stress responses in laparoscopic cholecystectomy patients. They observed that plasma vasopressin concentration significantly increased during pneumoperitoneum, noradrenalin and adrenalin concentrations and rennin activity did not change. Carbon dioxide(CO2) insufflation for pneumoperitoneum in long periods may cause stress hormone increase due to carbon dioxide diffusion. In our study mean duration of operation was nearly 45 minutes in both groups. Therefore it is considered that the reason of increase in cortisol level in the ETT group was not CO2 insufflation. Lentschener et al found that both humoral and hemodynamic responses initiated in the pneumoperitoneum by contact with CO2 have been prevented by continuous adequate depth of anaesthesia and normovolaemia. In the current study, the patients were operated in elective circumstances and depth of anaesthesia and volume were controlled easily and strictly so humoral and hemodynamic responses caused by pneumoperitoneum were lower than the estimations. We observed a significant increase in serum cortisol in both the groups 20 minutes after induction. But inter group analysis revealed the increase in ETT group was greater than I-GEL group. As dopamine, adrenalin and noradrenalin have short duration of activity with the plasma half time shorter than 2 minutes, they were not efficient enough for reflecting the metabolic stress response in our study.

Present study evaluated hemodynamic and ventilator parameters along with definitive stress hormone markers like catecholamine and cortisol but we were unable to take in consideration leak pressure of individual airway devices and other unwanted effects like sore throat, trauma, gastric distension and aspiration. Hence a large scale study is needed to draw a definitive conclusion.

Conclusion

Correctly placed I-GEL is a safe and efficient airway option to ETT and PLMA in laparoscopic cholecystectomy operations with lower incidence of metabolic stress responses. It can be used in selected elective surgical cases where these stress responses may be undesirable and better avoided.

Acknowledgements

The authors are grateful to the doctors of Dept. of Surgery and nursing staff of OT complex of Malda Medical College for the help rendered during the data collection of this study. A special note of thanks for DR RITA PAL, Dept of Biochemistry, Malda Medical College for the help in the analysis of blood sample which formed a crucial part of our study.
References


COMPARATIVE EVALUATION OF PLAIN AND HYPERBARIC ROPIVACAINE IN PATIENTS UNDERGOING LOWER ABDOMINAL SURGERY UNDER SPINAL ANESTHESIA

PUNEET DWIVEDI*, ANU KAPUR**
AND SANJAY KUMAR GUPTA***

Background: Preliminary work has shown that ropivacaine provides spinal anesthesia of shorter duration with greater sensory motor dissociation than bupivacaine, and may be of particular use in the day care surgery. Hypothetically, hyperbaric solution of ropivacaine could improve and shorten both sensory and motor block.

Material and Methods: This prospective, randomized, double blind study was conducted on 80 patients undergoing lower abdominal surgeries. Patients either received 20.25 mg of plain ropivacaine (group A) or 20.25 mg of hyperbaric ropivacaine in 5% dextrose (group B). The extent and duration of sensory and motor block, haemodynamics, time to home readiness, and the time to first rescue analgesia were recorded.

Results: All patients in group B achieved sensory block at or above T10 dermatome in comparison to only 87.5% patients of group A. Analgesia at T10 was reached in 4 min (4-6 min) in group B vs. 10 min (6-16 min) in group A (p<0.001). Patients in group B had a longer duration of analgesia at T10; 126 min (97-146 min) vs. 110 min (90-128 min) (p=0.047). Median duration of sensory block from injection of the anesthetic to complete recovery (regression to S2 dermatome) was shorter in Group B than Group A; 273.5 min (258 - 289 min) vs. 300 min (290 - 312 min) (p<0.001), as was the time to 2 segment regression 80 min (63-90 min) vs. 102 min (82-124 min) (p<0.001). Duration of complete motor block (mean ± SD) was significantly less in group B, 93.06 ± 17.38 min compared to 139.89 ± 25.17 min (p<0.001) in group A, as was the total duration of motor block (181.83 ± 30.21 min in group B vs. 254.91 ± 25.34 min in Group A; p<0.001). Patients in Group B attained discharge criteria earlier as indicated by a shorter time to home readiness. Cardiovascular changes were unremarkable throughout, and similar in the two groups. There were no major sequelae.

Conclusion: Addition of dextrose 5% to ropivacaine increases the speed of onset, block reliability, duration of useful block for surgery and speed of recovery. Plain solutions are less reliable for surgery above a dermatomal level of T10.

Keywords: block characteristics; home readiness; lower abdominal surgery; ropivacaine; spinal anesthesia.

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Introduction

Spinal anesthesia is a safe, reliable and inexpensive technique with the advantage of providing surgical anesthesia and post-operative pain relief. It not only alleviates operative pain but also blunts autonomic, somatic and endocrine responses.

Ropivacaine, a pure S (-) enantiomer, is well tolerated after intrathecal use and has been found to have a shorter duration of action than bupivacaine, making it a possible alternative to lidocaine because of the low incidence of transient neurological symptoms. Due to its property of sensory motor dissociation (ability to block sensory nerves to a greater degree than motor nerves), it allows a faster recovery of motor function that occurs after the use of bupivacaine.

Traditionally baricity of local anesthetics has been known to influence the spread of intrathecal local anesthetic solutions and characteristics of the subarachnoid block. However, very few studies have compared the clinical efficacy of hyperbaric and plain solutions of ropivacaine. Much of the published work is focused on intrathecal anesthesia with plain ropivacaine in lower limb, obstetric, perineal, urological and anal procedures.

We hypothesized that, intrathecal anesthesia with hyperbaric ropivacaine may be useful for procedures where a sensory and motor block of adequate duration for the procedure and a fast regression of motor block is required, resulting in faster discharge time. The aim of the current study is to compare the intraoperative characteristics and recovery profile of plain and hyperbaric solutions of ropivacaine in lower abdominal surgeries.

Methods

This randomized, double blind study was approved by the hospital ethical committee and written informed consent was obtained from each patient. Eighty patients (ASA 1 and 2) between 18-60 yrs of age, weighing between 45-80 kg, with height between 150 -180 cm, scheduled for elective lower abdominal surgery were randomly divided into two groups according to computer generated random numbers.

**Group A:** Plain group (n =40) received intrathecal injection of 20.25 mg of plain Ropivacaine (2.7 ml of 0.75% plain Ropivacaine + 0.3 ml normal saline).

**Group B:** Hyperbaric group (n = 40) received intrathecal injection of 20.25 mg of Ropivacaine with 5% glucose (2.7 ml of 0.75% plain Ropivacaine + 0.3 ml dextrose 50%).

Exclusion criteria included patients belonging to ASA class III, IV and V, unwilling patients, emergency surgeries, history of anaphylaxis to ropivacaine or any other aminoamide local anesthetic drug, pregnant and lactating females, patients with coagulation disorders or on anticoagulant therapy, local infection at the site of proposed puncture for spinal anesthesia, elective surgery more than 2 hours duration, surgeries requiring patient position other than supine, patient with medical complications like raised intracranial tension, anemia, heart disease, severe hypovolemia, shock, septicemia, and hypertension.

A detailed pre-anesthetic check up was done in all patients. Routine hematological, biochemical and radiological investigations were carried out in all patients. The special investigations were done as per the co-morbid condition of the patient.

All patients were asked to remain nil per oral intake for 6 hours before the planned surgical procedure and to be accompanied by an escort on the day of surgery. The anesthetic procedure was explained to the patient in detail. All patients were given tablet alprazolam 0.5 mg, the night before the surgery to have an adequate sound sleep. However, patient received no sedatives before arrival in the operating room.

In the operation theatre, baseline parameters were recorded (pulse rate, noninvasive blood pressure, heart rate). Intravenous access was secured with an 18G IV cannula and 10 ml/kg of ringer lactate was infused as a co-loading fluid. Patients were placed in the lateral decubitus position. Wide area of the back was cleaned and draped. L3-L4 intervertebral space was identified by palpation and infiltrated with 2% lidocaine. 26 G spinal needle (Quincke’s) was inserted into the desired interspace in the midline with the bevel facing upwards. After confirming free flow of CSF, needle was rotated so that the bevel faces cephalad and the study drug was injected over 15-20 seconds without any barbotage. Study drug was prepared aseptically just before intrathecal injection by an anestesiogist, who was not
involved in the study and had no clue about the group allocation. Therefore the investigator was blinded to the drug administered for intrathecal injection. Patient was placed supine immediately after the injection with the table maintained horizontally. Time of intrathecal injection was recorded. Vital parameters were monitored at 5 minute intervals till the end of surgery. Criteria for tachycardia, bradycardia and hypotension were more than 20% increase or decrease more than 20% from the baseline values, but treatment was given only if clinically indicated (systolic blood pressure <80 mmHg or heart rate <50 beats per minute). Injection of mephentermine 3 mg intravenous aliquots was given for hypotension and injection of atropine sulphate 0.6mg intravenous was given for bradycardia. Patients were given supplementary oxygen at 2-4 liters/min if saturation at room air was ≤ 92%.

Sensory block was assessed by loss of sensation to pin prick with a blunt 27 G needle bilaterally along the mid-axillary line every two minutes till two consecutive readings of sensory block remained the same (i.e. when highest cephalad spread of sensory block has occurred), after which it was assessed at ten minute intervals till the end of surgery.

Motor block was assessed by Modified Bromage Scale by Breen et al7 (MBS 1-6 with MBS 1 = Complete motor block, 2 = Almost complete motor blockade: patient is able to move the feet, 3 = Partial motor blockade: patient is able to move the knees, 4 = Detectable weakness of hip flexion: patient is able to raise the leg but is unable to keep it raised, 5 = No detectable weakness of hip flexion: patient is able to keep the leg raised for at least 10 seconds, MBS 6 = no motor weakness; patient is able to perform partial knee bend while supine).

As in sensory block, motor block was assessed every two minutes till two consecutive readings remained the same, (highest level of motor block) after which it was assessed every ten minutes till the end of surgery.

If sensory block at T10 dermatome was not attained even at twenty minutes after intrathecal injection of the drug, patient was given general anesthesia. In patients undergoing surgery under spinal anesthesia, no analgesia was given during the surgery unless the patient complained of pain. Inj. fentanyl 2µg/kg intravenously was given as a rescue analgesic if patient complained of pain intraoperatively. If patient still complained of pain, then no more analgesics were given and patient was given general anesthesia.

All the patients were monitored in the operative room for at least 60 minutes after the subarachnoid block to a keep close watch on the hemodynamics and block characteristics, even if the surgery ended earlier. After completion of surgery, levels of sensory blocks and motor blocks were recorded with the patient still on the operating table. The patients were shifted to the Post Anesthesia Care Unit (PACU) and they were assessed every 30 minutes for motor block by Modified Bromage Scale till they attain complete motor recovery. Sensory block was also assessed every 30 minutes by the same technique which was used during the intraoperative period until regression of sensory block to S2 dermatome (total duration of sensory block). Patients were assessed half hourly by Post Anesthesia Discharge Scoring System8 (PADSS) until a score of ≥ 9 was achieved, to check their readiness for discharge.

Time of request for the first analgesic was noted. Visual analogue scale (VAS) was used to assess postoperative pain at 0, 1, 2, 4 and 6 hour after completion of surgery. Inj. diclofenac sodium 75 mg by IV infusion was given for rescue analgesia once VAS score was ≥ 4 (0 = no pain, 10 = most severe pain). Bladder catheterization was performed when surgically indicated, but time to micturition was recorded in all other patients. On the day after the surgery patients were asked about any persistent symptoms like pain, nausea, vomiting, headache, backache, delayed voiding and neurologic symptoms such as tingling, numbness etc. and were treated accordingly. Follow up calls were made on telephone at 24 hrs and 3-7 days later to identify any sequela.

**Sample size**

The primary outcome variable was complete recovery from motor block and results of Khaw et al9 were used to estimate the sample size. When extrapolated from their study to our study with hyperbaric and plain solutions of ropivacaine, the mean time to complete motor recovery could be calculated.
as 117.45 and 177.39 min. The difference between the means was 59.94 min and SD was estimated to be 42.5 min from their study. With an α risk 0.05, and a power (β risk ≤ 0.03) of more than 97%, we calculated the sample size to be 40 in each group.

Statistical analysis

Statistical analysis was performed using the SPSS version 17.0 program for Windows (SPSS Inc., Chicago, IL, USA). We conducted a Shaipro Wilk test to verify the distribution of the data. All data were summarized as the mean ± standard deviation, while those with a skewed distribution were described as a median with an interquartile range (IQR). The chi-square test was used to compare the differences in variables between the two groups. Student’s t-test was used for continuous, normal variables. The Mann-Whitney test was used to test independent relationships between the variables that did not demonstrate normality. A two-sided P value less than 0.05 was considered statistically significant.

Results

Demographic profile

The two groups were comparable with respect to age, weight, height, sex, ASA status and duration of surgery (Table 1). Various types of lower abdominal surgical procedure were almost equally distributed amongst the two groups.

Hemodynamic parameters

The groups did not differ in hemodynamics in the operative and the recovery rooms (Table 2). In Group A (plain ropivacaine), only 4 out of 40 patients (10%) developed hypotension and 2 patients (5%) developed bradycardia. In Group B (hyperbaric ropivacaine), only 5 out of 40 patients (12.5%) patients developed hypotension and 3 patients (7.5%) developed bradycardia. Patients who developed bradycardia in the operative room were a subset of patients developing intraoperative hypotension. Patients in both groups were administered sympathomimetics or anticholinergics in the operating room as per protocol.
In the recovery room, 2 patients (5%) in both plain and hyperbaric ropivacaine groups developed hypotension but none of the patient in either group developed bradycardia. There was no need for sympathomimetics or anticholinergics in both groups in the recovery room.

### Sensory block characteristics

Sensory block reached T10 dermatomal level or above in all patients of group B, but there were 5 patients (12.5%) in group A in whom block failed to reach T10 dermatomal level (Table 3). Out of these 5 patients, 3 patients (7.5%) achieved a maximum sensory level at T12 dermatome and 2 patients (5%) at L1 dermatome (Figure 1).

![Fig. 1](image)

**Fig. 1**

*Maximum upper level of sensory block in the two groups.*

*Each point refers to one patient, and the horizontal line refers to the median. Patients with upper sensory level below T10 were given general anesthesia. Empty symbols indicate patients requiring intraoperative rescue analgesia to complete the surgery.*

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**Table 2**

*Baseline Hemodynamics in the operating room and the recovery room of the hyperbaric ropivacaine (Group A) and the plain ropivacaine (Group B). Data are expressed in mean ±SD or numbers of patients and percentages*

<table>
<thead>
<tr>
<th></th>
<th>Group A (n=40)</th>
<th>Group B (n=40)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operating room</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heart rate</td>
<td>70.17 ± 8.32</td>
<td>72.62 ± 12.21</td>
<td>0.298</td>
</tr>
<tr>
<td>Maximum heart rate</td>
<td>80.88 ± 11.93</td>
<td>78.35 ± 11.18</td>
<td>0.332</td>
</tr>
<tr>
<td>Minimum heart rate</td>
<td>60.33 ± 10.05</td>
<td>61.00 ± 8.55</td>
<td>0.935</td>
</tr>
<tr>
<td>Anticholinergic for bradycardia, n (%)</td>
<td>2</td>
<td>3</td>
<td>0.644</td>
</tr>
<tr>
<td>Systolic blood pressure</td>
<td>123.70 ± 12.23</td>
<td>127.25 ± 11.77</td>
<td>0.190</td>
</tr>
<tr>
<td>Maximum systolic blood pressure</td>
<td>128.10 ± 8.97</td>
<td>129.38 ± 7.31</td>
<td>0.488</td>
</tr>
<tr>
<td>Minimum systolic blood pressure</td>
<td>99.00 ± 9.80</td>
<td>96.93 ± 10.78</td>
<td>0.306</td>
</tr>
<tr>
<td>Sympathomimetics for hypotension, n (%)</td>
<td>4</td>
<td>5</td>
<td>0.724</td>
</tr>
<tr>
<td><strong>Recovery room</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum heart rate</td>
<td>77.91 ± 6.85</td>
<td>76.19 ± 9.90</td>
<td>0.839</td>
</tr>
<tr>
<td>Minimum heart rate</td>
<td>71.43 ± 9.02</td>
<td>70.58 ± 10.79</td>
<td>0.714</td>
</tr>
<tr>
<td>Anticholinergic for bradycardia, n (%)</td>
<td>0</td>
<td>0</td>
<td>1.000</td>
</tr>
<tr>
<td>Maximum systolic blood pressure</td>
<td>124.42 ± 7.07</td>
<td>126.55 ± 7.08</td>
<td>0.235</td>
</tr>
<tr>
<td>Minimum systolic blood pressure</td>
<td>97.11 ± 10.47</td>
<td>100.73 ± 11.65</td>
<td>0.214</td>
</tr>
<tr>
<td>Sympathomimetics for hypotension, n (%)</td>
<td>0</td>
<td>0</td>
<td>1.000</td>
</tr>
</tbody>
</table>
Table 3
Intraoperative Details. Data are represented as frequency (n) and percentage (%)

<table>
<thead>
<tr>
<th></th>
<th>Group A Plain ropivacaine (n=40)</th>
<th>Group B Hyperbaric ropivacaine (n=40)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensory block at or above T10 dermatome</td>
<td>Frequency</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td>35</td>
<td>87.5%</td>
</tr>
<tr>
<td>Sensory block below T10 dermatome</td>
<td>5</td>
<td>12.5%</td>
</tr>
<tr>
<td>Patients requiring general anesthesia</td>
<td>5</td>
<td>12.5%</td>
</tr>
<tr>
<td>Intraoperative pain</td>
<td>4</td>
<td>10%</td>
</tr>
<tr>
<td>Modified Bromage grade 1 (Complete motor block)</td>
<td>40</td>
<td>100%</td>
</tr>
<tr>
<td>Modified Bromage grade 2</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Modified Bromage grade 3</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Modified Bromage grade 4</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Modified Bromage grade 5</td>
<td>0</td>
<td>0%</td>
</tr>
</tbody>
</table>

Table 4
Sensory block characteristics. Data are represented as median with interquartile range (IQR)

<table>
<thead>
<tr>
<th></th>
<th>Group A Plain ropivacaine (n=40)</th>
<th>Group B Hyperbaric ropivacaine (n=40)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time to onset at T10 (min)</td>
<td>Median 10a IQR 6 - 16</td>
<td>Median 4 IQR 4 - 6</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Total duration at T10 (min)</td>
<td>Median 110a IQR 90 - 128</td>
<td>Median 126 IQR 97 - 146</td>
<td>0.047</td>
</tr>
<tr>
<td>Time to max. Cephalic Spread (min)</td>
<td>16 IQR 12 - 30</td>
<td>Median 14 IQR 10 - 25</td>
<td>0.454</td>
</tr>
<tr>
<td>Time to 2 segment regression (min)</td>
<td>102a IQR 82 - 124</td>
<td>Median 80 IQR 63 - 90</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Total duration of sensory block (min)</td>
<td>300 IQR 290 - 312</td>
<td>Median 273.5 IQR 258 - 289</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

*a: n = 35 as 5 patients in Group A did not achieve sensory block at T10 dermatome.

Table 5
Distribution of various grades of motor block (modified Bromage scale by Breen et al7). Data are represented as frequency (n).

<table>
<thead>
<tr>
<th>Time to onset at modified Bromage score</th>
<th>Group A Plain ropivacaine (n)</th>
<th>Group B Hyperbaric ropivacaine (n)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 5</td>
<td>0</td>
<td>2</td>
<td>0.494</td>
</tr>
<tr>
<td>Grade 4</td>
<td>29</td>
<td>20</td>
<td>0.021</td>
</tr>
<tr>
<td>Grade 3</td>
<td>38</td>
<td>31</td>
<td>0.017</td>
</tr>
<tr>
<td>Grade 2</td>
<td>40</td>
<td>34</td>
<td>0.019</td>
</tr>
<tr>
<td>Grade 1 (complete motor block)</td>
<td>40</td>
<td>33</td>
<td>0.566</td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
<td>40</td>
<td></td>
</tr>
</tbody>
</table>
Hyperbaric ropivacaine produced a more rapid onset of more extensive, but less variable sensory block, which regressed faster than in plain group (Table 4). The onset of analgesia to pinprick at T10 was faster (4 min vs. 10 min in plain group), and the maximum block height (median T6 vs T10) was greater (Figure 1), but less variable. Median time to maximum sensory block height (14 min vs. 16 min in plain group) was slightly faster in the hyperbaric group; however the difference was not statistically significant. Median time to regression of sensory block to T10 dermatome (14 min vs. 16 min in plain group) was longer in the hyperbaric group, but median times 2 segment regression (102 min in plain vs 80 min in hyperbaric) and regression of sensory block to S2 dermatome (300 min in plain vs 273.5 min in hyperbaric) were longer in the plain group.

Motor block characteristics

The onset of motor block at grade 4, 3 and 2 was significantly faster in Group B than in Group A and the differences amongst the two groups were statistically significant (Table 5). However, the median time to onset of grade 1 motor block was comparable in the two groups with no statistically significant difference. The mean duration of complete motor block (Duration of motor block at modified Bromage 1) was significantly shorter in the hyperbaric ropivacaine group (93.06 ± 17.38 min vs 139.89 ± 25.17 min in plain group), as was the total duration of motor block (181.83 ± 30.21 min vs 254.91 ± 25.34 min in plain group) (Table 6).

Table 6
Motor block characteristics. Data are represented as mean ± SD.

<table>
<thead>
<tr>
<th></th>
<th>Group A Plain ropivacaine (n=40)</th>
<th>Group B Hyperbaric ropivacaine (n=40)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration of complete motor block (min)</td>
<td>Mean ± SD 139.89 ± 25.17</td>
<td>Mean ± SD 93.06 ± 17.38</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Total duration of motor block (min)</td>
<td>Mean ± SD 254.91 ± 25.34</td>
<td>Mean ± SD 181.83 ± 30.21</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

a (n=35): (5 patients in Group A did not achieve sensory block at T10 dermatome and thus, these patients were given general anesthesia and therefore were not assessed for the duration of complete motor block).

b (n=33): (7 patients in Group B did not achieve complete motor block [grade 1]).

Table 7
Postoperative recovery. Data are represented as mean ± SD or median (range)

<table>
<thead>
<tr>
<th></th>
<th>Group A Plain ropivacaine (n=40)</th>
<th>Group B Hyperbaric ropivacaine (n=40)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time to first micturition (min)</td>
<td>377.68 ± 51.15</td>
<td>383.78 ± 61.93</td>
<td>0.649</td>
</tr>
<tr>
<td>Time to home readiness (min)</td>
<td>340.46 ± 35.53</td>
<td>285.95 ± 31.40</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Time to first Rescue Analgesia (min)</td>
<td>230 (20 – 337)</td>
<td>200 (15 – 270)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

a: (n = 37) in both the groups, as 3 patients in both the groups were operated for vesical calculus and therefore, urinary catheter was inserted intraoperatively in these patients and thus, time to first micturition in these patients could not be assessed.
Need for general anesthesia/ rescue analgesia

All the hyperbaric blocks were adequate for surgery while 5 patients in the plain group were given general anesthesia due to inadequate block height. These 5 patients in the plain group achieved complete motor block indicating that the inadequate block height was probably, a result of lesser cephalic spread of the drug and not a result of block failure. Also, the median time to reach complete recovery from sensory block (S2 dermatome) was approximately 300 min in these patients, which did not differ from the rest of the patients in Group A.

In Group A, 4 patients (10%) complained of intraoperative pain in comparison to only 1 patient (2.5%) in Group B (Table 3 and Figure 1). Majority of these patients experienced pain at the end of prolonged surgery and required supplemental analgesia with fentanyl 2µg/kg.

Postanesthesia care and discharge parameters

Patients in Group B complained of postoperative pain requiring rescue analgesic significantly earlier than patients in Group A (Table 7). None of the patients in the two groups experienced postoperative urinary retention and the time to first micturition was comparable in the two groups (table 7).

Patients in the hyperbaric ropivacaine group achieved criteria for home readiness (PADSS score ≥ 9) earlier than patients in the plain ropivacaine group (285.95 ± 31.40 min vs. 340.46 ± 35.53 min, respectively; p<0.001).

Two patients (5%) in both plain and hyperbaric ropivacaine group complained of mild backache at the puncture site, a day after the surgery, which was managed with non-steroidal anti-inflammatory drugs (NSAIDS). None of the patients in either group complained of persistence of these symptoms.

Discussion

This prospective, randomized, double blind comparative study conducted between plain and hyperbaric ropivacaine has shown that hyperbaric solution of ropivacaine produces a more consistent block with a greater success rate and less frequent incidence of intraoperative pain than a plain solution. Addition of glucose 50 mg/ml led to a more rapid spread to a higher median dermatomal level and with less variation in maximum height of sensory block.

We chose a dextrose concentration of 50mg/ml (5%) in the hyperbaric solution for two reasons. First, a previous study by Whiteside et al10 has demonstrated the clinical efficacy of a solution of ropivacaine containing glucose 50 mg/ ml. In the absence of a commercially available glucose preparation, this solution can be easily prepared before spinal anesthesia using readily available solutions, and provides a solution that is sufficiently hyperbaric for its purpose. Second, previous works by Bannister et al7 and Chambers et al12 with bupivacaine have suggested that lower concentrations of glucose than are present in the commercially available hyperbaric solution (8.3%) may be sufficient to provide the previously stated benefits over plain solutions.

When a hyperbaric solution is injected in the left lateral position, the tendency for it would be to spread in the cephalad direction, gravity presumably encouraging spread of the bolus of drug down the slopes of the lumbar curve when the patient is placed supine after injection resulting in a more even distribution of the local anesthetic solution13. In contrast, a plain solution being marginally hypobaric would not have such gravity- assisted spread and thus would concentrate in the lower lumbar segments. This would explain the less reliability of the block for abdominal surgery but prolonged sensory and motor block in the lower limbs due to dense blockade of the lumbar and sacral segments. This would also explain the 12.5% failure rate to achieve analgesia at T10 in the plain ropivacaine group and also higher number of patients requiring intraoperative supplemental analgesia (4 patient in plain vs. 1 patient in the hyperbaric group).

In agreement with previous work, in our study, the sensory block with the plain solution of local anesthetic spread unpredictably; 5 patients (12.5%) in Group A did not reach sensory block at T10 dermatome and the highest extent of sensory block varied widely. This is also in accordance with the results of Khaw et al9, who reported that all patients in the hyperbaric
group had sufficient analgesia for Caesarean section, but 25% of patients in Group plain needed rescue medication.

The cephalic spread of sensory block was significantly greater with hyperbaric ropivacaine T6 than in group plain T10 and this trend, is similar to earlier study by Kallio et al\textsuperscript{4}, with (15mg) ropivacaine having a median cephalad spread of T4 and T9 in the hyperbaric and plain groups, respectively. Whiteside et al\textsuperscript{6} studied hyperbaric ropivacaine 15 mg and reported a median maximum cephalic spread of sensory block at T7 dermatome, which is somewhat lower but comparable to our study with hyperbaric ropivacaine 20.25mg (T6).

In our study, the 126 min regression of the sensory block to the T10 level was comparable with that (115.8 min) in an earlier study by Chung et al\textsuperscript{13} with a slightly lower dose of hyperbaric ropivacaine (18 mg). The median time to 2 segment regression of sensory block was faster with hyperbaric ropivacaine (80 min) in comparison to plain ropivacaine (102 min). These findings were in accordance with Kallio et al\textsuperscript{4}, who found median time to 2 segment regression of sensory block with 15mg ropivacaine to be 90 min and 60 min in the plain and hyperbaric ropivacaine group, respectively.

Faster recovery from both sensory and motor block with an increase in the useful duration of sensory block translated into faster mobilization in the patients of hyperbaric group. Similar findings were also seen in two previous studies by Kallio et al\textsuperscript{4} and Essam et al\textsuperscript{14}, both of which stated that spinal anesthesia with hyperbaric ropivacaine was associated with early mobilization and faster discharge times.

In a recent Cochrane systematic review\textsuperscript{15}, authors have suggested that pain in the lower back is a very common complication after spinal anesthesia with any local anesthetic. Its etiology is unknown but no connection to neurologic pathology has been suggested in the literature. Data from previous studies\textsuperscript{16,17,18} suggests that ropivacaine is not associated with an increased risk of neurologic symptoms. We also did not find any evidence of transient neurological symptoms in our study. However, the available data is not enough to make definitive conclusions.

**Conclusion**

In conclusion, hyperbaric ropivacaine produced a more predictable and reliable sensory and motor block, with faster onset and recovery than a plain solution. Not only the duration of useful block for surgery was increased, but also patients mobilized more quickly after spinal anesthesia with hyperbaric ropivacaine, something that may be particularly useful for ambulatory surgery and any procedure where prolonged immobilization is undesirable. However, further studies are necessary to evaluate the role of hyperbaric ropivacaine in comparison to the plain solution for surgical procedures of short duration, particularly day care surgery.
References


6. **WHITIDES JB, BURKE D, WILDSMITH JA**: Comparison of ropivacaine 0.5% (in glucose 5%) with bupivacaine 0.5% (in glucose 8%) for spinal anaesthesia for elective surgery. *Br J Anaesth*; Mar, 90(3):304-8, 2003.


10. **WHITIDES JB, BURKE D, WILDSMITH JA**: Spinal anaesthesia with ropivacaine 5 mg ml(-1) in glucose 10 mg ml(-1) or 50 mg ml(-1). *Br J Anaesth*; Feb., 86(2):241-4, 2001.


THE BENEFICIAL VALUES OF TRANSOESOPHAGEAL DOPPLER IN INTRAOPERATIVE FLUID GUIDANCE VERSUS STANDARD CLINICAL MONITORING PARAMETERS IN INFANTS UNDERGOING KASAI OPERATION

EMAN SAYED IBRAHIM*, TAHAN AID YASSEIN**
AND WESAM SABER MORAD***

Abstract

Background: Fluid overload in infants can result from inappropriate volume expansion (VE). The aim of this work was to evaluate the beneficial values of Transoesophageal Doppler TED in intraoperative fluid guidance versus standard clinical monitoring parameters in infants undergoing Kasai operation.

Methods: Forty infants scheduled for Kasai procedure were randomly allocated into two groups (Doppler and clinical group). In Doppler group decided to provide VE (10-30 ml/kg of Hydroxyethyl starches HES) when the index stroke volume decreased by ≥15% from the baseline value, in clinical group, hemodynamic variables triggering colloid administration mean arterial blood pressure (MAP) less than 20% below baseline or central venous pressure (CVP) <5 cmH2O in both groups: Ringer’s acetate was infused at constant rate (6 ml/kg/h). Standard and TED-derived data were recorded before and after VE. Follow up the postoperative outcome and hospital stay.

Results: There were significantly lower mean volume of HES (42.85 ± 3.93 versus 84 ± 14.29 ml) and percent of infants required it (30% versus 90%) associated with earlier tolerance to oral feeding (2 ± 0.66 versus 3.4 ± 0.51), shorter hospital stay (5.30 ± 0.47 versus 6.7 ± 0.92 days) and lower rate of chest infection (15% versus 30%) in Doppler group than clinical group. There was no difference between the two studied groups regarding heart rate, MAP.

Conclusions: TED guided intraoperative fluid intake in infants undergoing Kasai operation optimize fluid consumption and improve outcome associated with shorter hospital stay.

Keywords: Infants, Kasai operation, Transoesophageal Doppler, volume expansion.

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Introduction

Extrahepatic biliary atresia (EHBA) is an inflammatory, progressive, fibrosclerosing cholangiopathy of infancy, affecting both the extrahepatic and intrahepatic bile ducts to a variable extent that results in destruction and obstruction of the biliary tract. Without medical and surgical intervention, disease progression leads to hepatic fibrosis, cirrhosis with portal hypertension, liver failure, and death within 2 to 3 years. It classically presents in 1 in 8,000 to 1 in 18,000 live births, during the neonatal period, with cholestatic jaundice, acholic stools, and hepatomegaly, in an otherwise apparently healthy infant. Current treatment of EHBA is surgical hepatoportoenterostomy (Kasai procedure) for the relief of biliary obstruction in these infants.

Perioperative fluid optimization is essential in Kasai procedures for reducing morbidity. Hypovolemia is associated in particular with improper organ perfusion and increased length of hospital stay, while excessive fluid administration produces the clinical picture of pulmonary peripheral and gut edema with associated morbidity and mortality. The assessment of perioperative hypovolemia and the trigger for volume expansion (VE) in pediatric anesthesia are based on the interpretation of multiple variables and clinical endpoints such as arterial pressure, heart rate (HR), pulse pressure, urine output, type of surgery, surgical events (e.g. bleeding), and laboratory findings (e.g. hematocrit, lactate). Fluid requirements when based only according to these variables can be inappropriate. Minimally invasive tools that could predict patient responsiveness to VE would be extremely useful. Transoesophageal Doppler (TED) has been shown to effectively measure CO in newborns and children and therefore, could allow for better assessment of the efficacy of VE.

We therefore designed a prospective, randomized, controlled trial to evaluate the effectiveness of TED on intraoperative fluid optimization versus standard clinical monitoring parameters in infants undergoing Kasai operation.

Methods

After receiving approval from Ethical Committee and informed consent from patient’s parents, this prospective cohort study enrolled 40 infants who were randomly assigned into two groups using a random number generator in sealed envelopes of 20 each: the Doppler group and the clinical group. Infants aged ≤3 months, weighing <10 kg, without myocardial dysfunction, American Society of Anaesthesiologists (ASA) grade I/II, who required general anesthesia and tracheal intubation for hepatoportoenterostomy for biliary atresia (BA) were included in the study. Exclusion criteria were ASA class >II, preoperative hemodynamic instability or catecholamine infusion, known congenital heart disease with hemodynamic consequences and esophageal malformation, any patient with history of bleeding tendency, and no written informed consent. All infants received an oral intake of 15 ml/kg of 10% glucose 2 h before surgery. Patients were optimized before operation and deemed hemodynamically stable and clinically euolemic before the induction of anesthesia. After denitrogenation, general anesthesia was induced by inhalation of 100% oxygen and 8% sevoflurane until the patient lost consciousness and then the sevoflurane concentration was decreased to 4%. An IV cannula was inserted and fentanyl (1 µg/kg) and atracurium (0.5 mg/kg) were administered to facilitate tracheal intubation. Anesthesia was then maintained with 50% oxygen, air and sevoflurane (1 MAC end-tidal concentration). Mechanical ventilation was performed in all patients using a semi closed system adjusted to keep SaO₂>95% and end tidal CO₂ between 25 mmHg and 35 mmHg (GE Datex Ohmeda S/5 Anesthetic Delivery Unit System). Arterial pressure was measured using a standard non-invasive cuff applied to the upper limb. Nasopharyngeal temperature was monitored and maintained in a normal range with a forced-air warmer (Bair Hugger Temperature Management Unit, Arizant, USA). Following induction of anesthesia, data of patients in the Doppler group (age, weight, and height) were registered in the Doppler monitor. A 4 MHz, flexible TED probe specific for single-patient pediatric use (KDP n-Kinder Doppler Probe) was greased with a lubricating gel and passed orally into the mid esophagus until aortic blood flow signals were
best identified. The optimal position of the probe was suggested by an audible, maximal pitch and a sharply defined velocity waveform with minimal spectral dispersion. The monitoring system used (Cardio QPTM, Deltex Medical TM, Chichester, UK) which shows all the needed hemodynamic variables both in numerical and graphical forms... The probe was rotated to display the best aortic blood flow signal before each measurement. Cardiac index (CI), index stroke volume (ISV), corrected flow time (CFT) (length of time of systolic blood flow adjusted for HR, that is, divided by the square root of the heart cycle time), peak velocity (PV) (maximal velocity during systole), of the descending aorta velocity waveform were recorded. TED measurements pre- and post-VE were completed and averaged In the clinical group (A 4- to 5.5-Fr central venous catheter AMECATH single lumen central venous catheter) was placed through the right internal jugular vein by ultrasound guided method (Sonosite-Nano Max ultrasound system-USA).

In Doppler group. Boluses of colloid were administered, guided by an algorithm depending on the Doppler estimations of ISV, when the ISV decreased by ≥15% from the baseline value.VE consisted of an infusion of 10-30 ml/ kg of colloid (Voluven hydroxyethyl starch 130/0.4 6%). Over a period of 20-40 min, repeated by other boluses only if ISV is not increased by ≥15% this algorithm was similar to that used by Roux et al.7, In clinical group, hemodynamic variables triggering colloid administration based on clinical appreciation and standard monitoring data that involves either a decrease in mean arterial blood pressure less than 20% below baseline or CVP≤5 mmHg.VE was the same of that used in TED group. In both groups, Ringer’s acetate solution was infused intraoperative at approximately constant rate (6 ml/kg/h) via an infusion pump (Fresenius Kabi, Germany) to cover fluid deficit and basal fluid requirements. Four sets of data were recorded and each set included: heart rate (HR), mean arterial pressure (MAP), end tidal CO₂ (ETCO₂), ISV, CFT, PV and cardiac output (CO). The measurements were obtained at 10 min after induction of anesthesia when hemodynamically stable with controlled ventilation established, (To) before VE (T1), T2: after VE (T2) and at the end of surgery (T3).

The primary out-come was to evaluate the beneficial values of TED in intraoperative fluid guidance versus standard clinical monitoring parameters in infants undergoing Kasai operation regarding volume of colloid administered. Secondary outcomes included evaluation of complications such as vomiting, post-operative pulmonary complications, return of bowel function and the length of intensive care and hospital stay.

20 patients in arm 1 (Doppler group) and 20 patients in arm 2 (clinical group) were recruited based on the following assumptions: with the power of 80 %, $\alpha = 0.05$ and the ratio of cases to controls = 1:1. The required sample size was determined using (power and sample size calculation) software.

The sample size was determined as regard patients attending our institute meeting the inclusion and exclusion criteria which are 40/year. Normally distributed data were analyzed using $t$-test, and categorical data were analyzed using the Chi-square test. Continuous data are presented as mean and standard deviation, whereas categorical data are presented as number of patients and percentage. Data were analyzed using IBM SPSS statistics 20.0 software. $P <0.05$ was considered statistically significant.

Results

Data is presented at baseline, before and after VE (Table 1). There were no differences in the demographic data between Doppler and clinical groups (Table 1). The percentage of patients who required volume expansion was significantly lower in the Doppler group (Table 1). Furthermore, the volume of HES needed was also significantly smaller I the Doppler group (Table 1). There was no statistically significant difference between both groups regarding Ringer’s acetate requirements (Table 1). There were no differences between the two studied groups regarding heart rate, mean blood pressure (MAP) (Table 2). The TED group demonstrated significant hemodynamic changes in post fluid boluses, increase of ISV and cardiac output associated with an increase in CFT and PV (Table 4). There was statistically significant decreased in mean heart rate post vs. pre- VE (123 ± 6.548 versus 136.8 ± 10.04 beat /min; $p <0.05$) and (112.2 ± 5.20 versus 132 ± 8.67 beat /min; $p <0.05$) in
Table 1
Patient characteristic data, and characteristics of VE differences between groups.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Clinical group (n=20)</th>
<th>Doppler group (n=20)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (days)</td>
<td>73.40 ±18.06</td>
<td>74.40 ± 19.06</td>
<td>0.87</td>
</tr>
<tr>
<td>Weight (gm.)</td>
<td>4.77 ± 0.71</td>
<td>5 ±0.62</td>
<td>0.28</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>65.70±65.70</td>
<td>65.20±5.28</td>
<td>0.97</td>
</tr>
<tr>
<td>Sex: male/ female</td>
<td>13/7</td>
<td>12/8</td>
<td>0.74</td>
</tr>
<tr>
<td>ASA I/II</td>
<td>18/2</td>
<td>17/3</td>
<td>0.63</td>
</tr>
<tr>
<td>Operative time (min)</td>
<td>202±54</td>
<td>186±44</td>
<td>0.31</td>
</tr>
<tr>
<td>Volume expansion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colloids (%pts)</td>
<td>18 (90%)</td>
<td>6 (30%)</td>
<td>0.00#</td>
</tr>
<tr>
<td>Volume (ml)</td>
<td>84±14.29</td>
<td>42.85±3.93</td>
<td>&lt; 0.01*</td>
</tr>
<tr>
<td>Total RA (ml)</td>
<td>290±39.44</td>
<td>274±39.44</td>
<td>0.20*</td>
</tr>
</tbody>
</table>

TED – Transoesophageal Doppler; ASA – American society of anaesthesia
RA- Ringer acetate

Table 2
Hemodynamic data for both groups.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Clinical group (n=20)</th>
<th>Doppler group (n=20)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR (beat/min)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T0</td>
<td>125.4±10.57</td>
<td>123.2±8.67</td>
<td>0.48</td>
</tr>
<tr>
<td>T1</td>
<td>136.8±10.04</td>
<td>132±8.67</td>
<td>0.11</td>
</tr>
<tr>
<td>T2</td>
<td>123±6.54</td>
<td>122.2±5.20</td>
<td>0.67</td>
</tr>
<tr>
<td>T3</td>
<td>123.5 ±8.07</td>
<td>122.5 ±12.14</td>
<td>0.76</td>
</tr>
<tr>
<td>MAP (mmHg)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T0</td>
<td>54.2±3.42</td>
<td>55.5±4.22</td>
<td>0.29</td>
</tr>
<tr>
<td>T1</td>
<td>43.4±2.72</td>
<td>44.6±4.50</td>
<td>0.31</td>
</tr>
<tr>
<td>T2</td>
<td>58.1±2.64</td>
<td>61.2±4.04</td>
<td>0.05</td>
</tr>
<tr>
<td>T3</td>
<td>56.5±2.95</td>
<td>56.8±5.37</td>
<td>0.82</td>
</tr>
</tbody>
</table>

Values are presented as mean (SD); HR – Heart rate; MBP – Mean blood pressure; TED – Transoesophageal Doppler; T0 – 10 min after induction of anaesthesia; T1– before fluid bolus ; T2 – After fluid bolus ; T3– At end of operation .

the clinical and Doppler group respectively, associated with statistically significant increase in MAP post VE compared to before it (58.10 ± 2.64 vs 43.40 ± 2.71 mm Hg; p <0.01) and (61.20 ± 4.04 vs 44.60 ± 4.50 mm Hg; p <0.01) in the control and TED group respectively. These changes associated with stable CVP with no statistically significant changes after fluid bolus in it Table 3. There was no mortality reported during the study period in any case involved in the study. There were earlier tolerance to oral feeding (2 ± 0.66 versus 3.4 ± 0.51 days), shorter hospital stay (5.30 ± 0.47 versus 6.7 ± 0.92 days) and lower rate of chest infection (15% versus 30%) and oral intolerance (10% versus 40%) in Doppler group than clinical group (Table 5). Eight patients in the clinical group needed antiemetic in comparison to two patients in the Doppler guided group. All patients were extubated immediately postoperative in the operating room and admitted to the intermediate care unit for the first 24 h.

Discussion
The results of this study demonstrate that TED was able to predict responsiveness to fluid
and optimize intraoperative fluid consumption, as indicated by significant lower mean volume of colloid (HES) received and percent of infants requiring volume expanders... In a study by Lee, et al., FTC and PPV (Pulse Pressure Variation) of Doppler were found to be better than CVP and LVEDAI (left ventricular end end-diastolic area index) in predicting fluid responsiveness and that changes in the stroke volume index caused by fluid loading correlated significantly with the FTC values. Estimation of intravascular volume status in critically ill infants and neonates is a particular challenge as traditional indices, such as blood pressure and heart rate, may not reflect mild to moderate blood loss and because, in the majority of cases, invasive monitoring is not used. In our study, fluid boluses based on standard clinical monitoring data was shown to be inappropriate in the patients as CVP was stable after fluid boluses in spite of significant changes in heart rate and MAP. MAP and HR did not reliably reflect CO in anesthetized pediatric patients. Kumar et al and Marik et al found that CVP is not able to indicate changes in intravascular volume and fluid responsiveness accurately. Value of CVP is influenced by the diastolic compliance of the right ventricle, intra-abdominal pressure, positive end expiratory pressure, and forced expiration. Indeed, CVP does not predict fluid responsiveness and only poorly reflects preload in adults, children, and pediatric animal models. The hypotensive effect of sevoflurane is well described and is especially significant in the youngest pediatric patients. This effect, mostly attributable to a decrease in systemic vascular resistance, may explain the arterial hypotension among our patients before fluid bolus. The increase in MAP observed in control patient’s post-fluid bolus, without an improvement in CVP may be explained by other factors such as the subsequent reduction in sevoflurane during the period of arterial hypotension. Our study was able to demonstrate the ability of minimally invasive TED to reduce fluid therapy when compared to standard clinical monitor parameter guided fluid management associated with earlier tolerance to oral feeding, shorter hospital stay.

### Table 3

<table>
<thead>
<tr>
<th>Variable</th>
<th>To</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CVP(cmH₂O)</td>
<td>4.10±0.99</td>
<td>4.10±0.87</td>
<td>3.80±0.63</td>
<td>3.87±0.44</td>
</tr>
</tbody>
</table>

Values are presented as mean (SD); CVP - Central venous pressure T0 – 10 min after induction of anesthesia; T1 – before fluid bolus (VE); T2 – After fluid bolus (VE); T3 – At end of operation. Data compared by paired t test.

### Table 4

<table>
<thead>
<tr>
<th>Variable</th>
<th>To</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
</tr>
</thead>
<tbody>
<tr>
<td>COP(ml/min)</td>
<td>1.19±0.21</td>
<td>0.76±0.05*</td>
<td>1.16±0.16#</td>
<td>1.09±0.16</td>
</tr>
<tr>
<td>CFT(m/sec)</td>
<td>333.74±31.88</td>
<td>311.3±11.73*</td>
<td>350.4±11.08#</td>
<td>338.2±6.72**</td>
</tr>
<tr>
<td>ISV(ml/beat/m²)</td>
<td>30.13±2.31</td>
<td>25.52±2.22*</td>
<td>32.88±1.83#</td>
<td>33.2±2.24</td>
</tr>
<tr>
<td>PV (cm/sec)</td>
<td>111.3±8.18</td>
<td>84.44±5.08*</td>
<td>109.80±7.32#</td>
<td>100.50±3.62*</td>
</tr>
</tbody>
</table>

Values expressed as mean (SD); COP (Cardiac output); ISV (index Stroke volume); CFT (Corrected flow time); PV (Peak velocity); T0 –10 min after induction of anesthesia; T1 – before fluid bolus (VE); T2 – After fluid bolus (VE); T3 – At end of operation. * P < 0.05 vs. To  # P < 0.05 vs. T1  ** P < 0.05 vs. T2

### Table 5

<table>
<thead>
<tr>
<th>Variable</th>
<th>Doppler group (n=20)</th>
<th>Clinical group (n=20)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chest infection n (%)</td>
<td>3(15%)</td>
<td>6 (30%)</td>
<td>0.26</td>
</tr>
<tr>
<td>Oral intolerance</td>
<td>2(10%)</td>
<td>8(40%)</td>
<td>0.03</td>
</tr>
<tr>
<td>Hospital stays (days)</td>
<td>5.30±0.47</td>
<td>6.7±0.92</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>Day of oral feeding (days)</td>
<td>2±0.66</td>
<td>3.4±0.51</td>
<td>&lt; 0.01</td>
</tr>
</tbody>
</table>
and lower rate of chest infection and oral intolerance. Recent randomized trials and meta-analyses have confirmed that intraoperative fluid optimization using TED improve outcome. Abi et al reported that the application of esophageal Doppler guided fluid management has produced a similar improvement in outcome for patients undergoing cardiac surgery. Roche et al studied Goal-directed fluid management with trans-esophageal Doppler and found a significant reduction in hospital stay. In the current study, chest infection and post-operative vomiting and intolerance to oral feeding were significantly less reported in the Doppler guided fluid group. This was also supported by Mythen and Webb study, which demonstrated that the esophageal Doppler guided plasma volume optimization significantly reduced the incidence of gastric mucosal hypoperfusion leading to a significant reduction in complication rates and length of hospital stay following cardiac surgery. Increase extravascular lung water from excessive intravascular volume may predispose patients to pneumonia and respiratory failure. It can lead to edema of the gut, which may inhibit gastrointestinal motility and prolong postoperative ileus and intolerance for enteric alimentation. The potential for bacterial translocation and development of sepsis and multiorgan failure is also increased. Increase cutaneous edema may decrease tissue oxygenation, which can lead to delayed wound healing. Previous literatures suggest that perioperative goal-directed therapy (GDT) based on flow-related hemodynamic parameters improve patient outcome. Clinical studies have mostly shown outcome benefits only within postoperative nausea and vomiting, ileus, morbidity, and hospital stay. However, only limited pathophysiological data are available to explain this benefit. Lopes et al. in their work revealed that there is reduced morbidity and hospital stay by GDT and this also associated with a reduced interleukin-6 response. Other studies on perioperative changes of the vascular barrier suggest that the endothelial gly-cocalyx plays a key role.

The limited number of cases enrolled in our study was related to the limited number of cases of biliary atresia selected for Kasai surgery in our national liver institute. The use of TED for intraoperative fluid guidance in infants undergoing Kasai operation need to be studied in further planned research work.

In conclusion: TED guided intraoperative fluid management in infants undergoing Kasai operation optimizes fluid consumption and improve outcome associated with shorter hospital stay.
References

BILATERAL ADDUCTOR VOCAL CORD PALSY: COMPLICATION OF PROLONGED INTRAOPERATIVE HYPOTENSION AFTER ENDOTRACHEAL INTUBATION

RAJNISH K. NAMA*, GURUPRASAD P. BHOSALE**, BINA P. BUTALA*** AND ANKIT R. SHARMA****

Endotracheal intubation for general anesthesia is usually a safe procedure. However, postoperative sore throat and mild hoarseness may occur due to laryngeal edema but bilateral vocal cord paralysis as a result of recurrent laryngeal nerve injury is a rare complication. We report a case of bilateral adductor vocal cord palsy following general anesthesia for abdominal surgery. Clinical presentation was hoarseness, aspiration pneumonia and hypoxemia requiring ventilatory support. Neuropraxia of recurrent laryngeal nerve due to prolong intra-operative hypotension, even with normal endotracheal tube cuff pressure was the likely mechanism.

Keywords: Endotracheal intubation, Adductor vocal cord palsy, Prolong intraoperative hypotension.

Introduction

Endotracheal intubation is essential part of anesthesia practice but rarely result in vocal cord paralysis which is a most serious complication resulting in vocal disability and aspiration1,2,3. Direct surgical trauma, quality of tracheal intubation and high cuff pressure are some common risk factors for this complication. In our current case, we report an incident of uncommon cause for vocal cords palsy.

Case History

A 50-year-old 60 kg male presented with abdominal pain in abdomen and hematuria and was diagnosed to have renal cell carcinoma with thrombus in inferior vena cava (IVC). He was posted for right radical nephrectomy with IVC thrombectomy. Patient had no comorbidities. His preoperative examination and laboratory investigations were insignificant. Airway assessment was normal with mallampati score grade-I.
Balanced general anesthesia was given and trachea was intubated with 8.0 mm cuffed portex endotracheal tube in a single attempt without any trauma. Cuff of the endotracheal tube was inflated with room air till no apparent leak. Endotracheal tube (ETT) cuff pressure was measured with aneroid manometer and it was less than 25 mmHg and was maintained throughout the procedure. Anesthesia proceeded with oxygen, air, isoflurane, and atracurium with IPPV. Unexpectedly there was massive blood loss as tumour was adherent to surrounding structures. Intra-operatively patient received 14 unit of packed cells volume (PCV), 6 unit of fresh frozen plasma (FFP), colloids and crystalloids even vasopressors were started to maintain blood pressure but most of time mean arterial pressure was less than 65 mmHg. Surgery lasted for 8 hours. After completion of surgery extubation was accomplished in the operating room with neostigmine and glycopyrrolate. Patient was shifted in stable hemodynamic condition to ICU for observation.

On the next day patient had hoarseness, coughing on swallowing liquids, breathlessness and hypoxemia. For protection of airway and reversing severe breathlessness, the trachea was smoothly intubated and patient was put on mechanical ventilator. During direct laryngoscopy sluggish movement of vocal cords were noted. Chest x-ray was done and it was suggestive of bilateral aspiration pneumonia (figure 1). Patient was treated with antibiotics and supportive management. Patient was weaned off ventilator gradually and extubated under fiberoptic bronchoscopy (FOB) guidance. During extubation both the vocal cords were seen lying in intermediate position with a gap. Reduced movements of both vocal cords were also noted and on coughing vocal cords failed to approximate completely (figure 2). Adductor vocal cord palsy due to possible recurrent laryngeal nerve injury was suspected. The patient was started nasogastric feed and transferred to his room. After 10 days mild hoarseness and coughing on swallowing liquid still persisted. ENT opinion was sought and indirect laryngoscopy was done by ENT specialist which showed bilateral bowing with reduced movement of vocal cords more on right side then left. Beside speech therapy no active treatment was prescribed and after 25 days the nasogastric tube was removed as patient could tolerate oral intake of liquid orally and by 40 days his voice recovered completely.

**Fig. 1**
*Chest X-Ray showing bilateral opacities*

**Fig. 2**
*Fiberoptic bronchoscopy view of larynx. Vocal cords failed to approximate completely during forced coughing*

**Discussion**

Acute hoarseness and sore throat after endotracheal intubation is common and is usually due to mucosal injury. Prolong or permanent hoarseness occurs in approximately 1% but postoperative vocal cord paralysis following endotracheal intubation,
leading to aspiration pneumonia and requiring mechanical ventilation is a rare occurrence.

Several risk factors for laryngeal injury have been identified including the size of the ETT, the cuff pressure and the quality and duration of tracheal intubation\textsuperscript{5,6}. Kikura et al found that the risk of vocal cord paralysis was increased three folds in patients aged older than 50 years, 15-fold in patient intubated 6 h or more and two folds in patients with diabetes or hypertension\textsuperscript{7}. In other cases, the cause of vocal cord paralysis still remains undetermined.

Minuck suggested that increasing endotracheal tube cuff pressure and asymmetrical cuff inflation might be the principle mechanism of recurrent laryngeal nerve palsy associated with endotracheal anesthesia\textsuperscript{8}. According to Cavo John, the probable site of injury is the subglottic region where anterior branch of recurrent laryngeal nerve is vulnerable to compression between expanded cuff and overlying thyroid cartilage\textsuperscript{9}.

General guidelines state that endotracheal tube cuff pressure should be not more than 25 mmHg (Possible maximal range of 15-30 mmHg) to maintain tracheal mucosa perfusion and thereby prevent mucosal ischemia, tracheal necrosis, rupture, stenosis, laryngeal nerve palsy and tracheoesophageal fistula\textsuperscript{10}.

As far as our patient is concerned direct injury to recurrent laryngeal nerve is unlikely. Trachea was intubated without trauma in single attempt with adequate size of ETT. Although surgery lasted for 8 hours but N\textsubscript{2}O was not used and cuff pressure was kept below 25 mmHg all the time; as such excessive cuff pressure could not be the reason for nerve injury. Our patient remained hypotensive (MAP less than 65 mmHg) for most of the time during the surgery and received vasopressors to maintain blood pressure. Prolonged intra-operative hypotension could have affected microcirculation of the larynx and led to the neuropraxia of the bilateral recurrent laryngeal nerve. Efrati et al suggested that when the patient is hemodynamically unstable and is being treated with vasoconstrictors the perfusion pressure in the tissue (tracheal mucosa) is significantly reduced. In this condition tissue hypoperfusion and hypoxia can happen even at lower cuff pressures (less than 25 mmHg)\textsuperscript{10}.

**Conclusion**

Severe and Prolonged intraoperative hypotension may adversely affect the microcirculation of larynx even with normal cuff pressure and can lead to neuropraxia of recurrent laryngeal nerve. We emphasize on keeping endotracheal tube cuff pressure in normal range and whenever patient is hypotensive and on vasopressors, ETT cuff pressure should be decreased as low as possible to maintain adequate tissue perfusion and prevent possible injury to recurrent laryngeal nerve and bilateral vocal cords palsy.
References

ANESTHESIA MANAGEMENT IN AN INFANT WITH GLYCOGEN STORAGE DISEASE TYPE II (POMPE DISEASE)


Abstract

Pompe or Glycogen Storage Disease type II (GSD-II) is a genetic disorder affecting both cardiac and skeletal muscle. Historically, patients with the infantile form usually die within the first year of life due to cardiac and respiratory failure. Recently a promising enzyme replacement therapy has resulted in improved clinical outcomes and a resurgence of elective anesthesia for these patients. Understanding the unique cardiac physiology in patients with GSD-II is essential to providing safe general anesthesia. Additional care in maximizing coronary perfusion pressure and minimizing arrhythmia risk must be given. For these reasons, it is recommended that anesthesia for infantile Pompe patients should specifically avoid propofol or high concentrations of sevoflurane and, instead, use an agent such as ketamine as the cornerstone for induction in order to better support coronary perfusion pressure and to avoid decreasing diastolic blood pressure (DBP) with vasodilatory agents. We present the anesthetic technique in a case of infantile type Pompe disease.

Keywords: metabolic disorders, Pompe disease, anesthesia.

Introduction

Pompe disease, also known as glycogen storage disease type II or acid maltase deficiency, is an autosomal recessive disorder caused by a deficiency of the lysosomal enzyme acid a-glucosidase1,2. For the infantile-onset subtype specifically, the birth prevalence is reported to range between 1: 40 000 and 1: 138 000 among different nations3. The early-onset, infantile subtype is typically fatal because of rapid intracellular accumulation of glycogen, which causes infiltrative pathology of the myocardium and skeletal muscle. Common presenting signs include cardiomegaly, hypotonia, macroglossia, failure to thrive and hepatomegaly. Without treatment, sequelae include rapidly progressive hypertrophic cardiomyopathy, arrhythmias, systolic and diastolic heart failure and chronic respiratory failure, followed by death usually within the first year of life1,2. During the last decade a promising enzyme replacement therapy, with recombinant human acid aglucosidase (rhGAA), has resulted in improved clinical outcomes in the treatment of infantile-onset Pompe disease.

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disease⁴. For this reason after early diagnosis, it is imperative for the infant to start as soon as possible enzyme replacement therapy (ERT) using rhGAA. We present the anesthetic management of an infant with Pompe disease.

Case Description

This is the case of a 2-month-old male (4.7 kg), with uncomplicated pregnancy and full term normal vaginal delivery. After birth the infant presented hypotonic and cyanotic. He was admitted to the NICU and remained 4 days under supplemental oxygen support and investigation. Electrocardiogram showed normal sinus rhythm, biventricular hypertrophy, ST depression and inverted T wave in inferior leads. Echocardiography demonstrated non obstructive hypertrophic cardiomyopathy with severe biventricular hypertrophy. The estimated left ventricular mass index (LVMI) on echocardiography was 169.6 g/m² (normal 48.8 ± 8). LVMI was calculated by Devereux’s formula⁵ considering the diastolic measurements of left ventricular internal diameter (LVID), interventricular septal thickness (IVST) and posterior wall thickness (PWT): LVMI (g/m²) = (1.04 [(IVST+LVID+PWT)³-LVID³]-14 g)/ Body surface area. The above findings led to an eventual diagnosis of infantile-onset Pompe disease. Diagnosis was confirmed in specialized laboratory centre in Germany, using whole blood and lymphocyte samples⁵,⁶. The infant was then scheduled to undergo general anesthesia for the placement of a central venous catheter prior to starting rhGAA therapy.

Standard monitoring was applied. Baseline heart rate ranged from 140 to 160 b/min) and blood pressure was 85/49 mmHg. The patient had a history of hypotonia, small mouth opening, macroglossia, and gastroesophageal reflux disease with adequate weight gain. Intravenous induction with ketamine (1 mg/kg) and fentanyl (2.0 mcg/kg) was performed. The patient was successfully intubated at the second attempt (Cormack and Lehane grade 3) without muscle relaxant. Following induction and after the fentanyl administration the heart rate transiently decreased to 110 b/min (>20% from baseline) and resolved spontaneously. Anesthesia was maintained with sevoflurane 1-2% and 50% nitrous oxide in oxygen. Maintenance intravenous fluids D5% LR were infusing at a rate on 100 ml/hr. About 10 minutes after induction, blood pressure decreased to 55/20 (>30% from baseline systolic and diastolic pressures, respectively) and restored with a fluids bolus of 5ml/kg. Postoperatively, the patient was transferred to the intensive care unit and discharged home 2 days later without incident.

Discussion

Pompe or Glycogen Storage Disease type II (GSD-II) is a genetic disorder affecting both cardiac and skeletal muscle. The intracardiac buildup of glycogen in infantile onset Pompe disease leads to a progressive hypertrophic cardiomyopathy characterized by abnormal diastolic function. Therefore, the hypertrophic cardiomyopathy in infantile-onset Pompe disease requires a delicate hemodynamic balance during induction and early maintenance of anesthesia. A noncompliant left ventricle predisposes these infants to diastolic heart failure with elevated left ventricular end-diastolic pressure (LVEDP), at lower ventricular volumes and an increased potential for subendocardial ischemia, necessitating adequate hydration and preload to maintain cardiac output. At the same time, diastolic blood pressure (DBP) must remain sufficiently higher than LVEDP to maintain adequate coronary perfusion pressure⁷.

Glycogen accumulation can also be present in the cardiac conduction system, as evidenced by the glycogen infiltration of the sinoatrial and atrioventricular nodes⁸. Coupled with a hypertrophied heart and an already labile coronary perfusion pressure, infantile Pompe patients become especially sensitive to the development of ventricular and supraventricular arrhythmias⁹. As such, patients suspected of having Pompe disease should routinely undergo extensive preoperative evaluation, conservative intraoperative management and have appropriate postoperative disposition. Preoperatively, it is essential to obtain, in addition to an ECG, echocardiography to assess ventricular cavity volume. In particular, measurement of LV mass index (LVMI) is imperative to help stratify risk. There is strong evidence for an association between LVMI and mortality risk⁹. Deaths resulting
from arrhythmias appeared to correlate with LVMI >350 g/m²⁹.

Propofol, should be avoided specifically for infantile Pompe patients, given its known rapid reduction in systemic vascular resistance and DBP. The use of propofol during induction or maintenance of anesthesia, has resulted in severe and even fatal arrhythmias and has been associated with negative outcomes⁹. Although sevoflurane is an acceptable anesthetic in these infants, the concentrations must be kept low to avoid hypotension, and therefore should only be used if other agents allow the sevoflurane to have an additive effect in an infant where immobility is difficult to obtain with a single agent. Sevoflurane does not appear to be a safe option as the sole anesthetic for this purpose.

In our case ketamine, known for its stable cardiovascular profile, was used for induction in combination with fentanyl and low concentration of sevoflurane. According to the current literature ketamine is suggested as the first choice in this group of patients⁹. Additionally, regional anesthetic techniques have been used successfully as alternative to general anesthesia for infants with Pompe disease¹⁰.

Conclusion

With the availability of enzyme replacement therapy (ERT) using rhGAA, increased survival is anticipated and more infantile Pompe patients will likely present for surgical procedures. Additional care in maximizing coronary perfusion pressure and minimizing arrhythmia risk must be given.
References

Recurarization after Acute Intraoperative Normovolemic Hemodilution and Use of Sugammadex

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Acute normovolemic hemodilution (ANH) is a blood conservation procedure that can be used in cases of refusal of blood transfusion for religious reasons. Herein, we describe a case of recurarization after reinfusion of collected blood. A combination of rocuronium/sugammadex has the potential to increase the safety of patients if ANH is done after induction. Prospective controlled studies evaluating this unique indication for sugammadex use are thus warranted.

Keywords: Advance Directives; Hemodilution; Jehovah’s Witnesses; Neuromuscular Blocking Agents; Bloodless Medical and Surgical Procedures.

Introduction

The Jehovah’s Witness religious community is remembered by health professionals for its refusal to receive blood products as part of the therapeutic arsenal. Minor fractions of blood and other transfusion alternatives, such as acute normovolemic hemodilution (ANH), are optional depending on the follower’s personal beliefs.

The perioperative management of patients who refuse to receive blood products requires interaction between various medical specialties as well as experience with blood conservation procedures. This case report presents the use of ANH in gynecological oncology surgery with recurarization after the infusion of collected blood and the use of sugammadex for reversal.

To our knowledge, this is the first reported case on the indication for and use of sugammadex for reversal of recurarization after ANH.

Case

The patient was a 76-year-old woman with arterial hypertension and type 2 diabetes mellitus. The operation proposed was a total abdominal hysterectomy associated with para-aortic pelvic lymphadenectomy, omentectomy, and biopsies because of an endometrial adenocarcinoma. Laboratory tests revealed the following: hemoglobin: 13.0 g/dL; hematocrit, 38.5% ; urea: 24 mg/dL; glucose: 145 mg/dL; and normal coagulation tests. The patient refused to receive the 4 main blood products under any circumstances owing to her religious conviction (Jehovah’s Witness).
During anesthesia, the patient was monitored with electrocardiography cardiography, pulse oximetry, capnography, esophageal temperature, bispectral index, train-of-four (TOF) stimulation, urine output, invasive blood pressure measurement with cardiac output and central venous oxygen saturation measurement. The anesthetic technique was general anesthesia with sevoflurane, remifentanil and rocuronium associated with a lumbar epidural puncture (L2–L3) using a catheter. The blood collection was started 5 min after the induction of anesthesia and 1,030 mL was obtained over 1 h. The hematocrit was 26% after collection.

Volume replacement was performed with continuous monitoring of changes in stroke volume. A total of 1,500 mL of colloids (0.6% hydroxyethylamide, 130/0.4) and 1,000 mL of crystalloids were administered through anesthesia. The operating time was 3 h, 15 min with an estimated bleeding of 1,000 mL. Monitoring of the neuromuscular function, rocuronium and sugammadex administration occurred as shown in Figure 1.

The patient was admitted to the intensive care unit in the immediate postoperative period without pain or other complaints. On the first postoperative day (POD) she presented with 33% hematocrit and 11.5% hemoglobin. Her pain was controlled using an epidural until the second postoperative day. The postoperative recovery was uneventful and the patient was discharged on the fifth postoperative day.

Discussion

ANH is usually well accepted by Jehovah’s Witnesses, and it is important to note that there is no religious prohibition to its use. For this, it is necessary to guarantee that the collected blood will remain in contact with the patient during all stages of the process, thus maintaining a closed system1.

We chose to collect blood after anesthesia induction. A very important technical aspect is the recirculation of drugs during the transfusion of collected blood. The drugs present in plasma at the time of collection will perform their action on the effector organs at the time of reinfusion. Neuromuscular blockers deserve special attention.

We opted to administer rocuronium for neuromuscular blockade because of the safety associated with rocuronium/sugammadex versus the other nondepolarizing neuromuscular blockers and succinylcholine. Cases of recurarization with the use of atracurium, vecuronium, mivacurium, and rocuronium have been described2. Sugammadex has been proven to be a safer reversal agent than neostigmine, particularly in moderate and deep blockade3. Thus, proper planning to prevent residual curarization is crucial when one opts for blood collection after induction.

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The use of the combination of rocuronium and sugammadex offers a unique opportunity to perform a suitable neuromuscular blockade at all stages of the surgical procedure without increasing the risk of postoperative residual paralysis.

Consent Statement

The patient provided written informed consent and the paper was accepted by the hospital’s research ethics committee.
References

MALPOSITIONED LMA CONFUSED AS FOREIGN BODY IN NASAL CAVITY

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We present a case of confusing white foreign body in the nasal cavity detected during Endoscopic Sinus Surgery (ESS) in a 35-yr-old male which turned out to be a malposition of classic laryngeal mask airway (LMA). Although malposition of LMA is a known entity to the anesthesiologist, if ventilation is adequate, back folded LMA in nasal cavity might not be recognized by the surgeon and lead to catastrophic consequences during endoscopic sinus surgery. In principle, misfolding and malpositioning can be reduced by pre usage testing, using appropriate sizes, minimizing cuff volume, and early identification and correction of malposition.

Introduction

Laryngeal mask airway (LMA) is now the airway of choice in nasal surgeries. Due to its blind technique of insertion, LMA carries inherent risk of malposition and misfolding which may compromise patient safety. Early recognition and corrective actions are therefore imperative for risk reduction.

Case History

A 35 year old male patient presented with history of bilateral nasal obstruction, post nasal drip and headache for last 4 years. Patient had a history of previous endoscopic sinus surgery 2 yrs back but his symptoms were persistent. He was a non-smoker, non-alcoholic and his medical history included no other comorbid condition. A CT scan revealed sinusitis along with bilateral polyps. He was then scheduled for Endoscopic Sinus Surgery (ESS) for polypectomy.

On examination, he had a Mallampati class I airway, poor dentition, and no artificial teeth or dentures. He was 161 cm tall and weighed 65 kg. His heart rate was 76 bpm and regular and arterial blood pressure was 128/76 mm Hg. The lungs were clear by auscultation.

On the day of surgery, after sedation with midazolam the patient was taken to the operating room (OR), where routine monitors were attached for monitoring blood pressure (systolic, diastolic and mean), SpO₂, heart rate and ECG. An eighteen G venous cannula was inserted. Induction of anesthesia was accomplished with 2.5 mg/kg propofol and 0.8 mg/kg rocuronium. A size 4 LMA

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was inserted in the first attempt and showed good chest rise with adequate oxygenation (SpO₂ of 100% throughout the surgery). There were no evidence of air leaks.

Towards the end of the surgical procedure which lasted two and a half hours, a white rubbery mass was seen in the nasopharynx which the surgeon thought to be some foreign material left during the previous surgery. The mass had a cystic consistency and was unlike any lesion of the nasopharynx. On positioning the nasal endoscope closer to the foreign body, the anesthesiologist recognized it to be the tip of the folded malpositioned LMA (figure 1). This was then confirmed by oral examination while the LMA was still in place. Endoscopy clearly revealed a folded distal cuff which was going into the nasopharynx (figure 1, 2). Despite this, the patient was being ventilated all through the surgical procedure without any air leak or fall in saturation.

After completion of surgery, proper suctioning was done and the LMA was removed and examined for the presence of any blood on the ventral part. Blood was present only on the dorsal part of the LMA whereas ventral aspect was absolutely clean. Patient had no signs and symptoms suggestive of any aspiration. Patient was fully conscious, with good cough reflex and there was no hoarseness of voice and sore throat in the immediate post-op period of 24 hours. Patient was closely monitored for any signs or symptoms of aspiration post-operatively. Thereafter the patient was discharged on the next day.

**Discussion**

LMA has gained widespread acceptance throughout the world as airway management device across a spectra of clinical situations. Because the larynx is not directly stimulated, respiratory and cardiovascular reflex responses to placement and removal of the LMA are reduced compared with those after tracheal intubation. These properties make awake removal of LMA a preferred technique after surgery. In nasal surgery, rapid rises in blood pressure can enhance bleeding and are best avoided. A smooth anesthesia induction, maintenance and emergence are required. The avoidance of coughing and return of airway reflexes to prevent aspiration is needed at the same time. This makes LMA a suitable option for airway management in nasal surgery. But due to the blind insertion technique, difficulty in ventilation through an LMA is not uncommon even in experienced hands. It commonly results from malposition and is often corrected by repositioning. Whereas difficulty in ventilating through an LMA may be the result of malposition, it can also be the result of pathological anatomy. Conversely, it is prudent to emphasize that adequate ventilation does not rule out malposition per se as aptly demonstrated by this case and may lead to complications in the intra and post-operative period. It has been found that a malpositioned LMA was 26 times more likely to be associated with gastric insufflation and subsequent aspiration.

In our case, the patient was being ventilated...
MALPOSITIONING OF LMA

in spite of the malpositioned LMA which was incidentally noticed during the procedure. The surgeon mistook it for a foreign body in the nasal cavity left by the previous surgery. The point of concern however remains that the patient was at considerable risk of aspiration throughout the procedure. Although the chances of aspiration were minimal due to fasting status and low pressure used for the positive pressure ventilation, they were still present. Previous research recommends certain signs to ascertain the correctness of LMA placement\textsuperscript{10,11}. These include slight outward movement of the tube upon LMA inflation, presence of a small oval swelling in the neck around the thyroid and cricoid area, no cuff visible in the oral cavity and expansion of chest wall on bag compression. This case emphasizes that, in spite of fulfilling all these criteria, the LMA may still be malpositioned or misfolded or both. The facts illustrated by this case, therefore raise a concern scarcely addressed by the literature till date. Although the risk of aspiration from LMA has been found to be only 2 per 10,000\textsuperscript{12}, it is still present and may often be preventable if proper positioning of LMA is ensured. Fibreoptic confirmation of the LMA position can be of immense benefit but may not be possible in all the cases routinely and in all the settings due to time and financial constraints. The grade of fiberoptic view has been graded in literature as: 1=glottis only seen, 2=epiglottis and glottis seen, 3=epiglottis impingin on grille, glottis seen, 4=epiglottis down folded, glottis not seen\textsuperscript{13}. A grade of 3 or more may need repositioning and reinsertion as it might be associated with increased risk of aspiration.

Another point of concern is that since the reusable LMA can be reused up to 40 times as per manufacturer’s recommendations, does the chance of misfolding and malposition increase with usage or not. The answer to this is not known and needs further studies in this regard but it has been found that the material in reusable classic LMAs does not lose its strength after 100 uses to the extent that its manufacturer claims. At least 100 uses may be considered safe for these devices\textsuperscript{14}. Another safeguard may be the manufacturer recommended pre use performance tests consisting of visual inspection, 180 degree tube flexion test, cuff overinflation test, airway connector examination, checking for discoloration, inflation line testing and mask aperture testing\textsuperscript{15}. These may significantly decrease the chances of misfolding and malposition due to device related issues. In our case, the LMA was being used for the thirty first time and pre use check had not revealed any obvious abnormality.

It is pertinent to mention improper technique of insertion as one of the causes of a malpositioned/misfolded LMA. In our case, we inserted the LMA using the classic technique as per manufacturer’s recommendations\textsuperscript{15} with a fully deflated cuff and were able to achieve adequate ventilation satisfying the aforementioned criteria in the very first attempt by an experienced anesthesiologist using the LMA for past ten years.

The most common causes of reported complications of LMA usage including sore throat, laryngospasm, voice hoarseness, hypoglossal, lingual nerve injuries\textsuperscript{16}, bilateral vocal cord palsy\textsuperscript{17}, sialadenopathy\textsuperscript{18} and arytenoid dislocation\textsuperscript{19} have been documented to be either a faulty insertion technique, or using an undersized LMA with an overinflated cuff or malposition/misfolding or a combination of these
This case demonstrates that the LMA might be malpositioned or misfolded in spite of patient being adequately ventilated and whenever possible, a fibreoptic view grading should be done to ascertain the proper position. Further safeguards to prevent complications include limiting the peak airway pressures (below 20 cm of water\textsuperscript{12}), using recommended pre use testing and proper insertion technique. Since economic considerations cannot be used when reducing risks: any risk has to be reduced as far as possible whatever the economic cost\textsuperscript{26}, a possible approach in minimizing the patient risk might be to use single usage devices like the LMA Unique. The cost effectiveness and practicality of doing so may, however, be guided by the regional and institutional factors. Moreover, further high power studies are needed to actually quantify the amount of risk reduction achieved with these single use devices. The change in the incidence of malposition and misfolding with increasing number of uses of LMA also needs to be studied.

References

AIRTRAQ® OPTICAL LARYNGOSCOPE FOR TRACHEAL INTUBATION IN A PATIENT WITH AN UNCOMMON GIANT LIPOMA ON THE POSTERIOR ASPECT OF NECK AND ADDITIONAL RISK FACTORS OF ANTICIPATED DIFFICULT AIRWAY: A CASE REPORT

Vassilios Dimitriou*, Amr El Kouny***, Mohammed Al Harbi**, Freddie Wambi***, Nasser Tawfeeq****, Aziz Tanweer***, Abdulallem Al Atassi*** and Georges Geldhof*****

Patients with restricted neck movement present a difficult airway situation because of improper positioning and inadequate extension of the atlanto-occipital joint. The Airtraq optical laryngoscope is a new single use device that permits an indirect view of the glottis without the need to achieve a direct line of sight by conventional use of the ‘sniffing position’. We present and discuss a case of uncommon giant lipoma (16x12x10 cm) in the posterior aspect of the neck in addition with other independent factors of anticipated difficult airway, intubated successfully in the semi-lateral position with the use of Airtraq®.

Keywords: Intubation, Difficult airway, Lipoma, Laryngoscopes.

Introduction

The Airtraq® optical laryngoscope (AL) (Prodol Ltd. Vizcaya, Spain) is a relatively new disposable tracheal intubation device, developed to facilitate tracheal intubation in patients with normal or difficult airways1-5. It is designed to provide a view of the glottis without alignment of the oral, pharyngeal and tracheal axes. This is due to the exaggerated curvature of the blade and a series of lenses, prisms and mirrors that transfer the image from the illuminated tip to a proximal viewfinder. A guiding channel on the right side of the blade acts as a conduit holding and directing the tracheal tube through the glottis opening when the vocal cords are visualized. AL is commercially available in three sizes. The larger size 3 utilizing tube sizes 7.0-8.5 internal diameter (ID), the size 2 utilizing tube sizes 6.0-7.5 ID and the pediatric size utilizing sizes 4.0-5.5 ID according to the manufacturer. The width of the guiding channel in size 3 is 14 mm and in size 2 12 mm. The length of the guiding channel in size 3 and size 2 is 20 and 19 cm, respectively. The angle between the guiding channel and the blade is 93° in all AL sizes. The extreme curvature of the blade and the optical components help to visualize the glottis without the need for aligning the three airway axes, i.e. oral, pharyngeal and laryngeal. It also does not obstruct the endoscopic view.

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of the vocal cord during laryngoscopy because of its inbuilt conduit for endotracheal tube.

Restricted head extension represents an important independent risk factor during laryngoscopy and tracheal intubation. We present and discuss a case of restricted head extension due to an uncommon giant lipoma located in the posterior aspect of the neck and anticipated difficult airway, intubated with the use of AL.

Case Report

A female, 42 years old (height: 150cm, weight: 108 kg, BMI: 46 kg/m²), American Society of Anesthesiologists class II, presented to the surgical outpatient department with a history of gradually progressive swelling mass on the posterior aspect of neck for the last 12 years. On clinical examination and investigations the diagnosis of lipoma was made and the patient was planned for excision. Cervical spine CT showed a giant neck lipoma (16X12X10 cm) without bony or articular abnormality (Figure 1 and 2).

During preoperative airway assessment, the morbidly obese patient presented with severely restricted head extension (45°) due to the giant lipoma, leading to a very short thyromental distance (4.9 cm). Mouth opening was small (interincisor distance 3.5 cm) with protruding incisors, leading to Mallampati scale III. Additionally, the patient reported history of gastroesophageal regurgitation and obstructive sleep apnea, without previous history of surgical procedure under general anesthesia during the last 12 years. An anticipated difficult airway was confirmed.

Awake fibreoptic intubation was recommended for airway management of the anticipated difficult airway. However, the patient denied to give consent for awake intubation and so general anesthesia was planned. The night before the procedure the patient was given 40mg of esomeprazole and 2h before surgery metoclopramide 10mg orally. On the table, standard monitoring was applied and the patient was put to lie in a semi-lateral position with the back appropriately supported, in a way to achieve maximal neck extension and to avoid compression of the lipoma. After preoxygenation, anesthesia was induced with i.v. fentanyl 1µg.kg⁻¹ and propofol 2 mg.kg⁻¹. After confirmation of adequate bag mask ventilation neuromuscular relaxation was achieved with 1.5 mg.kg⁻¹ of succinylcholine. Cricoid pressure was applied soon after loss of consciousness and during intubation, without distorting the laryngoscopy and view of glottis.

Tracheal intubation was performed by an experienced anesthetist (instructor in national and international airway courses) in the use of Airtraq. An Airtraq® size 2 blade was introduced into the oral cavity in the midline, over the base of the tongue. The view of glottis was optimized on the first attempt, which required vertical lift adjusting maneuver. A 7.5 mm ID conventional polyvinyl chloride (PVC) endotracheal tube the tracheal tube was passed through the vocal cords and the cuff inflated. The tube was then held in place while the AL was removed. Anesthesia was maintained with nitrous oxide (66%) and sevoflurane (1-2%) in oxygen. The intraoperative course was uneventful and lasted 70min. The lipoma removed weighted 1.3kg.
Discussion

Airway management is fundamental for safe anesthetic practice and anesthetists need to be skilled in airway management techniques. We report a case of tracheal intubation with the Airtraq® laryngoscope in a patient with giant neck lipoma and anticipated difficult airway. The patient presented with a significant number of independent risk factors indicating anticipated difficult airway management. These included severely restricted head extension, decreased mouth opening, morbid obesity, history of gastroesophageal reflux and obstructive sleep apnea.

Management of the potential difficult airway still remains a major challenge. Awake fiberoptic intubation is considered to be the gold standard and the safest option in patients of anticipated difficult airway. However, this is technically more difficult and requires adequate experience. Alternatively, awake tracheal intubation using the Airtraq® could be an option. However, even if there were no technical limitations like in our case, some patients remain apprehensive about the procedure and refuse to remain awake. Supraglottic airway devices (SAD) are of proven value in difficult airway situation. Nevertheless, the 4th National Audit Project (NAP4) from the United Kingdom, documented cases of inappropriate use of SAD to avoid tracheal intubation resulted in patient morbidity. In our patient there were two important limitations for the SAD to be the primary airway management device. First, the history of morbid obesity combined with gastroesophageal reflux and the possible risk of aspiration and second the site of operation in close proximity with the airway, that possibly could lead to inadvertent SAD mis-positioning during anesthesia.

Recent reports have demonstrated that the use of the AL is superior to the Macintosh laryngoscope in patients at low or increased risk for difficult intubation. Additionally, the AL has been used successfully in a number of cases with difficult airway management, including patients with cervical spine immobilization, morbid obesity, following failed tracheal intubation in anesthetized patients as well as in cases where AL was used successfully for awake tracheal intubation.

Head extension is an important point during laryngoscopy and an adequate extension of the atlantooccipital joint is important to align the three axes i.e. oral, pharyngeal and laryngeal. Intubation in patients with restricted neck movements like ankylosing spondylitis or in patients with cervical spine immobilization, therefore present a difficult airway situation because of improper positioning and non-alignment of the three axes. The AL is a new single use device that permits an indirect view of the glottis without the need to achieve a direct line of sight by conventional use of the ‘sniffing position’. Actually, in our case sniffing position was impossible due to the giant lipoma, restricting severely the head extension. For this reason the patient was put to lie in a left semi-lateral position on the table, in order to achieve the maximal head extension. Additionally, AL has been used successfully for tracheal intubation in the lateral position. Another similar case has been reported recently with the patient in supine position.

Following the induction of general anesthesia and before administering the neuromuscular blocking agent, adequate face mask ventilation was confirmed. Prior significant clinical experience with the use of Airtraq demonstrated that in cases when tracheal tube was not possible to be directed into the trachea, optimization maneuvers were attempted. Optimization maneuvers included extension, rotation or vertical lift of the AL, with the latter to be used most commonly like in our case.

The operation site was at the same level and in close proximity with the airway while the patients’ head was covered. For these reasons, someone should argue that it should be reasonable to choose a reinforced tracheal tube. However, conventional PVC tracheal tube was used instead, taking into account the increased failure rate with reinforced tracheal tubes during tracheal intubation, when using Airtraq optical laryngoscope.

In conclusion, this case of uncommon giant lipoma (16x12X10 cm) in the posterior aspect of the neck in addition with other independent factors of anticipated difficult airway, was intubated successfully in the semilateral position with the use of Airtraq®.
References


DIAGNOSIS OF AORTIC THROMBUS
AFTER PELVIC SURGERY

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We describe the case of a patient who was found to have an aortic thrombosis while in the recovery room after an abdominal perineal resection. If not treated early, aortic thrombosis can be a devastating complication, leading to paralysis, need for amputation, or death. Understanding the risk factors that pre-dispose patients to thrombosis can allow the anesthesiologist to make an earlier diagnosis in the recovery room. In addition, patients at high risk of intraoperative thrombosis may benefit from an anesthetic plan that includes particular attention to patient positioning and hemodynamic stability.

Case Description

A 62-year-old gentleman with a recto-urethral fistula after radiation for prostate cancer presented to the operating room for an abdominal perineal resection. His past medical history included hypertension, diabetes mellitus, chronic renal insufficiency, and tobacco use. His previous surgeries included a radical cystectomy with an ileal conduit and ureteral stent placement.

The patient was induced with general anesthesia and placed into lithotomy position with steep Trendelenburg for the duration of the six-hour surgery. The intra-operative blood loss was approximately 750 mL. Soon after tracheal extubation, the patient began complaining of right leg pain. He was also unable to move his leg. Both legs were cold to the touch: the right leg was pale, and the left leg was cyanotic. Dorsalis pedis pulses were not palpable in either leg. Suspecting acute limb ischemia, the anesthesiologist immediately consulted a vascular surgeon. When multiple attempts to locate a pulse with Doppler were unsuccessful, the patient was taken for a computed tomography angiogram, which confirmed the diagnosis of an aortic thrombus beginning above the bifurcation and extending into both iliac arteries (figure 1). The patient was taken emergently to the operating room for a thromboembolectomy, approximately five hours after the end of his original procedure. Three months later, the patient was discharged to a subacute rehabilitation facility, although he was unable to stand without assistance.

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Discussion

To our knowledge, only one other case report has described a post-operative aortic thrombosis after pelvic surgery\(^1\). That patient experienced progressive weakness and decreased sensory function of both legs after undergoing a low anterior resection. These symptoms were initially mis-attributed to the patient’s epidural analgesia. The diagnosis of aortic occlusion was not made until postoperative day one, when a femoral pulse could not be palpated in either groin. Despite successful surgical restoration of blood flow to salvage the lower extremities, the patient was unable to ambulate afterwards.

A similar clinical scenario was seen in two other patients who had post-operative thrombosis of their indwelling aortic endo-grafts after pelvic surgery\(^2\). Both patients had undergone endovascular repair of an abdominal aortic aneurysm one week prior to their colectomy. After the colectomy, both patients had loss of palpable lower extremity pulses. However, because the diagnosis was made within two hours and re-vascularization was performed immediately, neither patient experienced neurologic or vascular sequelae. The anecdotal evidence from this limited number of cases suggests that the avoidance of adverse consequences requires early diagnosis in the recovery room and prompt treatment. Studies of spontaneous acute aortic occlusion have also shown that patients who have motor or sensory deficits at the time of diagnosis have a higher chance of adverse events\(^3\). Therefore, it may be prudent to identify patients preoperatively who are at higher risk of thrombosis and pre-emptively perform postoperative vascular checks before motor or sensory symptoms develop.

Acute aortic occlusion often presents with the signs and symptoms of acute limb ischemia: pain, pallor, poikilothermia, paresthesia, paralysis, and pulselessness. In order to avoid mistaking a patient’s symptoms for a neurologic deficit and delaying appropriate intervention, physical examination of the patient with any of the first five “P’s” should also include a thorough pulse (including Doppler\(^4\)) examination, which may be the first indication that the underlying symptoms are caused by a vascular etiology and not a neurologic one\(^1\).

\(\text{Fig. 1} \)
Computed tomography angiogram (CTA) showing an aortic thrombus beginning above the bifurcation (A) and extending into both iliac arteries (B, C).
Spontaneous aortic thrombosis has been associated with smoking, diabetes, coronary artery disease, hypertension, hyperlipidemia, chronic renal insufficiency, atherosclerosis, peripheral artery disease, cancer, hypercoagulable states, radiation therapy, and male gender. Some authors have hypothesized that thrombosis occurs during low-flow states, such as with low cardiac output or hypovolemia, both of which can occur during surgery.

Patients who present to the hospital on the day of surgery may be hypovolemic from NPO status or bowel preparation. Additional intra-operative factors include extensive surgical dissection or retraction leading to vascular injury; prolonged lithotomy and Trendelenberg position; and compression of legs from stirrups or serial compression devices. Both of these latter two factors - lithotomy positioning and serial compression devices - have been implicated in compartment syndrome of the lower extremities, leading to decreased circulation. Although there have not been any reports of ureteral stents causing thrombosis, it is also possible that turbulent blood flow through the common iliac arteries at the point over which the ureters and stents cross could contribute to thrombosis.

Some authors have advocated certain measures to improve circulation to the lower extremities. Confirming the presence of distal pulses when the patient is first positioned in the lithotomy position may prevent unnecessary compression of the lower extremities. In prolonged procedures in the lithotomy or Trendelenberg position, intermittently placing the patient into supine position or tilting the table so that the legs are below the level of the left atrium may decrease the duration of time that the lower extremities are hypoperfused. 
References

BILATERAL SUPERFICIAL CERVICAL BLOCKS AS THE PRIMARY ANESTHETIC FOR THE PATIENT UNDERGOING AN EVACUATION OF NECK HEMATOMA AFTER PARATHYROID SURGERY

BENJAMIN HELLER* AND ADAM LEVINE**

Abstract

This is the case of an 80-year-old female who presented for evacuation of a neck hematoma on POD#3 after a parathyroidectomy. Her medical history included coronary artery disease with a drug-eluding stent, off aspirin for 2 weeks. She had a significant hematoma from the hyoid bone extending down to below the suprasternal notch. She reported hoarseness. The anesthesiology team provided regional anesthesia with bilateral superficial cervical blocks, supplemented with minimal sedation for patient compliance. The surgical team used no adjuvant local anesthetic. A deep exploration was performed and significant clot was evacuated. The patient went home safely from the PACU.

Introduction

Parathyroidectomy is a surgery commonly performed on a daily basis in many hospitals throughout the United States. The complications of this surgery have been well described and include postoperative bleeding resulting in hematoma, laryngeal edema, unilateral or bilateral recurrent laryngeal nerve injury, and hypocalcemia. Patients may return to the operating room as a result of these complications, and the anesthesiologist must be prepared to manage these cases in both an urgent and emergent fashion. Furthermore, otolaryngological surgery is commonly associated with airway fire risk, and these cases are no exception. For a fire to occur, there needs to be fuel, oxygen, and an ignition source. The ASA has released a practice advisory for the prevention and management of operating room fires, which includes an operating room fire algorithm for both the prevention and treatment of this complication.

There are a variety of issues that must be addressed when creating an anesthetic plan for the patient undergoing evacuation of a neck hematoma. Airway patency is of utmost importance, but the risk of airway fire and the management of co-morbid medical conditions must always be taken into account. The anesthesiologist’s main duty to the patient is to safely manage the patient during the intra-operative period, however, if one is able to minimize the risk of post-operative complications and improve long term patient outcomes, that must be taken into consideration as well.
This patient signed written surgical consent which included a statement regarding publication of the surgery/treatment/procedure for medical, scientific, or educational purposes, provided the patient’s identify is not revealed. Furthermore, the patient was consented separately for the explicit goal of presentation of the anesthetic management of this case. The authors of this case have the original copy of the patient’s consent to the presentation of this case. Both authors contributed to the care of this patient.

Case Description

Our case is an 80-year-old female who is presenting for an evacuation of a neck hematoma. The patient underwent parathyroid exploration and removal of right inferior parathyroid adenoma three days prior. Approximately 36 hours after the surgery, the patient reported she had a coughing fit and then noticed she began to have swelling in her neck and hoarseness. She presented to her surgeon, who performed a flexible fiberoptic endoscopy. This demonstrated moderate laryngeal edema, some slight ecchymosis of the left aryepiglottic fold, normal vocal cord motion, but an overall clear airway. She was admitted to the hospital and scheduled for surgery the following morning.

The patient’s medical history was significant for coronary artery disease with a stent in the left anterior descending artery, placed 6 years ago. She had been off of her aspirin for 14 days on the day of this surgery. Her other medical co-morbidities included anxiety, non-insulin dependent diabetes mellitus, hypertension, former smoker, and hyperlipidemia. She had been NPO since the previous evening, and had no complications with prior anesthetics. She was a mallampati 2. Physical exam was significant for a significant hematoma extending from the hyoid bone down to below the suprasternal notch (Figure 1).

A discussion was had with the patient, the anesthesiology team, and the surgical team. The patient noted that she was a singer, and manipulation of her vocal cords was of concern to her. The patient was motivated, and was amenable to a regional technique. The risks and benefits were explained to the patient, and it was emphasized that conversion to general anesthesia would be at the discretion of the anesthesiology team.

The patient was brought into the operating room and standard ASA monitors were applied. A fiberoptic tower was in the room, along with an arterial line setup. Glycopyrolate 0.2mg was given in case conversion to general anesthesia was required. The patient was given a bolus of 20meg of remifentanil for comfort during block placement. Bilateral superficial cervical blocks were placed, with 15ml of 0.5% bupivacaine injected on each side. A low dose remifentanil infusion was started at 0.05meg/kg/min for patient compliance and to prevent movement during the surgery. A bolus of 30meg of remifentanil was given before the start of surgery to assist with immobility.

Surgery was performed successfully with a deep exploration of the neck and evacuation of a significant amount of clot (Figure 2). No supplemental local anesthetic was given by the surgical team, and no adjuvant bolus sedation was required. The infusion of remifentanil was maintained between 0.02meg/kg/min and 0.05meg/kg/min. The patient was awake, responding appropriately to commands, breathing spontaneously, and comfortable throughout the procedure.

Of note, as demonstrated in figure 3, we created a unique apparatus designed to provide the patient with oxygen but to minimize the risk of airway fire. The nasal cannula provided the oxygen, the face tent provided the barrier, and the suction at the top of the tent eliminated risk of oxygen pooling. The combination of entrapped oxygen and electrocautery was concerning; therefore, this apparatus was created, and the surgical team used minimal cautery.

Discussion

This case presents multiple issues that the astute anesthesiologist must consider. The most concerning is the patient’s airway. The patient had a significant neck hematoma, and reported new hoarseness. However, she had been stable on the floor overnight, with no acute changes. Since this patient was off of aspirin for 2 weeks, it is possible her risk of cardiac complications was increased, as at least one randomized, double blind, placebo-controlled study has shown in high-risk patients undergoing non-cardiac surgery that perioperative aspirin reduces the risk of major adverse
Fig. 1
Demonstrates the extent of the hematoma in this patient, extending from the hyoid bone down to below the suprasternal notch.

Fig. 2
A deep exploration of the neck and evacuation of a significant amount of clot was performed.

Fig. 3
We created a unique apparatus designed to provide the patient with oxygen but to minimize the risk of airway fire. The nasal cannula provided the oxygen, the face tent provided the barrier, and the suction at the top of the tent eliminated risk of oxygen pooling.
cardiac events. While the surgical stress is not attenuated with this technique, general anesthesia may incur increased risk from variations in blood pressure and manipulation of the airway. The authors had to weigh this risk against the risk of having to convert to general anesthesia intra-operatively. Our patient was motivated, and preferred as little airway manipulation as possible. We have good rapport with our surgeon, who was confident the surgery could be performed in a short period of time. We decided to proceed with a regional anesthetic, and had all the materials necessary to convert to a general anesthetic if it was required.

Furthermore, we were aware of the risk of airway fire in this surgery. Typically, in a general anesthetic it is possible to turn the oxygen down to minimize the oxidative source. Our patient was awake, and although there was minimal risk of an accumulation of oxygen, we made a unique apparatus that applied suction near the patient, minimizing oxygen building and the rebreathing of carbon dioxide. This decreased the risk of operating room fire in this head and neck monitored anesthetic care case.

In conclusion, this case was unique in that a regional anesthetic was given to prevent manipulation of a possibly tenuous airway, and to possibly lower the cardiac risk that this patient was likely incurring having been off aspirin for 2 weeks. Careful planning between the anesthesiology and surgical teams, combined with thorough preparation, contributed to the success of this plan, and a positive outcome for this patient.

References


EXTRA CORPOREAL MEMBRANE OXYGENATION IN ACUTE RESPIRATORY DISTRESS SYNDROME

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Abstract

A young female presented with pneumonitis and worsened acute respiratory distress syndrome (ARDS) failed all the conservative ventilator management, was managed with extra corporeal life support technology, and was successfully discharged.

Keywords: Extra Corporeal Membrane Oxygenation (ECMO); Acute Respiratory Distress Syndrome (ARDS).

The Case

A 15 year old female, known case of chronic inflammatory demyelinating polyneuropathy, presented to emergency room (ER) on 02/01/2013 with chief complaints of shortness of breath, chest pain, fever, vomiting and diarrhea for 3 days. Her condition worsened in the ER due to respiratory distress, hypoxia and shock. Eventually she was intubated and mechanically ventilated. Post intubation chest x-ray (CXR) showed right upper zone pneumonia and she was shifted to intensive care unit (ICU) where she was managed with lung protective ventilation, antibiotics, antivirals and all other supportive critical care measures. Initial Ventilator settings were assist- pressure control mode with inspiratory pressure set between 26 - 30 cmH2O, fraction of inspired oxygen (FiO2) of 0.9, positive end expiratory pressure (PEEP) of 12 cmH2O, respiratory frequency of 22 with an I:E of 1:2. Her ideal body weight (IBW) was 46 kg. Tidal volume generated was 160-200, which was just adequate. The patient was severely hypoxemic with oxygen saturation (SpO2) of 85-88%. Arterial blood gas (ABG) reported P/F ratio of 90 with mild acidosis. Repeat CXR revealed worsening of right lung opacity and bronchoscopy was done to rule out any collapsed segment. Lung recruitment maneuvers with CPAP of 35 - 40 cmH2O for 40 seconds were performed in view of recurrent severe oxygen desaturation and hypoxemia. The same management continued on 03/01/2013, and the frequency of recruitment maneuvers was increased. Recruitment maneuvers resulted in transient improvement of SpO2. On 04/01/2013
Chest X-rays

**Fig. 1**
02/01/2013- Initial CXR

**Fig. 2**
04/01/2013- Worsened CXR

**Fig. 3**
04/01/2013 CXR Post ECMO cannulation

**Fig. 4**
08/01/2013- CXR improving

**Fig. 5**
14/01/2013-CXR, Post ECMO decannulation

**Fig. 6**
24/01/2013-CXR, 3 days after extubation
hypoxia and shock worsened and vasopressors were stepped up. CXR also worsened with bilateral infiltrates. High frequency oscillatory ventilation (HFOV) was initiated with FiO2 of 1.0; Frequency of 6.0 Hz.; amplitude ensured adequate chest wiggle and continuous distending pressure (CDP) of 35 cmH2O. In spite of this, hypoxemia was persistent. The patient suffered a cardiac arrest (pulseless electrical activity for 3 minutes, secondary to severe hypoxia) and was resuscitated. Mean arterial pressure (MAP) of >65 mmHg was achievable with maximal vasopressor support. All conventional lung protective strategy, recruitment maneuvers and HFOV failed to improve oxygenation. The decision to initiate Veno-Venous Extra Corporeal Membrane Oxygenation (VV ECMO) was made in view of severe refractory hypoxemia. The circuit was primed with crystalloid, plasma and heparin. The right internal jugular vein (Rt. IJV) was cannulated with 19F cannula and right femoral vein with 25F cannula. The cannulation procedure was uneventful. Settings were as follows: ECMO Flow: 4.5 to 5.5 LPM (120-150 ml/kg/min); Targeted ACT: 180-220 sec; FiO2: 100%; Sweep Gas: 4 LPM; Temperature: 36°C. The patient was kept on minimal ventilator settings with a minimal PEEP of 5 cmH2O, low tidal volume (4-6 ml/kg IBW) and respiratory rate of 18. On 05/01/2013, patient’s oxygenation status started to improve with stable hemodynamics, and subsequently the inotropic support was stepped down. Virology panels were negative for H1N1. There were no clear improvement in CXR and hence bronchoscopy was done again to rule out lung collapse. Infection control practices and nutritional support were strictly followed. On 08/1/2013, the CXR started to improve and Glasgow coma scale (GCS) was 9/15T. A pig tail catheter was inserted for right pleural effusion on 09/01/2013. The following days were uneventful with steady improvement in oxygenation. On 13/01/2013 morning, CXR revealed that Rt. IJV cannula was slipped out about 6 cm, and was reinserted with no adverse events. On 14/01/2013, weaning from ECMO was initiated, as the patient showed significant clinical improvements. CXR showed significant clearance of lung fields and patient was maintaining a SpO2 of 95% on ECMO FiO2 of 0.6. Arterial blood gas parameters were acceptable with a partial pressure of arterial oxygen (PaO2) of 102 mmHg and a MAP of >80 mmHg with no vasopressors. On the morning of 15/01/2013, oxygen challenge test was performed. Ventilator FiO2 was increased to 1.0 for 15 minutes and a subsequent ABG showed a PaO2 of 180, which marked oxygen challenge test as satisfactorily positive. ECMO FiO2 was decreased to 0.21 and eventually the ECMO machine was stopped and later the patient was decannulated. The patient was hemodynamically stable and maintained good oxygenation on minimal ventilator setting. The patient was successfully liberated and extubated on 21/01/2013 and post extubation phase was uneventful. On 04/02/2013, patient was shifted out to ward and rehabilitation phase was started. The patient was discharged home on 17/03/2013.

Discussion

There are many conservative adjuncts in treating patients with severe ARDS like recruitment maneuvers, prone positioning, aggressive diuresis, high frequency ventilation, shunt reduction techniques and extra corporeal life support as a last resort. ECMO is a re-evolving life support technology which has been in use for 40 years. There is a general consensus about the use of extra corporeal life support in neonatal and pediatric population with reversible cardiorespiratory failure. The supportive evidence for its extensive use in adults has only emerged in the recent past, with the publication of the CESAR (Conventional ventilatory support vs extracorporeal membrane oxygenation for severe adult respiratory failure) trial and a report of large number of H1N1 ARDS patients treated with ECMO. Currently ECMO has become more reliable across the world with improved technology and increased experience, which has reflected in improved outcome. The Australian and CESAR studies suggest that ECMO can indeed save lives as a rescue therapy when conventional methods fail. Of note ECMO can be considered as a supportive therapy rather than disease modifying treatment and best results are obtained if we choose the right patient, with the right mode and configuration at the right time.
References


LETTER TO THE EDITOR

SEVEN-DAY HOSPITAL MODEL: A FUTURISTIC ACTUALITY

Deepak Gupta MD*

As medicine realizes and accepts that it has been theoretically and financially surviving on corporate business menu card for some time now, it will have to eventually imbibe the futuristic actuality of seven-day hospitals that will run full-fledged round-the-clock (a full-fledged advancement on New York University Langone Medical Center’s concept of working weekends)1. Firstly, it is time to understand that there has been a lot of data2-10 suggesting that patients may be likely to face higher risks of in-hospital morbidity and mortality during weekends most likely secondary to the fewer human resources during weekends. Then there is the other side of the coin wherein hospitals are potentially losing money1 because of non-functioning to minimally functioning weekends suggesting hospital infrastructures are primarily-to-exclusively utilizing 5-out-of-7 days in each week with personnel’s vacationing/weekending forcing worksites’ major shutdowns on weekends every week. To complicate it further, there is constant non-resolving debate about deeming appropriateness to electivity of procedures/interventions11 and separating elective procedures-from-emergency procedures12. Finally, there is innovative/creative concept of doing “free” elective surgeries/procedures on Sundays and Saturdays13-14 for non-insured or poorly insured patients so as to avoid the costs borne by the hospitals in the event of elective surgeries/procedures deteriorating into emergencies and presenting into emergency rooms for non-covered/insured immediate-mandated medical management.

The futuristic seven-day MODEL should be based on the “Three Patterns for all” (each and every personnel working in the hospital): Mon-Fri AND Tue-Sat AND Sun-Thu. For non-biased rotation across the three patterns, the personnel will be mandated to follow monthly change: Mon-Fri THEN Tue-Sat THEN Sun-Thu. If somebody is only working four-days-a-week, then they will have to choose similarly but the monthly rotation will have to include at least one true weekend day per rotation cycled over every four months rather than the cycled rotation every three months in the case of five-days-a-week workers. So four-days-a-week workers will have to follow Mon-Thu THEN Tue-Fri THEN Wed-Sat THEN Sun-Wed. This will ensure that each person has one true weekend day. Additionally, mandatory monthly rotation will have to accommodate annual rotation so as to take long weekends’ months into consideration. Moreover, if a person is working less than 7-days in a month due to any reason (like long vacations), that month will have to be excluded from the monthly rotation’s account.

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As all seven-days will be deemed as weekdays for hospital personnel, there will not be any requirements for extra incentives/payments for working on true weekend days. The rationale behind this is that each personnel will be mandated to have 2-contiguous-days off each week (their personal “weekend” each week) plus their annual job-specific vacation days. Now the situation may arise that despite opening the scheduling for all seven days-a-week for elective admissions/procedures/surgeries, the true weekend days (Saturdays and Sundays) may see less patient/clientele traffic in the hospitals if patients want to enjoy their own weekends instead of being in a hospital; however, that will not preclude those true weekend days from acting as weekdays for the hospital personnel’s staffing. The only thing that can be accommodated irrespective of it being a true weekday or true weekend day will be the option of paying per hour across the board so that when relieved from duty due to paucity of clientele traffic, the hospital personnel can enjoy home. Coming to work and going home early will not mean that it was NOT a holiday because there will be a mandatory personal weekend per week anyway. As far as immovable infrastructure of the hospitals is concerned, the only true holidays for them will be for regularly mandated maintenance (and an additional bonus of vacations for the personnel during that maintenance periods if those time periods are NOT miniscule).

Alternately in terms of limitations of the seven-day hospital MODEL, it may happen that true weekend days may see increased footfalls of the patients in the hospitals to take advantage of the fully functioning hospitals being open on true weekend days so that patients can avoid wasted sick-leave days in the event of elective procedures being scheduled on true weekdays. Moreover, the additional reasons why true weekends may not be considered and may not evolve as weekdays for the hospital personnel is that though the equipment costs will be the same, the personnel costs may be demanded higher because true weekends were invented to accommodate the humane need for “weekly” break off the work-routine (some may even say that they could have been invented to match to even out with the seven-day lunar phases of waxing crescent, waxing gibbous, waning gibbous and waning crescent) and simultaneous advent of weekend social activities to rejuvenate exhausted personnel for their next weekly work-routine. So even though personal weekends will ensure the “weekly” break off for the hospital personnel but these personal weekends may frequently fall on non-Saturdays-non-Sundays when everyone else is working and they are “holidaying” and vice-a-versa. How hospital personnel will enjoy “weekends” with paucity of week-end activities as week-end activities will not be planned according to the hospital personnel’s working patterns until and unless “Three Patterns for all” percolates into all business activities of the societies so that there are always long weekends’ activities from Fridays to Mondays round-the-year for accommodating the work-schedules of Sun-Thu AND Mon-Fri AND Tue-Sat across the societies. The pro-business aptitude of the society may further want to envisage a future of opening even night-times for scheduling the elective admissions/procedures/surgeries (converting fully functioning seven-day hospitals to fully functioning 24x7 hospitals). However, this model or any model for that matter will NOT be able and should NOT be allowed to override the physiological needs of maintaining daily circadian rhythms of the human beings including the patients themselves because even the inanimate equipment and infrastructure needs a daily downtime (nighttime that is by nature devoid of sunlight) for proper functioning day-in-day-out and human brains and bodies are no different from the computerized brains and robotic hands.

In summary, the time may be ripe to consider this futuristic actuality of seven-day hospitals model wherein complete hospital’s infrastructure is functional round the year with each day being non-unique as far as for catering/welcoming the patients/clientele while accommodating and non-compromising the provisions of weekly personal “weekends” of the hospitals’ personnel.
References


DOES CISATRACURIUM AT A CLINICAL DOSE
ATTENUATE THE IMMUNOSUPPRESSION AFTER
SURGERY IN SMOKING PATIENTS WITH
NON-SMALL CELL LUNG CANCER?

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Immunosuppression is a feature of the postoperative stress response and is associated with anesthesia, blood transfusion, hypothermia, mechanical ventilation, and the patient’s underlying disease12. There is a shift from a T helper cell 1 (Th1) to a Th2 immune response in those patients with non-small cell lung cancer after surgery, which appears to be associated with infections, sepsis, and cancer formation and progression1.

Cisatracurium is a benzyl isoquinoline non-depolarizing muscle relaxant, which is widely used during anesthesia due to its Hofmann degradation independent of liver and kidney functions, no release of histamine and its intermediate duration4. It is well known that nicotine can inhibit immune function and attenuate systemic inflammatory responses via activating α7 nicotinic acetylcholine receptors (nAChRs), which is termed the cholinergic anti-inflammatory pathway5. Besides blocking muscle nAChRs, non-depolarizing muscle relaxants, such as d-tubocurarine, can also block α7 nAChRs expressed on multiple-type cells in vitro6, but limited data is available in clinical settings.

The hypothesis

Cisatracurium at clinical dose may be useful in attenuating postoperative immunosuppression in smoking patients with non-small cell lung cancer.

Evaluation of the Hypothesis

Nicotinic acetylcholine receptors (nAChRs) are composed of five receptor subunits, including α1 to α10, β1 to β4, γ, δ, and ε, which form ligand-gated ion channels7. According to their physiological distribution, nAChRs are classified as either muscle or neuronal nAChRs8. In neurons, α7 nAChR assembles as a homopentamer composed of five individual α7 subunits that form a central pore with ligand binding at subunit junctions. α7 nAChR also widely expressed in human immune cells, including T lymphocytes, B lymphocytes, dendritic cells, monocytes, macrophages, neutrophils, and microglia cells9,10. These receptors play an important role in controlling angiogenesis, apoptosis of T cells, and the development and antibody secretion of B cells as well as down-regulating proinflammatory cytokine synthesis in macrophages and glial cells11,12.
Nicotine, the main addictive component of tobacco, binds to various subtypes of nicotinic acetylcholine receptors that are expressed on neurons and some non-neuronal cells, such as α7 nAChRs in immune cells. Activation of α7 nAChRs by nicotine leads to elevated intracellular calcium levels sufficient to activate signal transduction pathways that suppress innate and adaptive immune responses\textsuperscript{15}. Nicotine reduces T cell proliferation and the production of Th1 and Th17 cytokines\textsuperscript{16} and enhances immunosuppressive function of CD4\textsuperscript{+}CD25\textsuperscript{+} Tregs via α7 nAChR\textsuperscript{17}. There are also reports on the inhibition of antigen presentation of dendritic cells and disruption of their ability to induce Th1 lineage differentiation by nicotine\textsuperscript{18-19}. It has been reported that chronic exposure to nicotine up-regulates expression of α7 nAChRs on circulating monocytes in humans and CD4\textsuperscript{+} T cells in mice\textsuperscript{16,20}. Therefore, smoking deteriorates the immune system function in patients with lung cancer. The effects of cisatracurium on the immune response in patients with lung cancer after surgery has not been well established. Cisatracurium is able to block α7 nAChRs on immune cells because it has a similar chemical structure and more potent effect compared with d-tubocurarine which is confirmed to block α7 nAChRs\textsuperscript{6}. We hypothesize that nicotine induced immunosuppression may be attenuated due to antagonizing α7 nAChRs on human peripheral blood mononuclear cells by cisatracurium, thus protecting against the postoperative immunosuppression in smoking patients with lung cancer.

Consequences of the Hypothesis and Discussion

If α7 nAChRs on peripheral immune cells are blocked by cisatracurium at clinical dose, it would very likely affect systemic immunity, such as enhancing Th1-type cytokines production, inducing Th1-type lymphocyte differentiation and proliferation, weakening CD4\textsuperscript{+}CD25\textsuperscript{+} regulatory T cells suppressive activity. Therefore, the administration of cisatracurium or other non-depolarizing muscle relaxants to smoking patients with non-small cell lung cancer during surgery should be given great importance and a continuous infusion with a deeper level of neuromuscular blockade is recommended.

In conclusion, the postoperative immunosuppression in smoking patients with non-small cell lung cancer may be attenuated by continuous infusion of cisatracurium during surgery. Non-depolarizing muscle relaxants may play an important role in regulating postoperative immune response in smoking patients with non-small cell lung cancer and may lower the risk for tumor development and enhance the clinical outcome of surgical treatment.
References

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