"For some must watch, while some must sleep"

HAMLET - Act. III, Sc.ii
MIDDLE EAST JOURNAL OF ANESTHESIOLOGY
Department of Anesthesiology
American University of Beirut Medical Center
P.O. Box 11-0236. Beirut 1107-2020, Lebanon

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The Journal is published three times a year (February, June and October) The volume consists of a two year indexed six issues. The Journal has also an electronic issue accessed at www.aub.edu.lb/meja

The Journal is indexed in the Index Medicus and MEDLARS SYSTEM.
E-mail: meja@aub.edu.lb
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¹ Train-of-four
² Post tetanic count
³ Second twitch

**REFERENCES:**

1. BRIDION Summary of Product Characteristics (SPC).

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CONTENTS

EDITORIAL

Succinylcholine Neuromuscular Block in the Myasthenia Gravis Patient

................................................................. Anis Baraka 349

REVIEW ARTICLE

Perioperative Reflex Bradycardia and Cardiac Arrest

............................................................... Alia S. Dabbous, Mabelle C. Baissari, Patricia W. Nehme,
Jean J. Esso, Ahmad M. Abu Leila 353

SCIENTIFIC ARTICLES

Comparative Hemodynamic Advantages of Subarachnoid Administration of Atypical and Non-Atypical Opioids

................................................................. Jide Michael Afolayan, Tokunbo O. Olajumoke,
Frederick E. Amadasun, Joseph O. Fadare, Peter O. Areo 361

Comparison of Epidural Butorphanol Versus Epidural Morphine in Postoperative Pain Relief

................................................................. Geeta P. Parikh, Shah Veena R, Kalpana Vora,
Beena Parikh, Anish Joshi 371

General Anesthesia in Cesarean Sections: A Prospective Review of 465 Cesarean Sections Performed Under General Anesthesia

............................................................... S. Nafisi, M. E. Darabi, M. Rajabi, M. Afshar 377

Glidescope® Videolaryngoscope Versus Flexible Fiberoptic Bronchoscope for Awake Intubation of Morbidly Obese Patient with Predicted Difficult Intubation

............................................................... Ashraf Abualhasan Abdellatif, Monaz Abdulrahman Ali 385

Comparison of Ilioinguinal/Iliohypogastric Nerve Blocks and Intravenous Morphine for Control of Post-Orchidopexy Pain in Pediatric Ambulatory Surgery

................................................................. Khaled R. Al-Zaben, Ibrahim Y. Qudaisat,
Sami A. Abu-Halaweih, Walid S. Zuabi, Hashem M. Al-momani,
Nader M. Albsoul, Faisal A. khatib 393

Comparison of the ‘Sniffing the Morning Air’ Position and Simple Head Extension for Glottic Visualization During Direct Laryngoscopy

............................................................. Nur Hafizhoh AH, Choy Yin Choy 399

Comparative Study Between Ultrasound Determination and Clinical Assessment of the Lumbar Interspinous Level for Spinal Anesthesia

............................................................. Wafik A. Amin, M. Osama. Abou Seada, Elsaid M. A. Bedair,
Mansour M. Elkersh, Ekambaram Karunakaran 407

Curriculum Development for an Advanced Regional Anesthesia Education Program: One Institution’s Experience from Apprenticeship to Comprehensive Teaching

............................................................ Jean-Pierre P. Ouanes, Deborah Schwengel,
Vineesh Mathur, Omar I. Ahmed, Marie N. Hanna 413
IMPROVED RESIDENTS’ KNOWLEDGE AFTER AN ADVANCED REGIONAL ANESTHESIA EDUCATION PROGRAM

Vicente Garcia-Tomas, Deborah Schwenk, Jean-Pierre P. Ouanes, Sarah Hall, Marie N. Hanna

CASE REPORTS

BACK PAIN AFTER LABOUR UNDER EPIDURAL ANALGESIA

Serpil Z. Ustalar Ozgen, Serdar Ozgen, Reyhan Celiker, Fevzi Toraman, Nigar Baykan

PULMONARY ARTERY RUPTURE IN A PATIENT RECEIVING AN ORTHOTOPIC HEART TRANSPLANT AFTER TOTAL ARTIFICIAL HEART EXPLANT

Koichi Nomoto, Menachem M. Weiner, Adam Evans

ANESTHESIA CHALLENGE IN DENTAL ABSCESS INDUCED TRISMUS: A CASE REPORT

Mohamed Hassan Ahmed Soliman, Hesham El Zenati, Amer Smajilagic, Sami Moustafa Ibrahim, Kiran Saeed, Osama Kokach

ERRATUM


EdIToRIAl

SUCCINYLCHOLINE NEUROMUSCULAR BLOCK
IN THE MYASTHENIA GRAVIS PATIENT

Myasthenia gravis (MG) is an autoimmune disease resulting from the production of antibodies against the acetylcholine receptors of the endplate. These antibodies reduce the number of active receptors, brought about either by functional block of the receptors, by increased rate of receptor degradation, or by complement-mediated lysis.

Under normal conditions, only 25-30% of the endplate receptors (AChR) are required to maintain neuromuscular transmission; the remaining 70-75% of the receptor pool constitutes a “safety margin”. In myasthenia gravis, there is a decrease of the functional AChR, with a subsequent decrease of the “safety margin”.

The decrease of “functional” endplate receptors in MG can decrease the response to the chemical transmitter acetylcholine, as well as to the depolarizing muscle relaxant succinylcholine. In contrast, the decreased “safety margin” results in a marked sensitivity to nondepolarizing relaxants. In normal patients, the wide “safety margin” may explain the slow onset of non-depolarizing block, as well as the rapid onset of succinylcholine depolarizing block. In myasthenic patients (Fig. 1), the decreased “safety margin” not only potentiates the neuromuscular block of non-depolarizing neuromuscular lockers, but also speeds its onset of action. In contrast, this can decrease the depolarizing action of succinylcholine, with a subsequent resistance and delayed onset of action.

In normal patients, repeated doses of succinylcholine manifest a progressively diminishing neuromuscular block, secondary to progressive endplate receptor desensitization. In contrast, the administration of successive does of succinylcholine to the myasthenic patient (Fig. 2) results in a progressive potentiation of its neuromuscular block secondary to gradual desensitization of the endplate receptors and the development of phase two block.

Fig. 1
Electromyographic response to ulnar nerve stimulation.
Succinylcholine 1.5 mg.kg⁻¹ resulted in a rapid and complete depolarizing neuromuscular block (T₁:T₄ > 0.8) in the normal patient (upper tracing), and resulted in a slower onset of incomplete block (T₁:T₄ < 0.5) in the myasthenic patient (lower trace).

The response to succinylcholine in the myasthenic patient is also complicated by the interaction with the preoperative pyridostigmine therapy (Fig. 3). The anticholinesterase action of pyridostigmine does not only inhibit the acetylcholine esterase, but also the plasma cholinesterase with a subsequent delayed hydrolysis of succinylcholine and potentiation of its action. Our previous report suggests that the response to succinylcholine in the myasthenic patients can show marked variations according to the level of their plasma cholinesterase activity. The degree and duration of succinylcholine block in the myasthenic patient receiving pyridostigmine is inversely related to their plasma cholinesterase activity; in patients managed till the morning of surgery by pyridostigmine, succinylcholine administration results in a complete and prolonged neuromuscular block.

In conclusion, the neuromuscular block of succinylcholine in the myasthenic patients can show wide variations. Myasthenic patients untreated with anticholinesterases show resistance to succinylcholine. However, repeated doses of succinylcholine can result in gradual desensitization of the endplate receptors to the chemical transmitter acetylcholine and to the depolarizing action of succinylcholine resulting in a progressive development of prolonged phase II block. In myasthenic patients treated by pyridostigmine which inhibits both acetylcholine esterase and plasma cholinesterase, succinylcholine block is potentiated; the degree of potentiation is inversely related to the plasma cholinesterase activity.

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References

PERIOPERATIVE REFLEX BRADYCARDIA
AND CARDIAC ARREST

Alia S. Dabbous*, Mabelle C. Baissari**, Patricia W. Nehme**, Jean J. Esso** and Ahmad M. Abu Leila**

Introduction

Vasovagal syncope or Neurocardiogenic syncope refers to the loss of consciousness that occurs secondary to hypotension resulting in reduced blood supply to the brain. It is the most common form of unexplained syncope (50-60%) in the outpatient setting. Bradycardia and vasodilation are the primary causes of this hypotension. Fear, pain, dehydration, alcohol consumption, anxiety, tight clothing and hot climate may be its triggering agents1,2. Although it is benign, it can result in significant morbidity (falls, accidents); mortality is 5-10%. Treatment varies from drugs to pacing2.

Bezold-Jarisch reflex (BJR) is a term that describes perioperative bradycardia with hypotension that result from activation of cardiac mechanoreceptors1,3. The afferent limb of this reflex are the nonmyelinated, type C vagal fibers. Activation causes inhibition of sympathetic outflow coupled with bradycardia, peripheral vasodilation and hypotension1,3.

Mechanism

Cardiac unmyelinated sensory fibers and non cardiac afferents namely arterial baroreceptors constitute the afferent limb of this reflex1,3. These afferents enter the brain via the vagus and glossopharyngeal nerves, synapse in the nucleus tractus solitarius and the ventro-lateral medulla (Figure 1).

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These cardiac unmyelinated sensory fibers are mechanically sensitive, whereas stimulation of the chemosensitive afferents occurs secondary to cardiac pathology\textsuperscript{1,3}.

In addition, there is evidence that endogenous opioids are important neurotransmitters in the nucleus tractus solitarius\textsuperscript{1,4}. Naloxone pretreatment did not stop this reflex\textsuperscript{1,5,6}. The delta receptors subtype may be more important than the mu receptor\textsuperscript{1,7}. Further studies are needed to document whether delta specific antagonists may be beneficial.

The efferent responses include increase vagal activity especially to the heart and decrease sympathetic activity resulting in bradycardia and vasodilation causing hypotension. Increased parasympathetic activity occurs not only in the heart, the gastrointestinal tract is affected which account for the nausea that accompanies syncope\textsuperscript{1,8}. The vasodilation is caused by sympathetic inhibition. There is a decrease in the concentration of norepinephrine along with the sympathetic inhibition with an increase in the epinephrine concentration. The vasodilation that occurs results in a reduction of systemic vascular resistance. However, at the same time, there is evidence of cerebral vasoconstriction\textsuperscript{1,8}. Figure 1.

**Risk Factors:**

**Patient Related Factors**

Some patients have an increased risk of intraoperative reflex bradycardia due to enhanced cardiac vagal modulation that, at the same time, is associated with markedly increased mortality\textsuperscript{9-14}. This “altered autonomic balance” is related to physiological factors, pathological factors and extrinsic factors (table 1).

**Physiological factors**

Age and physical fitness: Advanced age causes a decrease in vagal control of heart rate and is generally lower among women; however it results in more evident impairment of vagal function at rest\textsuperscript{9,10}. The decrease in vagal modulation, often attributed to increasing age, may instead be the result of a decline in fitness\textsuperscript{11}. Young, healthy and vagotonic patients are more frequently associated with severe bradycardic episode and cardiac arrest during neuraxial anesthesia\textsuperscript{15-17}.

**Pathological factors**

Cardiac: Myocardial ischemia: Acute inferior myocardial ischemia often provokes transient bradycardia and hypotension “Bezold-Jarisch Reflex” and, has been explained by the preferential distribution of unmyelinated cardiac fibers with chemosensitive afferent vagal pathways in the inferior wall of the left ventricle\textsuperscript{1,3,12,13}.

Myocardial infarction: Infarct location is a major determinant in the short term prognostic implications of third degree atrio-ventricular block. Anterior infarction is associated with an adverse prognosis\textsuperscript{18}.
**Others:**

Secondary hypothyroidism: Patients with low heart rate caused by secondary hypothyroidism are prone to intraoperative severe bradycardia if no preoperative treatment is given.19,20

Atopic dermatitis: Patients with atopic dermatitis have also been linked to increase vagal modulation due to shift of autonomic balance towards parasympathetic predominance.14

Electrolyte imbalance: Atropine resistant bradycardia was also reported in cases during which there is electrolyte imbalance especially potassium disturbances.21

**Extrinsic factors**

Drugs associated with reflex perioperative bradycardia are: beta- blockers, digitalis, other cardiac glycosides, lithium, calcium antagonists, cholinesterase inhibitors, clonidine, other centrally acting alpha 2-adrenergic agonists, tricyclic antidepressant agents and phenytoin.22

**Anesthesia related factors**

Several anesthetic drugs administered mainly during induction of anesthesia such as propofol,23-29 suxamethonium,30-32 opioids,26,32-33 contribute to a remarkable decrease in heart rate and at times cardiac arrest. On the other hand, ketamine, a drug with vagolytic activity, has not been shown to improve the incidence of the oculocardiac reflex.15 In addition, spinal, epidural and regional anesthesia can cause severe reflex bradycardia and in some cases resulting in asystole, (table 1).

**Drug related anesthetic factors**

Propofol: Several data have shown that propofol increases the risk of bradycardia compared with other anesthetics. This bradycardia can lead to atrioventricular block, asystole and cardiac arrest. Its incidence can be decreased by anticholinergic drugs prophylaxis and increased in combination with administration of other drugs such as opioids, beta blockers, suxamethonium, or any drug that potentiates vagal stimulation. Propofol induced bradycardia can also be evident in the presence of any risk factor such as previous syncope, light anesthesia, preoperative conduction abnormalities, and in the presence of procedures that increase risk of bradycardia such as laparoscopy.23,38 This bradycardia is more evident in old patients and in children less than 2 years.

Dexmedetomidine: has been used for its sedative, anxiolytic and analgesic effects. However, this alpha 2 agonist can cause hypotension and bradycardia leading to pulseless electrical activity. This can be potentiated when the dose and rate are increased, as well as, in the presence of hypovolemia, and the use of beta adrenergic blockade.40,41

Opioids: Fentanyl and other potent opioids are well known for their vagotonic effects through the inhibition of sympathetic outflow.26 Several reports have described heart rate slowing and sinus arrest when opioids were given alone or in combination with other drugs such as propofol and succinylcholine.31,32

Succinylcholine: is known to cause bradycardia mainly by stimulating afferent vagal receptors. Its incidence increases by subsequent injected doses as the choline produced by its hydrolysis sensitizes patients to subsequent doses. In addition, administration of central vagotonic or sympatholytic drugs can exaggerate the muscarinic effects of suxamethonium.31,32

Cholinesterase inhibitors: Acetylcholine esterase inhibitors produce an elevation in acetylcholine that stimulate cardiac muscarinic receptors and prolong the refractory period and conduction time at the sinoatrial (SA) and atrio-ventricular (AV) nodes causing bradycardia. This can result in a decrease in cardiac output, blood pressure and sometimes cardiac arrest.43

**Procedures related anesthetic factors**

Spinal and epidural anesthesia: Bradycardia and asystole can occur unexpectedly in neuraxial block. Several risk factors have been identified such as, low baseline heart rate less than 60 beats/min, male gender, anesthetic
level above T6⁴⁴,⁴⁵ and prolonged PR interval in the electrocardiogram⁴⁶. One of its possible mechanisms is that neuraxial anesthesia causes inhibition of the preganglionic sympathetic efferent limb of the autonomic nervous system. The resulting decreased venous return may initiate bradycardia by a spared parasympathetic nervous system⁴⁷. This vagal reflex has also been reported in thoracic epidural anesthesia⁴⁸.

Interscalene block: Sudden profound hypotension and bradycardia may occur in awake seated patients who have interscalene block¹,⁴⁹-⁵². It is postulated that the combination of increased levels of circulating epinephrine combined with the sitting position and a contracted blood volume may irritate the left ventricle, leading to parasympathetic outflow that is responsible for this reflex. Patients who receive epinephrine either for the interscalene block or for injection into the surgical sites are more likely to develop bradycardia. This could be the result of the β-agonist effects of epinephrine reducing systemic vascular resistance and stimulating the myocardium¹. Beta blocker pretreatment has been shown to be effective in reflex reduction⁵³. Stellate ganglion block and intraoperative administration of intravenous fentanyl contribute to the development of this reflex⁴⁹-⁵².

Laryngoscopy and intubation: are potent triggers for the sympathetic and parasympathetic afferents⁵⁴. The net result of airway stimulation ranges from severe hypertension and tachycardia to severe bradycardia and arrest⁵⁴-⁵⁸. Although hyperdynamic response is more common to occur, vagal reflex can cause bradycardia and asystole⁵⁷-⁵⁸. This vagal response is potentiated by drugs such as propofol and opioids⁵⁶. Other contributing factors including prolonged laryngoscopy, preexisting bradycardia caused by medications, athletics, severe hypoxemia, and elevated intracranial pressure⁵⁹. Severe bradycardia can also be induced by suspension laryngoscopy even after safely completing intubation with direct laryngoscopy⁶⁰.

Anesthetic Depth: MAC bar (1.5-2 MAC) is the concentration of inhaled anesthetics that inhibit the autonomic reflexes. Thus, there is an inverse relation between the anesthetic depth and the occurrence of reflexes. A deep anesthetic level attenuates the oculocardiac reflex⁶¹.

Surgical factors

Reflex bradycardia may occur in a variety of procedures, from neurosurgery to obstetrical, abdominal, ophthalmic, facial and anal surgery¹,⁶¹-⁷¹,³⁴,³⁵, (table 1). It is mostly described in ocular surgeries and involves a reflex arc known as oculocardiac reflex. The afferent arm of this reflex is via the ophthalmic branch of the trigeminal nerve⁷². Asystole can occur⁶⁴. Whereas, anesthetic depth, anticholinergic premedication and retrobubar block prevent the occurrence of this reflex⁶¹,³⁵, ketamine induction does not³⁵. However, the ophthalmic division is not the only branch of the trigeminal nerve. Stimulation of the mandibular branch or the maxillary branch of the trigeminal nerve is also responsible for the trigeminocardiac reflex and manifest clinically as oculocardiac reflex⁷³. The incidence of this reflex is 10-18% in neurosurgical procedures around the trigeminal nerve⁷⁰. Subdural empyema can trigger this reflex⁷¹. The trigeminocardiac reflex has been described also during repair of a nasal fracture⁷⁴. Carotid sinus hypersensitivity (CSH) can be triggered by positioning during head and neck surgery causing asystole⁷⁵. Besides surgical stimulation, there is a strong evidence that hypercapnea facilitates the occurrence of the oculocardiac and trigeminocardiac reflex⁶⁹,⁷⁶-⁷⁷.

Parasympathetic afferents supply numerous organs in the abdomen. Surgical related causes of bradycardia are primarily due to stimulation of parasympathetic nerve endings that initiate the reflex (table 2). This could explain the vagal response seen in cases where there is peritoneal stretching and stimulation of coeliac plexus reflex during laparotomy⁷⁸. Severe bradycardia after high flow rate CO₂ insufflation also occurs in laparoscopic surgery⁷⁹. Reflex bradycardia can occur during colonoscopy⁸⁰ and sigmoidoscopy under general anesthesia⁶⁹. Stimulation of the pelvic splanchnic nerves supplying the anal canal initiate the reflex⁶⁸-⁶⁹.

In late pregnancy some women suffer an acute circulatory collapse, severe enough to mimic haemorrhagic shock, in the supine position. This could be reversed by turning to the lateral recumbent position. The cause is compression of the inferior vena
cava by the gravid uterus, reducing venous return and right atrial pressure. Sudden bradycardia occurred in some cases1.

Table 2
Surgery and related reflex

<table>
<thead>
<tr>
<th>Surgery</th>
<th>Reflex</th>
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<tbody>
<tr>
<td>Ocular surgery</td>
<td>Oculocardiac reflex:</td>
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<tr>
<td>- Afferent: ophthalmic branch of trigeminal nerve.</td>
<td></td>
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<tr>
<td>- Efferent: depressor fibers of vagus nerve.</td>
<td></td>
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<tr>
<td>Maxillofacial surgery</td>
<td>Trigeminocardiac reflex</td>
</tr>
<tr>
<td>- Afferent: ophthalmic, maxillary, mandibular branches.</td>
<td></td>
</tr>
<tr>
<td>- Efferent: depressor fibers of vagus nerve.</td>
<td></td>
</tr>
<tr>
<td>Laparotomy and laparoscopy</td>
<td>Celiac plexus stimulation</td>
</tr>
<tr>
<td>Anal, uterine surgery</td>
<td>Pelvic splanchnic nerve stimulation</td>
</tr>
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</table>

Anesthetic Management

Preoperative management should include any history of vasovagal events, precipitating factors, drug intake and medical diseases such as cardiac1,3,12-14, thyroid dysfunction19,20 or atopic dermatitis individuals14. Proper cardiac evaluation and consultation should be done to patients with potential cardiac events; for cardiopulmonary events causing bradycardia are more likely than other causes to be associated with cardiac arrest80. Oral premedication with a sedative and anticholinergic should be considered1,81. If one of the precipitating factors is venipuncture then topical local anesthetic cream should be applied before venipuncture8.

Induction of general anesthesia should avoid drugs associated with bradycardia and asystole such as propofol, fentanyl, suxamethonium and vecuronium1. During maintenance of general anesthesia, although vasovagal syncope is not known to occur1; reflex bradycardia can occur in response to surgical bleeding1, oculocardiac reflex35,73, anal dilation68,69, laparoscopy38,78,79 and other surgeries (table 2). At this point, the stimulus should be removed and the problem is usually resolved80. Also, the use of drugs which produce bradycardia like dexamethomidine is not recommended40,41.

When regional anesthesia is performed, lateral position for insertion of the spinal or epidural is preferable to the sitting position1,82 at the same time, caution should be given to drug dosage, baricity and patient positioning to control cephalad spread of the anesthetic1,83. Special care should be taken to hydrate the patient before the start of regional anesthesia for, preexisting hypovolemia before induction of regional anesthesia may lead to cardiovascular collapse1. The treatment of the bradycardia during neuraxial blockade, which is associated with vasodilation and significant hypotension, is urgent correction of the venous return to prevent the occurrence of asystole1,84. A special care is given to relieve the compression of the vena cava in obstetrical patients, the supine hypotensive syndrome observed in these patients can be aggravated with regional anesthesia and surgical bleeding1.

Although ephedrine is the most logical choice of single drug to correct the changes because of its combined action on the heart and peripheral blood vessels1, anticholinergic drugs are often the first line of treatment for slow heart rate during general anesthesia1,80. Hypotension during vasovagal syncope may persist after the relief of bradycardia by atropine1. On the other hand, sympathomimetic drugs can counteract the vasodilation present. Drugs like ephedrine, metaraminol and phenylephrine have been used1,80. The direct sympathetic effect on the heart rate of ephedrine are advantageous1, however if hypotension persists adequate doses of ephedrine, an alpha agonist might be considered1. When bradycardia occurs and the patient is pulseless, or when asystole develops, then the cardiac arrest algorithm (pulseless arrest unshockable rhythm) should be followed with chest compressions and prompt treatment with epinephrine80.

In summary, whenever bradycardia occurs in the perioperative period, the first step should be to withhold the stimulus if known, when vasodilation is suspected for example with neuraxial blockade, intravenous bolus fluids should be given along with a sympathomimetic drug like ephedrine. Whenever hypovolemia is not suspected the bradycardia can be treated by anticholinergic drugs like atropine. If the bradycardia is complicated by cardiac arrest then the
treatment becomes chest compressions, epinephrine and fluid resuscitation.

In conclusion, a proper preoperative history, adequate risk factor stratification, preventive measures from premedication to avoidance of drugs that cause bradycardia and judicious patient care from positioning during regional anesthesia, involving the surgeon by stopping the insult, proper hydration and management when bradycardia occurs is warranted.

References

PERIOPERATIVE REFLEX BRADYCARDIA AND CARDIAC ARREST


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Abstract

Background: Subarachnoid administration of opioids such as pethidine and fentanyl had been proven safe but that of tramadol has been controversial. Tramadol is cheap and readily available, hence the need to further evaluate its intrathecal safety.

Purpose: The study aimed at determining the hemodynamic and side effect profile of intrathecal tramadol.

Methods: One hundred and eighty six (186) ASA I or II patients scheduled for emergency open appendicectomy under spinal anesthesia were included in the study. Group BF (n=62) received intrathecal fentanyl 25µg plus 3ml of 0.5% hyperbaric bupivacaine, Group BS (n=62) received 0.5ml normal saline plus 3ml of 0.5% hyperbaric bupivacaine and Group BT (n=62) received intrathecal tramadol 25mg plus 3ml of 0.5% hyperbaric bupivacaine. Hemodynamic profile and side effects were monitored intraoperatively and 12 hours postoperatively.

Results: Fifteen (24.2%), 13 (20.9%) and 15 (24.5%) patients respectively in Groups BF, BS and BT had hypotension (P = 0.886). The incidence of postoperative vomiting occurred in 2 patients (3.2%) in Group BF as compared to 3 patients (4.8%) in Group BS and 10 patients (16.1%) in Group BT (P=0.016).

No surgeon in Group BF reported dissatisfaction but 18 patients (29%) in Group BS and 1 patient (1.6%) in Group BT had their surgeons reporting dissatisfaction (P = 0.0001)

Conclusion: This study shows that intrathecal tramadol 25mg has higher incidence of post operative nausea and vomiting than 25µg of intrathecal fentanyl but both drugs were safe.

Conflict of interest: None.

Keywords: Subarachnoid block, appendicectomy, fentanyl, hemodynamics
Introduction

The early experience with addition of large doses of opioids to local anesthetic agents for subarachnoid block produced not only prolonged duration of analgesia and anesthesia, but also side effects such as delayed emergence, respiratory depression, nausea and pruritus, which dampened the early enthusiasm of using spinal opioids1,2. Sudarshan et al demonstrated that intrathecal fentanyl with 0.5% heavy bupivacaine provided excellent surgical anesthesia with few side effects3. Lack of side effects is related to the dose of fentanyl used. Gielen et al also reported that intrathecal fentanyl is one of the safest opioids that were not associated with any troublesome side effect4. In developing countries like Nigeria, opioids like fentanyl, morphine and pethidine are not only scarce but controlled and expensive. Moreover, the problem of getting fentanyl or pethidine by most hospitals in Nigeria contributes to its under-utilization. Recently, the search for less expensive, readily available but safe subarachnoid opioids drew attention to intrathecal tramadol. Researchers have demonstrated administration of preservative-free tramadol in both appendicectomies, obstetric and major gynecological surgeries5,6,7 with resultant difference in side effect profile.

The aim of the current study is to compare the hemodynamic profile and side effects of subarachnoid tramadol compared to subarachnoid fentanyl in patients undergoing emergency open appendectomy under spinal anesthesia.

Methods

Ethical clearance and approval were obtained from the University of Benin Teaching Hospital Ethical Committee (Institution Approved Protocol Number: ADM/E.22 A/VOL. VII/416). Informed consent of every participating patient was obtained before the study was commenced. This was a prospective, randomized, placebo-controlled clinical study, comparing safety of subarachnoid tramadol with subarachnoid fentanyl and a normal saline placebo-controlled bupivacaine subarachnoid block.

One hundred and ninety five ASA I or II patients scheduled for emergency appendicectomy, aged between 18 and 60 years were included in the study.

Exclusion criteria included patients who had appendicular mass, rupture appendix or any co-existing surgical procedure. Patients for elective appendicectomy were not included because their overnight fast might affect incidence of nausea and vomiting. Patients with history of hypersensitivity to local anesthetic agent and opioids were also excluded. Patients with peripheral neuropathy or having contraindications to regional anesthesia or patients who could not attain a minimum height block of T6 at 4th minute following injection of spinal solution were also excluded.

Preoperative assessment of the patients was carried out. Routine investigations such as hemoglobin concentration, urinalysis, serum electrolytes and urea were done for every patient. Visual Analogue Scale [VAS] score for pain assessment, consisting of 100mm line with 0=no pain and 100 = worst pain ever, was adequately explained to every patient during the preoperative visit.

In the operating room, baseline pulse rate, non-invasive blood pressure, oxygen saturation and respiratory rate were obtained and recorded before administration of spinal anesthesia and subsequently during the procedure. A venous access was secured using 16 or 18 gauge cannula and the patient was preloaded with normal saline (15ml/kg) before the injection of spinal anesthesia. In ensuring correct blinding, one anaesthetist was responsible for patients’ randomization while a second anaesthetist was responsible for peri-operative data collections. Neither the patient nor the second anaesthetist was aware of group allocation. Aseptically, induction of spinal anesthesia was carried out in a sitting position, using 25G Quincke spinal needle at L3-4 or L2-3 interspace. Having observed a free flow of cerebrospinal fluid, patients in Group BF (n=65), Group BS (n=65) or Group BT (n=65) received the following spinal solution combinations. Group BF received 0.5ml (25µg) fentanyl plus 3ml (15mg) of 0.5% heavy bupivacaine. Group BS received 0.5ml of normal saline plus 3ml (15mg) of 0.5% heavy bupivacaine. Group BT received 0.5ml (25mg) tramadol plus 3ml (15mg) of 0.5% heavy bupivacaine.
Maximum sensory block height was assessed at one minute, two minutes, 3 minutes and 4 minutes following injection of spinal solution, using loss of sensation to cold and gentle pinprick test. A minimum sensory block height of T6 at 4th minute was the minimum desired level for commencement of surgery. Any patient who did not meet this minimum sensory block height was excluded from the study. The level of sensory analgesia defined as loss of sensation to pinprick test was recorded. Pulse rate, blood pressure, respiratory rate and oxygen saturation were also recorded every 3 minutes for the first eighteen minutes and then at interval of 5 minutes until the end of surgery. Time of skin incision was noted. Following skin incision, VAS scores were recorded every 3 minutes for the first eighteen minutes and then at interval of 5 minutes until the end of surgery. Intraoperative complications such as hypotension (reduction in systolic blood pressure greater than 30% of the baseline), bradycardia (reduction in pulse rate greater than 30%), itching, paraesthesia, vomiting and shivering were identified and treated accordingly. Pain and discomfort such as dragging sensation, chest tightness, nausea, vomiting and retching were documented and treated appropriately. The time surgery ended was noted and duration of surgery in minutes was calculated and recorded.

Postoperative complications were assessed and recorded within 12 hours following surgery. The effectiveness of analgesia produced by either intrathecal fentanyl, tramadol or normal saline placebo intraoperatively was judged by presence or absence of pain.

Degree of both patient’s and doctor’s satisfaction with the subarachnoid block for the procedure was sought and each of them responded to the different grades of satisfaction: Not satisfied, satisfied, very satisfied or excellent.

A minimum of 65 patients were adequate for the study based on effect size of 0.2 reduction in side effects at a power of 0.8 and alpha of 0.05. The data obtained were analysed using statistical programme for social sciences (SPSS) 16.0 software (Chicago Illinois, USA). All parametric data were analyzed using one way ANOVA. Non-parametric data were analyzed using chi square, Fisher’s exact or Mann-Whitney test where applicable. Probability values <0.05 were considered statistically significant.

### Result

Sixty two patients were analyzed in each of the groups having excluded nine patients for protocol violations. There was no statistically significant difference amongst the three groups with regard to age, height and weight (Table 1).

Fifty patients (80.3%) in group BS as compared with 11 patients (17.7%) in Group BF and 19 patients (30.6%) in Group BT attained T6 dermatomal level at the 4th minute. The difference was statistically significant (P-value = 0.0001).

### Table 1

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Group BF (n = 62)</th>
<th>Group BS (n = 62)</th>
<th>Group BT (n = 62)</th>
<th>P. value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>28.58 ± 1.37</td>
<td>28.79 ± 1.34</td>
<td>28.55 ± 1.23</td>
<td>0.54</td>
</tr>
<tr>
<td>BMI (Kg/m²)</td>
<td>25.34±1.01</td>
<td>25.03±1.01</td>
<td>25.28±1.01</td>
<td>0.17</td>
</tr>
<tr>
<td>Gender [n(%)]</td>
<td></td>
<td></td>
<td></td>
<td>0.85</td>
</tr>
<tr>
<td>Male</td>
<td>23 (37.1%)</td>
<td>25 (40.3%)</td>
<td>22 (35.5%)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>39 (62.9%)</td>
<td>37 (59.7%)</td>
<td>40 (64.5%)</td>
<td></td>
</tr>
<tr>
<td>Onset Time:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At 4th Min</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T2</td>
<td>15 (24.2%)</td>
<td>0 (0.0%)</td>
<td>8 (12.9%)</td>
<td>0.0001</td>
</tr>
<tr>
<td>T4</td>
<td>36 (58.1%)</td>
<td>12 (19.7%)</td>
<td>35 (56.5%)</td>
<td>0.0001</td>
</tr>
<tr>
<td>T6</td>
<td>11 (17.7%)</td>
<td>50 (80.3%)</td>
<td>19 (30.6%)</td>
<td>0.0001</td>
</tr>
</tbody>
</table>
Figure 1 shows the trend in pulse rate over time. The differences in mean pulse rates at 3min, 6min, 9min, 12min and 15min did not achieve any statistical significance at each of these time interval (P-values = 0.71, 0.65, 0.32, 0.15 and 0.97 respectively). However the difference in the mean pulse rate among the three groups at 43min, 48min, and 53min was statistically significant (P-values = 0.01, 0.02 and 0.012 respectively).

The trend in systolic blood pressure over time is shown in Figure 2. Intra-operative trend in systolic blood pressure showed a non-statistically significant fall in systolic blood pressure at 3min, 6min, 9min, 12min and 15min. Similarly, the mean value of systolic blood pressure at 18min, 23min, 28min and 33min did not achieve any statistical significant difference. However, the difference in the mean systolic blood pressure at 38min, 43min, 48min and 53min was statistically significant. Trends in diastolic blood pressure and mean arterial blood pressure over time are illustrated in Figures 3 and 4 and they were similar to the trend observed with systolic blood pressure.

Table 2 shows the incidence of perioperative complications. None of the patients in Group BF and BT had any complaint of pain, chest tightness, vomiting, retching or nausea. Five patients (8.1%), 7 patients (11.1%), and 3 patients (4.8%) in Group BS reported pain, chest tightness and vomiting respectively. The difference in the incidence of pain or chest tightness was statistically significant (P-value=0.011 and 0.001 respectively). Three patients (4.8%) had episodes of nausea and another three (4.8%) had retching in Group
BS. The difference in the incidence of vomiting, nausea or retching among the three groups was not statistically significant. No patients in Group BF and Group BT had bradycardia whereas one patient (1.6%) in Group BS had bradycardia. Fifteen (24.2%), 13 (20.9%) and 15 (24.2%) patients respectively in Groups BF, BS and BT had hypotension with no statistical significance. Apart from headache and vomiting, there were no other complications within 12 hours postoperatively among the study population. Vomiting was observed in 2 patients (3.2%) in Group BF as compared to 3 patients (4.8%) in Group BS and 10 patients (16.1%) in Group BT. The incidence of post-operative vomiting was statistically significant.

Table 3 shows the degree of patient’s satisfaction for each group. Every patient was satisfied in Group BF and BT while 17 patients (27.4%) in Group BS were not satisfied with the quality of analgesia produced. This difference was statistically significant. Forty six patients (73.8%) and 45 (72.1%) in Groups BF and BT respectively were excellently satisfied with the analgesia as compared to 21 (33.9%) in Group BS. The difference was statistically significant.

Table 4 shows degree of surgeon’s satisfaction for each group. No surgeon in Group BF reported dissatisfaction while 18 patients (29%) in Group BS and 1 patient (1.6%) in Group BT had their surgeons reporting dissatisfaction. The difference was statistically significant.

### Table 2
**Peri-operative complications n (%)**

<table>
<thead>
<tr>
<th>Complication</th>
<th>Group BF (n = 62)</th>
<th>Group BS (n = 62)</th>
<th>Group BT (n = 62)</th>
<th>P. value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain</td>
<td>0 (0.0)</td>
<td>5 (8.1)</td>
<td>0 (0.0)</td>
<td>0.011</td>
</tr>
<tr>
<td>Chest tightness</td>
<td>0 (0.0)</td>
<td>7 (11.3)</td>
<td>0 (0.0)</td>
<td>0.001</td>
</tr>
<tr>
<td>Vomiting</td>
<td>0 (0.0)</td>
<td>3 (4.8)</td>
<td>0 (0.0)</td>
<td>0.108</td>
</tr>
<tr>
<td>Retching</td>
<td>0 (0.0)</td>
<td>3 (4.8)</td>
<td>0 (0.0)</td>
<td>0.108</td>
</tr>
<tr>
<td>Nausea</td>
<td>0 (0.0)</td>
<td>3 (4.8)</td>
<td>0 (0.0)</td>
<td>0.108</td>
</tr>
<tr>
<td>Bradycardia</td>
<td>0 (0.0)</td>
<td>1 (1.6)</td>
<td>0 (0.0)</td>
<td>1.000</td>
</tr>
<tr>
<td>Hypotension</td>
<td>15 (24.2)</td>
<td>13 (20.9)</td>
<td>15 (24.2)</td>
<td>0.886</td>
</tr>
<tr>
<td>Shivering</td>
<td>0 (0.0)</td>
<td>3 (4.8)</td>
<td>0 (0.0)</td>
<td>0.108</td>
</tr>
<tr>
<td>Itching</td>
<td>4 (6.5)</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>0.035</td>
</tr>
<tr>
<td>Paraesthesia</td>
<td>1 (1.6)</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>1.000</td>
</tr>
<tr>
<td>PDPH</td>
<td>1 (1.6)</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>1.000</td>
</tr>
<tr>
<td>PONV</td>
<td>2 (3.2)</td>
<td>3 (4.8)</td>
<td>16 (16.1)</td>
<td>0.016</td>
</tr>
</tbody>
</table>

### Table 3
**Degree of patient’s satisfaction for each group n(%)**

<table>
<thead>
<tr>
<th>Satisfaction</th>
<th>Group BF (n = 62)</th>
<th>Group BS (n = 62)</th>
<th>Group BT (n = 62)</th>
<th>P. value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not satisfied</td>
<td>0 (0.0)</td>
<td>17 (27.4)</td>
<td>0 (0.0)</td>
<td>0.0001</td>
</tr>
<tr>
<td>Satisfied</td>
<td>5 (8.2)</td>
<td>8 (12.9)</td>
<td>7 (11.5)</td>
<td>0.676</td>
</tr>
<tr>
<td>Very satisfied</td>
<td>11 (18.0)</td>
<td>16 (25.8)</td>
<td>10 (16.4)</td>
<td>0.351</td>
</tr>
<tr>
<td>Excellent</td>
<td>46 (73.8)</td>
<td>21 (33.9)</td>
<td>45 (72.1)</td>
<td>0.0001</td>
</tr>
</tbody>
</table>
Experimental studies have shown that addition of opioids to local anesthetic agent intrathecally was able to relieve pain and discomfort. Subarachnoid tramadol had been studied by few researchers such as Parthasarathy et al, Susmita et al, Alhashemi et al and Frikha et al, however its subarachnoid safety profile is still controversial. Tramadol is a synthetic 4-phenyl-piperidine analogue of codeine with a dual mechanism of action. It stimulates the µ- receptor and to a lesser extent δ- and κ- opioid receptors. Like tricyclic antidepressants, it also activates spinal inhibition of pain by decreasing the reuptake of norepinephrine and serotonin. This produces a non-opioid basis of analgesia. A report suggesting that tramadol may have a direct serotonin-releasing action has been documented. Analgesic doses of tramadol may produce less respiratory depression in part because of its non-opioid receptor mediated actions.

The dose regime used in this study was based on the study carried out by Belzarena which demonstrated that intrathecal fentanyl 0.5-0.75 µg/kg provided excellent surgical anesthesia. Mean intrathecal fentanyl doses used by Techanivate et al were 0.18 and 0.33 µg/kg. In the present study, a fixed dose (25µg) of fentanyl was used. Based on the average weight of patients in the fentanyl Group, the average intrathecal dose of fentanyl used in this study was 0.36µg/Kg. This dose was more than the dose used by Techanivate et al but less than the dose used by Belzarena. Twenty five milligram of intrathecal tramadol was considered adequate for the study based on the work carried out by Alhashemi where 25mg of intrathecal tramadol was proven to be safe during spinal anesthesia. Although Frickha et al used 50mg tramadol, Parthasarathy used 10mg and Susmita used 20mg of tramadol in their studies but 25µg of fentanyl is equipotent with 25mg of tramadol according to report by Duthie. He also reported that tramadol has the same analgesic potency as pethidine, one fifth (1/5) that of nalbuphine, one-tenth (1/10) that of morphine and one-thousandth (1/1000) that of fentanyl.

Side-effects are mediated by opioid receptors. Segmental analgesia after intrathecal opioids administration should confer a lower side-effect profile compared with systemic opioids administration. A recent prospective survey of 6000 patients reported a low incidence of side effects and good patients’ satisfaction after single administration of low dose intrathecal opioids. The side effects of intrathecal opioids are sedation, sweating, delayed gastric emptying, urinary retention, pruritus, nausea and vomiting and respiratory depression, however previous studies have suggested that side-effects are dose-related. High dose intrathecal opioids administered in error may result in an acute apneic episode requiring naloxone and supportive ventilation.

This study also compares the trends of hemodynamic changes following induction of spinal anesthesia using bupivacaine with or without opioids. The current findings support the previous findings that showed no significant difference in the episode of hypotension between fentanyl group and control group. Alhashemi et al and Frikha et al found that intrathecal tramadol did not affect blood pressure which was in agreement with the findings of Parthasarathy et al and this present study. This indicates that intrathecal

<table>
<thead>
<tr>
<th>Satisfaction</th>
<th>Group BF (n = 62)</th>
<th>Group BS (n = 62)</th>
<th>Group BT (n = 62)</th>
<th>P. value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not satisfied</td>
<td>0 (0.0)</td>
<td>18 (29.0)</td>
<td>1 (1.6)</td>
<td>0.0001</td>
</tr>
<tr>
<td>Satisfied</td>
<td>4 (6.6)</td>
<td>11 (17.7)</td>
<td>5 (8.2)</td>
<td>0.090</td>
</tr>
<tr>
<td>Very satisfied</td>
<td>12 (19.7)</td>
<td>13 (21.0)</td>
<td>11 (17.7)</td>
<td>0.902</td>
</tr>
<tr>
<td>Excellent</td>
<td>46 (73.8)</td>
<td>20 (32.3)</td>
<td>45 (72.6)</td>
<td>0.0001</td>
</tr>
</tbody>
</table>

Table 4

Degree of surgeon’s satisfaction for each group n(%)
COMPARATIVE HEMODYNAMIC ADVANTAGES OF SUBARACHNOID ADMINISTRATION OF ATYPICAL AND NON-ATYPICAL OPIOIDS

opioid did not result in significant hypotension and the episodes of hypotension in these different studies could be probably due to the effect of different doses of bupivacaine.

In this current study, no patient in fentanyl and tramadol groups had bradycardia. One patient (1.6%) in placebo group had bradycardia. One patient in group 20 had bradycardia, no one had bradycardia in groups 10 and 0 in Techanivate et al16 study. There was no significant difference in the incidence of bradycardia amongst the study population of John et al27. Bogra et al28 reported that bradycardia resulted from the blockade of sympathetic cardio-accelerator fibres and decreased venous return to the heart. In their study, bradycardia occurrence was overall 7%, with no significant intergroup variation. This is in keeping with the findings of Parthasarathy5, Alhashemi10 and Susmita7.

Shivering occurrence did not achieve any significant difference when comparing patients in tramadol group with fentanyl and control groups. No patient in fentanyl group and tramadol group had shivering but three (4.8%) patients in control had shivering in the current study. This was not in accordance with Techanivate et al16 who observed shivering in fourteen patients (70%) in placebo group and nine (45%) and eight (40%) in the groups with 10µg fentanyl and 20µg of fentanyl respectively. This might be due to the sympatholytic effect of high dose of intrathecal bupivacaine used in their study (4ml) of 0.5% as compared to 3ml of 0.5% used in the current study. Biswas et al1 and Bogra et al28 found no significant difference in the episodes of shivering. However, Wheelahan29 reported that adding epidural fentanyl to epidural lidocaine decreases the shivering threshold compared with epidural lidocaine alone. Petel et al30 demonstrated that intrathecal fentanyl was significantly better than placebo in the prevention of intra-operative shivering.

In this study, itching occurrence was 6.5% in the fentanyl group with significant intergroup variation. In a similar study conducted by John et al27 nine patients (33.3%) out of 27 with intrathecal fentanyl had itching intra-operatively and finding from these studies also corroborated finding of Hunt et al31. Techanivate et al16 did not record any itching episode amongst their study population. Unlike John et al27, Techanivate16 and the current study recorded lower incidence of itching probably because higher doses of hyperbaric bupivacaine were administered when compared with the dose administered by John et al27. It has been documented that local anesthetic agent and dextrose independently decrease the incidence of pruritus when added to intrathecal fentanyl solution32,33. This might be attributed to low dose of intrathecal fentanyl used (10µg and 20µg) in the two groups treated with fentanyl. Biswas1, Bogra et al28 and Dahlgren et al34 reported no significant difference in the incidence of pruritus among their study population. Parthasarathy3 and Susmita et al7 recorded no itching in the group treated with tramadol in their studies which was in agreement with the current study. Frickha et al finding was not in support of Parthasarathy3, Susmita7 and this present study as they reported more episodes of itching in the tramadol group. The high incidence of itching reported by Frickha6 might be associated with high dose of opioids (50mg of tramadol plus 10µg of fentanyl) administered to each of the patients in one of the groups in the obstetric population studied.

Reuben et al35 reported that patients who received intrathecal fentanyl up to 50µg did not experience respiratory depression, even in elderly patients who had cardiac and pulmonary diseases. Also in the study carried out by Techanivate16, none of the patients experienced respiratory rate < 12 cycles per minute and S\textsubscript{a}O\textsubscript{2} < 92% during the operation. This was in accordance with the current study where no patient had respiratory depression and S\textsubscript{a}O\textsubscript{2} never dropped below 95%.

There was a low incidence of post-dural puncture headache among patients in this current study. One patient in the fentanyl group had post-dural puncture headache. This was similar to the works of Techanivate et al and Parthasarathy et al where low incidence of post-dural puncture headache was observed. The low incidence of post-dural puncture headache in these study groups may be due to the use of smaller spinal needles (25-27) by these authors. Akpa and colleagues, in a series of spinal anethetics using 16 guage spinal needles, demonstrated a high incidence of post-dural puncture headache21. It has been documented that the larger the bore of the spinal needles, the bigger the
opening left in the meninges, the greater the amount of cerebrospinal fluid that is drained and the higher the incidence of post-dural puncture headache\textsuperscript{36,37,38}.

In the current study, post operative vomiting was highest in the tramadol group. This was significantly high compared with the work of Parthasarathy\textsuperscript{3}, where only (4\%) of the patients vomited post-operatively. Since incidence of vomiting is dose dependent, the difference between Parthasarathy’s study and this study in terms of post-operative vomiting might be due to low dose (10mg) of intrathecal tramadol used by Parthasarathy and colleagues\textsuperscript{3}. Frikha et al\textsuperscript{25} reported higher frequency in vomiting when a high dose (50mg) of intrathecal tramadol was injected into subarachnoid space in pregnant women undergoing Caesarean section.

**Conclusion**

Intrathecal tramadol 25mg has higher incidence of post operative nausea and vomiting than 25μg of intrathecal fentanyl. Both intrathecal opioids produced comparable adequate analgesia and low side effects and hemodynamic changes.
COMPARISON OF EPIDURAL BUTORPHANOL VERSUS EPIDURAL MORPHINE IN POSTOPERATIVE PAIN RELIEF

GEETA P. PARIKH*, SHAH VEENA R**, KALPANA VORA***, BEENA PARIKH*** AND ANISH JOSHI****

Abstract

Introduction: Epidural route is preferable for postoperative pain relief in thoraco-abdominal and lower limb surgeries. We aimed to compare epidural butorphanol versus morphine for post-operative analgesia up to 24 hours in open nephrectomy surgery.

Methods: 80 ASA physical status I and II adult patients were selected for this randomized double blind prospective study. A standard balanced general anesthesia technique was applied for all patients. Epidural catheter was placed in lower thoracic inter-vertebral space before the start of surgery. Injection butorphanol 0.04 mg/kg in group B (n=40) or morphine 0.06mg/kg in group M (n=40) was given in a double blind manner after completion of surgery and before extubation through the epidural catheter. Patients were observed for pain relief by Visual Analogue Scale (VAS) for the next 24 hours. Dose was repeated when VAS was > 4. The onset and peak effect of pain relief, duration of analgesia of 1st dose, frequency of drug administration and side effects if any were observed.

Results: The average onset of analgesia was 26.5± 7.61 minutes with butorphanol and 62.5±13.4 minutes with morphine group which was statistically significant (p<0.05). The mean peak effect of pain relief following 1st dose was 173 ± 51.25 minutes with butorphanol and 251 ± 52.32 minutes with morphine group. The duration of pain relief after 1st dose was statistically significant and was 339.13 ± 79.57 minutes in group B and 709.75 ±72.12 minutes in group M which was gradually increased on repeated dosing in group B while it was almost same in Group M. Number of doses required in 24 hours was significantly higher (p<0.05) in butorphanol group than morphine group. Somnolence was the main side effect in group B while pruritus was the main side effect with group M.

Conclusion: Epidural butorphanol appears to provide safer and faster postoperative analgesia without much untoward effects but its analgesic action is short so more repeated doses are required than morphine via epidural catheter up to 24 hours.

Keywords: epidural technique, butorphanol, morphine, post-operative analgesia.

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*** MD, Professor.
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**Introduction**

Post-operative pain is maximum during the initial 48-72 hours of post-operative period and it declines thereafter. The goal of post-operative pain management is to reduce an individual patient’s pain to a tolerable level.

From all routes of pain relief, epidural remains the best route for thoraco-abdominal and lower limb surgeries since it preserves the pulmonary function and provides early ambulation with lower risk of postoperative deep venous thrombosis. Epidural morphine, a potent narcotic analgesic, produces profound postoperative analgesia but it is associated with the occurrence of undesirable side effects including pruritus, nausea, vomiting, urinary retention, and respiratory depression. Butorphanol tartrate is a potent partial agonist antagonist narcotic analgesic. When administered parenterally, it provides pain relief similar to morphine but with shorter duration and with lesser side effects. This study was undertaken to compare the onset, quality and duration of pain relief and side effects of butorphanol versus morphine given by epidural route.

**Methods**

This prospective double blind randomized study was conducted in adult patients with ASA physical status of I-II who were scheduled for open nephrectomy. After ethical committee approval, 80 patients were recruited for the study. The exclusion criteria included history of allergic reaction to study drugs, contraindication to epidural catheter, difficult localization of epidural space or catheter blockage during the study period. All patients were familiarized with standard 0-10 visual analogue scale (VAS) prior to study where 0 stood for “no pain at all” while 10 stood for “worst pain imaginable”. Potential side effects were also described.

A standard balanced general anesthesia technique was applied with intravenous fentanyl 2 µg/kg as premedication. After induction of general anesthesia, epidural catheter was placed in the lower thoracic inter-vertebral space. Anesthesia was maintained with 50% N2O in oxygen and isoflurane with intravenous atracurium as muscle relaxant. An epidural bolus dose of 7mL 0.25% bupivacaine was injected prior to surgical incision. Intravenous tramadol 1.0 mg/kg was given during closure of the wound. After completion of surgery and before extubation, dose of study drug was given by double blind method. Randomization was done by closed envelope method. In group B, epidural butorphanol 0.04 mg/kg in 10 ml saline was given while group M patients received epidural morphine 0.06 mg/kg in 10 ml saline.

After the surgery, patients were shifted to the recovery room and monitored for vital signs, VAS score, sedation and any side effects like pruritus, nausea, vomiting and respiratory depression initially every half an hour for the first two hours followed by every two hours for 24 hours. Urinary retention was not elicited because per-urethral catheter was kept for 24 hours in all patients undergoing nephrectomy.

When the patient complained of uncomfortable pain (i.e. VAS score >4), same drug at the same dose was given. Total number of doses required in 24 hours was recorded. Nausea and vomiting were treated with intravenous ondansetron and pruritus was treated by intravenous chlorpheniramine. If respiratory rate went below ≤ 9/min, further doses were withheld and O2 was supplemented. Sedation was graded as 0 to 3 with 0 being fully awake and 3 being extremely sleepy. After 24 hours, the epidural catheter was removed.

Sample size calculation was done by power analysis. This analysis was based on two samples with statistical significance of 0.05 & 80% power. The sample size required was 40 in each group. Statistical analysis was performed using SPSS version 12. Continuous variables were described as Mean ± SD and categorical variables are given as number (%). Continuous variables were compared using t-test for two independent samples. Percentages were compared using Chi-square analysis. P value < 0.05 was considered to be statistically significant.
Results

There were no significant difference in demographic data and hemodynamic changes between the two groups (Table 1, figure 1, 2). Duration of surgery in both the groups was comparable.

<table>
<thead>
<tr>
<th>Demographic data</th>
<th>Group-B</th>
<th>Group-M</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>52 ± 2.1</td>
<td>50.4 ± 2.22</td>
<td>0.65</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>56.1 ± 1.54</td>
<td>55.9 ± 1.2</td>
<td>0.5190.93</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>158 ± 1.1</td>
<td>156 ± 1.2</td>
<td>0.32</td>
</tr>
<tr>
<td>Sex (M/F)</td>
<td>30/10</td>
<td>28/12</td>
<td>0.617</td>
</tr>
<tr>
<td>Duration of surgery (min)</td>
<td>111.12±17.99</td>
<td>112.87±16.82</td>
<td>0.65</td>
</tr>
</tbody>
</table>

The VAS scores were lower for 1st 4 hours in butorphanol group while 4 hours onwards in morphine group after 1st dose administration (figure 3). The

<table>
<thead>
<tr>
<th>Onset and duration of pain relief</th>
<th>Group-B (Mean±SD)</th>
<th>Group-M (Mean±SD)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onset of pain relief following 1st dose</td>
<td>26.5 ± 7.61</td>
<td>62.5 ± 13.4</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Duration of pain relief following 1st dose</td>
<td>339.13±79.57</td>
<td>709.75±72.119</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Duration of pain relief following 2nd dose</td>
<td>440.3 ± 76.9</td>
<td>710.1 ± 55.6</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Duration of pain relief following 3rd dose</td>
<td>504.7 ± 149.1</td>
<td>721.1 ± 41.8</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Duration of pain relief following 4th dose</td>
<td>506.6 ± 70.7</td>
<td>--</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

Fig. 1 
Hemodynamics

Fig. 2
Comparison of Mean Blood Pressures

Fig. 3
Mean Visual Analogue Score (VAS)

Comparison of Mean VAS SCORE

Fig. 4
Mean sedation score

Table 2
Onset and duration of pain relief

Table 1
Demographic data
Mean onset of pain relief was 26.5 ± 7.61 minutes in group B compared to 62.5 ± 13.4 minutes in group M suggesting faster & statistically significant onset in Group B compared to Group M (p<0.05). The mean peak effect of pain relief following 1st dose was 173 ± 51.25 minutes in Group B while in Morphine group, it was delayed and 251 ± 52.32 minutes (p< 0.05). The mean duration of pain relief following 1st dose was significantly longer in group M than group B (709.75 ± 119 vs339.13 ± 79.57 minutes, p< 0.05) which was gradually increased on repeated dosing in group B while it was almost same in Group M (table 2). All 40 patients required 3 doses in butorphanol Group and two doses in morphine group while 24 patients required the 4th dose in B Group & 27 patients required 3rd dose in morphine group in 24 hours (table 3).

The patients in Group B had overall higher sedation score as compared to Group M. Pruritus, respiratory depression & hypotension were only observed in Group M in 37.5 %, 7.5 % & 5 % of cases respectively while somnolence was seen in 75% cases in Group B as compared to 12.5 % cases in Group M. Nausea & vomiting were seen in both groups but higher in Group M. Dizziness, warm sensation & blurring of vision was seen in one patient of Group B only (Table 4). No bradycardia was noted in either of the group.

**Table 3**

<table>
<thead>
<tr>
<th>Number of doses</th>
<th>Group-B(40)</th>
<th>Group-M(40)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 doses</td>
<td>40</td>
<td>27</td>
<td>0.00008</td>
</tr>
<tr>
<td>4 doses</td>
<td>24</td>
<td>00</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

**Table 4**

<table>
<thead>
<tr>
<th>Side effects</th>
<th>Group-B</th>
<th>Group-M</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pruritus</td>
<td>0</td>
<td>15</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Somnolence</td>
<td>30</td>
<td>5</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Nausea</td>
<td>1</td>
<td>3</td>
<td>0.305</td>
</tr>
<tr>
<td>Vomitting</td>
<td>1</td>
<td>2</td>
<td>0.556</td>
</tr>
<tr>
<td>Respiratory depression</td>
<td>0</td>
<td>3</td>
<td>0.077</td>
</tr>
<tr>
<td>Dizziness</td>
<td>1</td>
<td>0</td>
<td>0.314</td>
</tr>
<tr>
<td>Warm sensation</td>
<td>1</td>
<td>0</td>
<td>0.314</td>
</tr>
<tr>
<td>Blurred vision</td>
<td>1</td>
<td>0</td>
<td>0.314</td>
</tr>
<tr>
<td>Hypotension</td>
<td>0</td>
<td>2</td>
<td>0.152</td>
</tr>
</tbody>
</table>

**Discussion**

Epidural morphine has been used since long but it has many side effects as it is a µ receptor agonist. Butorphanol is a µ receptor agonist/antagonist & κ agonist so it produces analgesia with fewer side effects except somnolence. In our study, there was no statistical difference in hemodynamic parameters like mean values of pulse, systolic, diastolic and mean arterial pressure during study period. Morphine is hydrophilic & has a low lipid partition co-efficient, hence crosses blood brain barrier with difficulty. So, it has got slow onset and prolonged duration of action. As Butorphanol is lipophilic, it has faster onset, faster peak of analgesia and short duration of action. The lowest VAS score following the first dose in group B was observed at 2 to 4 hours while at 6 to 8 hours in group M. The mean duration of analgesia was gradually prolonged on repeated dosing with butorphanol while it remained almost similar with morphine which could be due to lipophilicity of butorphanol and hydrophilic nature of morphine.

Side effects like pruritus was observed only in 37.5% cases in morphine group in our study because it is pure µ receptor agonist. Bromage et al9 found itching 3 hours after administration of epidural morphine. Somnolence is the main side effect observed in 75% patients of butorphanol group which is κ receptor mediated & 12.5 % in morphine group. Abdoud et al. found somnolence in 67% patients with 4 mg epidural butorphanol & in 21 % patients with 5 mg epidural morphine and respiratory depression (≤10/minute) was observed in 7.5 % cases of group M. Morphine being a hydrophilic agent, spreads rostrally leading to delayed respiratory depression while butorphanol is lipophilic having minimum respiratory depression. Butorphanol has a ceiling effect for respiratory depression. Increasing the dose of butorphanol causes increase in duration of effect, not the degree of respiratory depression. In our study, only in morphine group, two patients had a fall in respiratory rate to 10/minute at 4 hours and one patient had at 6 hours but that time SpO2 was maintained. Nausea (7.5%) & vomiting (5%) were observed more in morphine group than butorphanol (2.5%). This could be due to modulation of the afferent input at the area postrema or at the nucleus of tractus solitarius which might be affected by morphine.
Palacios found duration of analgesia > 24 hours with 5mg morphine and 4 hours with 4mg butorphanol. The VAS score was constantly lower in group B than group M while number of doses required during 24 hours are more with butorphanol than with morphine suggesting short duration of action of butorphanol. He also could not find any statistical difference in hemodynamic parameters. He found pruritus in 43% with morphine & 1.4 % with butorphanol group.

Ackerman et al reported more prolonged duration of analgesia with morphine (5mg) and shorter duration with butorphanol (1mg) than ours which might be due to dose variation. They found pruritus in 60% patients of morphine & 6.66% of butorphanol (1mg).

Abboud et al found analgesia of approximately 8 hours with 4 mg epidural butorphanol and 21 hours with 5 mg morphine. Mok et al also found faster onset of action and peak effect due to higher dose of butorphanol (4mg) and morphine (5mg) while duration of action was almost similar to ours (324minutes) in B group but prolonged in group M (912minutes). Martin et al studied with different doses of epidural morphine and concluded 2.0 mg morphine as optimum dose because higher doses were more effective but with more side effects in the form of nausea & vomiting. Rawal et al found 10.7 hours duration of analgesia with 2mg and 4mg of epidural morphine but 4mg had systemic responses so more than 2 mg should be avoided in elderly and fragile patients. Bromage found maximum itching after 3 hours of epidural morphine. Binsted found pruritus with 5 mg morphine without any respiratory depression. Fuller found pruritus in 58% of patients.

The limitation in this study is to administer more frequent number of doses of butorphanol as compared to morphine group.

Conclusion

Epidural butorphanol is safe and effective in providing post-operative pain relief having faster onset and shorter duration of action as compared to morphine. Butorphanol is associated with only minor side effects like sedation where the patient is arousable at any time which may be advantageous to the patient in early postoperative period.
References

GENERAL ANESTHESIA IN CESAREAN SECTIONS:
A PROSPECTIVE REVIEW OF 465 CESAREAN SECTIONS
PERFORMED UNDER GENERAL ANESTHESIA

S. Nafisi*, M.E. Darabi**, M. Rajabi***
and M. Afshar****

Abstract

Background: In many countries, neuraxial blocks comprise the majority of anesthetics given for cesarean section. In Iran, however, general anesthesia for cesarean section is prevalent. In our institution, the rate of general anesthesia for cesarean section is 39%, providing an opportunity to collect data regarding airway management in the parturients. We report on the outcomes of a series of patients who received general anesthesia for cesarean section.

Methods: A prospective observational study was conducted in two university hospitals, with approximately 5,500 deliveries annually. Demographics and airway characteristics were recorded. Eight potential risk factors for difficult intubation (short neck, obesity, facial edema, swollen tongue, receding mandible, and single, missing or protruding maxillary incisors) were analyzed. Then, laryngoscopic view, difficulty at intubation, and major complications were recorded.

Results: Data were obtained from 465 patients. There was a significant correlation between higher Mallampati score and both higher laryngoscopic view graded on the Cormack-Lehane system ($P < 0.001$) and difficulty at intubation ($P$-Value=0.05). Emergency cesarean section was not associated with difficult intubation ($P=0.67$). Multivariate analysis showed that receding mandible was the only potential risk factor for difficult tracheal intubation ($P < 0.001$) and removed short neck or protruding maxillary incisor which initially was powered as a risk factor by univariate analysis. A grade 3 laryngoscopic view was obtained in 15 cases (3.2%). There was no case of grade 4 view. There was only one failed intubation (0.2%), and 9 cases of very difficult intubation (1.9%).

Conclusion: General anesthesia for cesarean section is safe with minimal risk.

Keywords: obstetric anesthesia; difficult intubation; failed intubation; risk factor.
**Introduction**

In Western Europe and North America, elective cesarean section is most frequently performed using regional anesthesia. Most of the statistics we have about the difficulty or failed tracheal intubation apply primarily to trainees in anesthesia, rather than fully qualified practitioners. We do not know the incidence of failed or difficult intubation when anesthesia is performed by experienced individuals. General anesthesia in obstetrics is usually given in emergency situations such as hemorrhage or nonreassuring fetal heart rate.

Iranian women frequently express a preference for general anesthesia over regional anesthesia for cesarean section. Common reasons cited by patients for this preference include fear of pain during the regional anesthetic procedure, pain during the cesarean section, awareness of voices and operating room sounds, and cultural preferences for not being awake during surgery. Therefore, our practice mandates a high percentage of patients requiring airway management at term pregnancy, allowing us to determine the incidence of problems during airway management in this patient population over a relatively short period. The aim of the current study is to assess the incidence of difficult intubation as well as identifying the risk factors associated with difficult intubation in a group of Iranian women undergoing cesarean sections.

**Methods**

The study was conducted over a 31-month period from February 18, 2007 to September 9, 2009. Research ethics board waived the need for written consent. There was no conflict of interest in the study. Patients who were emergent, NPO for at least 8 hours, or declined neuraxial block were included in the general anesthesia group.

Preoperative patient data, airway assessment, history of previous intubation, and potential risk factors for difficult intubation were recorded prospectively on a group of patients presenting for cesarean section under general anesthesia at Shabih-Khani and Beheshti Hospitals, the teaching hospitals of Kashan University of Medical Sciences, Kashan, Iran, with approximately 5,500 deliveries annually and 45% cesarean section rate.

All but four cases were intubated by the same anesthesiologist. All patients were intubated with a size 7 cuffed SUPA (SUPA C E, Tehran, Iran), PVC tracheal tubes, without an intubating stylet. Prior to anesthesia an assessment was made of the oropharyngeal structures using the test first described by Mallampati and subsequently modified by Samsoon and Young. The classification was as follows: class I = soft palate, fauces, uvula, and tonsillar pillars visible; class II = soft palate and fauces seen, tip of uvula obscured; class III = soft palate and only base of uvula seen; and class IV = soft palate not visible. Patients were asked not to phonate during the test since the classification may be affected by this maneuver.

For the purposes of this study “true” high BMI is defined. True high BMI is considered where a very high proportion of total body fat is distributed in head, neck, and upper chest, which interferes with intubation. Following assessment of oropharyngeal structures, patients were examined for the following eight potential risk factors: short neck; true obesity; missing maxillary incisors; protruding maxillary teeth; single maxillary tooth; receding mandible; facial edema; and swollen tongue. Short neck, true obesity, facial edema, and swollen tongue were subjectively assessed as either present or absent by the anesthesiologist. Receding mandible was assessed by placing three fingers under the mandible between the thyroid cartilage and the mentum. If the thyromental distance was less than the breadth of the three fingers, the patient was assessed as having a receding mandible. Protruding maxillary incisors were assessed as present or absent in a patient with no receding mandible viewed from the lateral position with the head in the neutral position and the teeth clenched. Single maxillary incisor and missing upper incisors are self-explanatory.

Patients were transferred to the operating room in the left lateral position. After 3 min of preoxygenation, anesthesia was induced with thiopental (5mg/kg) followed by succinylcholine (1.5mg/kg), then after 60 seconds the trachea was intubated. We did not use nerve stimulators as they were not available in our obstetric centers. Cricoid pressure was applied by nurse anesthetist upon loss of consciousness and maintained...
until the trachea was intubated, the cuff inflated, and correct tube location verified. Mcintosh laryngoscope blades were used for all intubations.

During the rapid-sequence induction, an assessment was made of the view at laryngoscopy as described by Cormack and Lehane\(^9\). The classification is as follows: grade A = most of the glottis visible; grade B = only the posterior extremity of the glottis visible; grade C = no part of the glottis visible, only the epiglottis visible; grade D = the epiglottis not visible.

After laryngoscopy, the trachea was intubated, and an assessment of the ease or difficulty of intubation was made according to the following scale: grade 1 = easy intubation at the first attempt, no difficulty; grade 2 = some difficulty, insertion of tracheal tube not achieved on the first attempt but successful after adjustment of laryngoscope blade and/or adjustment of head position but not requiring additional equipment, removal, and reinsertion of the laryngoscope; grade 3 = very difficult, requiring removal of the laryngoscope, further oxygenation by mask ventilation and subsequent intubation with or without the use of an introducing stylet, an alternative laryngoscope blade; and grade 4 = failed intubation, failure to pass tracheal tube after several attempts, or unrecognized esophageal intubation\(^10\).

For each patient the following data were recorded: age, weight, height, indication for cesarean section, including emergency versus elective nature.

### Statistical analysis

Statistical analysis was performed using SPSS version 16 (SPSS inc., Chicago, IL). Descriptive statistics were used for demographic data. Preoperative oropharyngeal classification (Mallampati), grade of view at laryngoscopy (Cormack), and ease or difficulty at intubation were presented as descriptive data. Preoperative oropharyngeal classification and each of the specific potential risk factors were compared for association with difficulty at intubation using univariate analysis (Chi square test). Grade 1 and 2 were combined into one group and compared against combined grade 3 (very difficult) and 4 (failed) using binomial logistic regression. Factors that have a significant association with difficult intubation on univariate analysis were then subjected to a stepwise elimination procedure. A \(P\) Value of less than 0.05 was considered statistically significant.

### Results

A total of 465 cases were entered into the study of which 461 were intubated by the same anesthesiologist. The patient’s demographics are presented in Table 1. Emergency cesarean section was not associated with increase in laryngoscopic grade (Table 2) or difficulty of intubation (Table 3).

#### Table 1
Demographic characteristics

<table>
<thead>
<tr>
<th></th>
<th>Mean ± SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr)</td>
<td>27.6 ± 5</td>
<td>(16-43)</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>78.7 ± 13.1</td>
<td>(39-127)</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>158.9 ± 6.5</td>
<td>(140-180)</td>
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</tbody>
</table>

#### Table 2
Laryngeal view (Cormack) during direct laryngoscopy in patients subjected to elective or emergency cesarean section

<table>
<thead>
<tr>
<th>Laryngoscopic view</th>
<th>Elective</th>
<th>Emergency</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>163 (72.4%)</td>
<td>165 (68.8%)</td>
<td>328 (70.5%)</td>
</tr>
<tr>
<td>B</td>
<td>56 (24.9%)</td>
<td>66 (27.5%)</td>
<td>122 (26.2%)</td>
</tr>
<tr>
<td>C</td>
<td>6 (2.7%)</td>
<td>9 (3.8%)</td>
<td>15 (3.2%)</td>
</tr>
<tr>
<td>D</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>225 (100%)</td>
<td>240 (100%)</td>
<td>465 (100%)</td>
</tr>
</tbody>
</table>

#### Table 3
Ease of intubation in elective and emergency cesarean section

<table>
<thead>
<tr>
<th>Grade</th>
<th>Elective</th>
<th>Emergency</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 1 (Easy intubation)</td>
<td>207 (92.0%)</td>
<td>215 (89.6%)</td>
<td>422 (90.8%)</td>
</tr>
<tr>
<td>Grade 2</td>
<td>14</td>
<td>19</td>
<td>33</td>
</tr>
<tr>
<td>Grade 3 (Some difficulty)</td>
<td>4 (6.2%)</td>
<td>5 (7.9%)</td>
<td>9 (7.1%)</td>
</tr>
<tr>
<td>Grade 4 (Very difficult)</td>
<td>0 (1.8%)</td>
<td>1 (2.1%)</td>
<td>1 (1.9%)</td>
</tr>
<tr>
<td>Failed intubation</td>
<td>0 (0.4%)</td>
<td>1 (0.2%)</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>225 (100%)</td>
<td>240 (100%)</td>
<td>465 (100%)</td>
</tr>
</tbody>
</table>
The classifications of the patients according to their Mallampati classification and their Cormack grade as well as their easy/difficulty to tracheal intubation are presented in Table 4 and Table 5.

There was a significant association between Mallampati class and view at laryngoscopy ($P < 0.001$) as well as difficulty at intubation ($P = 0.05$). None of the parturients was a Mallampati class 4. Only 8.8% and 4% of class 3 airway cases were associated with grade C laryngoscopic view and very difficult intubation respectively. None of the class 3 airway cases were associated with a failed intubation. There were nine cases of difficult intubation (1.9%) and only one case of failed intubation, giving an overall incidence of 1 in 465 (0.2%) of cases.

The overall frequency of obesity (BMI >30 kg/m$^2$) was 284 (61.2%), including 84 (18.2%) whose BMI was >35 kg/m$^2$, and 13 (3%) with BMI >40 kg/m$^2$. There was neither an association between obesity and laryngoscopic view ($P = 0.71$) nor difficulty at tracheal intubation ($P = 0.6$).

In order of frequency of occurrence, 53 (11.3%) were truly obese; 18 (3.8%) had facial edema, 8 (1.72%) had protruding maxillary teeth, 5 (1%) patients were assessed as having a short neck, 4 (0.86%) had a receding mandible, and 3 (0.64%) had a swollen tongue. The association between individual risk factor (univariate analysis) laryngoscopic view and difficulty at intubation are shown in table 6.

Multivariate analysis recognized receding mandible as the only risk factor for difficult intubation

<table>
<thead>
<tr>
<th>Mallampati Classification</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cormack Grade</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>99 (21.4%)</td>
<td>176 (38%)</td>
<td>51 (11%)</td>
<td>0</td>
<td>326 (70.4%)</td>
</tr>
<tr>
<td>B</td>
<td>17 (3.7%)</td>
<td>73 (15.8%)</td>
<td>32 (6.8%)</td>
<td>0</td>
<td>122 (26.3%)</td>
</tr>
<tr>
<td>C</td>
<td>0</td>
<td>7 (1.5%)</td>
<td>8 (1.8%)</td>
<td>0</td>
<td>15 (3.3%)</td>
</tr>
<tr>
<td>D</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>116 (25.1%)</td>
<td>256 (55.3%)</td>
<td>91 (19.6%)</td>
<td>0</td>
<td>463 (100%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mallampati Classification</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tracheal Intubation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 1</td>
<td>111</td>
<td>234</td>
<td>75</td>
<td>0</td>
<td>420</td>
</tr>
<tr>
<td>(Easy intubation)</td>
<td>95.7%</td>
<td>91.4%</td>
<td>82.4%</td>
<td>0</td>
<td>90.7%</td>
</tr>
<tr>
<td>Grade 2</td>
<td>4</td>
<td>17</td>
<td>12</td>
<td>0</td>
<td>33</td>
</tr>
<tr>
<td>(Some difficulty)</td>
<td>3.4%</td>
<td>6.6%</td>
<td>13.2</td>
<td>0</td>
<td>7.1%</td>
</tr>
<tr>
<td>Grade 3</td>
<td>1</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>(Very difficult)</td>
<td>0.9%</td>
<td>1.6%</td>
<td>4.4%</td>
<td>0</td>
<td>1.9%</td>
</tr>
<tr>
<td>Grade 4</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>(Failed)</td>
<td>0</td>
<td>0.4%</td>
<td>0</td>
<td>0</td>
<td>0.2</td>
</tr>
<tr>
<td>Total</td>
<td>116</td>
<td>256</td>
<td>91</td>
<td>0</td>
<td>463</td>
</tr>
<tr>
<td></td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td></td>
</tr>
</tbody>
</table>
in cesareans. Twenty five percent of patients with receding mandible ended up being difficult to intubate. Only one patient had restricted neck extension.

Combination of risk factors increases the probability of difficult intubation. Presence of receding mandible increases the chance of difficult intubation. Probability of difficult intubation in presence of receding mandible and other risk factors are even more when receding mandible is the only risk factor for difficult intubation. Relationship between the presence of one or more risk factors and the percentage for the presence of difficult intubation are shown in Table 7.

**Table 6**
Univariate Analysis of Individual Risk Factors and Their Association with Class C & D Laryngoscopic View and or with Difficulty at Tracheal Intubation

<table>
<thead>
<tr>
<th>RISK FACTOR</th>
<th>Chi Square (P-value) Laryngoscopic View</th>
<th>Chi Square (P-value) Tracheal Intubation Difficulty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protruding Maxillary Incisor</td>
<td>10.856 (0.004)</td>
<td>18.710 (0.000)</td>
</tr>
<tr>
<td>Short Neck</td>
<td>11.39 (0.003)</td>
<td>14.41 (0.001)</td>
</tr>
<tr>
<td>Obesity</td>
<td>4.134 (0.127)</td>
<td>2.118 (0.347)</td>
</tr>
<tr>
<td>Facial Edema</td>
<td>0.97 (0.616)</td>
<td>0.397 (0.820)</td>
</tr>
<tr>
<td>Swollen Tongue</td>
<td>0.184 (0.912)</td>
<td>0.182 (0.913)</td>
</tr>
<tr>
<td>Receding Mandible (n=4)</td>
<td>16.06 (0.000)</td>
<td>41.97 (0.000)</td>
</tr>
</tbody>
</table>

**Table 7**
Probability of experiencing difficult intubation (Combined grade 3 and 4)

<table>
<thead>
<tr>
<th>Combination of risk factors</th>
<th>Probability (%) of difficult intubation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-class 1</td>
<td>0.85</td>
</tr>
<tr>
<td>2-class 2</td>
<td>1.50</td>
</tr>
<tr>
<td>3-class 1 + RM</td>
<td>16.15</td>
</tr>
<tr>
<td>4-class 1 + PI</td>
<td>0</td>
</tr>
<tr>
<td>5-class 1 + SN</td>
<td>2.037</td>
</tr>
<tr>
<td>6-class 2 + RM</td>
<td>25.50</td>
</tr>
<tr>
<td>7-class 2 + PI</td>
<td>0</td>
</tr>
<tr>
<td>8-class 2 + SN</td>
<td>3.56</td>
</tr>
<tr>
<td>9-class 1 + RM + PI</td>
<td>0</td>
</tr>
<tr>
<td>10-class 1 + RM + SN</td>
<td>31.82</td>
</tr>
<tr>
<td>11-class 1 + PI + SN</td>
<td>0</td>
</tr>
<tr>
<td>12-class 2 + RM + PI</td>
<td>0</td>
</tr>
<tr>
<td>13-class 2 + RM + SN</td>
<td>45.33</td>
</tr>
<tr>
<td>14-class 2 + PI + SN</td>
<td>0</td>
</tr>
<tr>
<td>15-class 1 + RM + PI + SN</td>
<td>0</td>
</tr>
<tr>
<td>16-class 2 + RM + PI + SN</td>
<td>0</td>
</tr>
</tbody>
</table>

RM = Receding Mandible
PI = Protruding Maxillary Incisor
SN = Short Neck

**Discussion**

A recent decrease in the number of general anesthetics for cesarean section has caused inadequate exposure of residents to the techniques of airway management in parturients, and as a result mothers may be endangered when general anesthesia is necessary. Furthermore, the average age and weight of women giving birth is rising and the medical complexity of cases is increasing.

The incidence of failed intubation in this study which was 1 in 465 or 0.2% is less than that the reported studies from Australia, UK, and from USA which was about 1 in 250 or 0.4%. One explanation may be that in this study all but four of the patients were
intubated by a consultant anesthetist, while in the studies referenced above the patients were intubated by trainees. General anesthesia given for obstetrics is safer in experienced hands compared to trainees, and the likelihood of encountering difficult intubation is predicted by the experience of the anesthetist2.

The incidence of difficult intubation in this study was 1 in 51 (1.9%) and consistent with Rocke et al.'s finding but lower than some previous studies in obstetric patients2,12-13. Although having grade C laryngoscopic view increases the probability of difficult intubation, 4 of our 9 cases of difficult intubation had grade B laryngoscopic view.

In this study, there was only one case of failed intubation without any obvious risk factor, indicating that difficult or failed intubation can occur unexpectedly16. Attempting to predict difficult intubation is therefore unlikely to be useful15. Adequate preparation with experienced personnel and appropriate equipment when general anesthesia is performed in the obstetric population.

The main risk factors for predicting difficult intubation (short neck, protruding maxillary incisor, and receding mandible) are structural and not necessarily related to pregnancy. A good airway examination is crucial and it has been shown that the predictive value of incremental risk factors for difficult intubation is greater than one isolated risk factor16.

Urgency of the operation does not worsen the laryngoscopic view nor increase the chance of difficult or failed intubation, which is in agreement with McDonnell et al.'s findings.

The distribution of body fat and high BMI, as shown in this study, are not necessarily equivalent. Distribution of body fat (true obesity) was assessed subjectively by considering the accumulation of fat in the face, neck or upper chest might interfere with intubation. Many of the patients with BMI>30 kg/m² had accumulation of fat in their buttocks, groins or abdomen with thin neck and faces. Rocke et al.10 also recommended to exclude weight as a risk factor because in a large proportion of their patients, weight was distributed around the patient’s thighs and buttocks. True obesity is defined as the appearance of accumulation of upper body fat deemed significant by the evaluating anesthesiologist. Neither subjectively (truly) obese patients nor patients with high BMI showed intubation difficulty. Our experience in obese non obstetric patients also indicates that true (subjective) obesity is not accompanied with difficult intubation. However, there were a few obese patients and difficult intubations in the current study; so it may not be acceptable to generalize the results of this work to the general obstetric population. Finding from the current study is comparable to what Bamgbde et al.17 found in their observational study. The incidence of obesity of pregnancy in this study was the same as their population. Also McDonnell et al.2 reported that a weight of 100 kg or more is not an independent predictor of a difficult intubation and the obesity does not necessarily make intubation difficult. In contrast, Hood and Dewan20 have shown that there is a significant correlation between obesity and difficult tracheal intubation when compared with the control group. D’Angelo and Dewan reported an incidence of 33% difficult intubation in morbid obese parturients19. We not only had a low number of morbid obese patients (n=12) but also their BMI (40-47) was obviously less than the patients in these studies. This may be a possible explanation for this difference. In addition Shiga et al.16 in a meta-analysis confirmed that obese nonpregnant patients have a greater incidence of difficult intubation due to an increase in oral soft tissue, but because of the small number of studies, data in obstetric population is inconclusive. A feature of this study demographics is homogeneity of the population unlike many western countries where the population is heterogenous and this factor may play a dominant role in determining intubation success rate.

In conclusion, although neuraxial anesthesia has become the preferred method of anesthesia for cesarean sections, general anesthesia can be given safely when necessitated by the condition of the parturients or fetus, and experienced physician and necessary equipments are available.

**Acknowledgement**

The authors thank Professor Stephen Halpern, Director of Obstetrical Anesthesia, Sunnybrook Health Sciences Centre, University of Toronto for his assistance designing this project. We acknowledge the
valuable statistical analysis performed by Dr. Hossein Bovjari, Azad University, Kashan, Iran. The authors would like to thank H. Hajighafari, S. Nejati, R. Arabbeygi, and Z. Gandomkar for their significant help in data collection. We also appreciate Professor Medge Owen, Department of Anesthesiology, Wake Forest University, NC, USA for her assistance in writing the article.
References

GLIDESCOPE® VIDEOLARYNGOSCOPE VERSUS FLEXIBLE FIBEROPTIC BRONCHOSCOPE FOR AWAKE INTUBATION OF MORbidLY OBESE PATIENT WITH PREDICTED DIFFICULT INTUBATION

ASHRAF ABUALHASAN ABDELLATIF* and MONAZ ABDULRAHMAN ALI*

Abstract

**Background:** Awake fiberoptic intubation is the gold standard for management of predicted difficult intubation. The purpose of this study was to test whether Glide Scope video laryngoscopy (GVL) will provide significant advantages over fiberoptic bronchoscopy (FOB) for awake intubation in morbidly obese patients with predicted difficult intubation. We therefore tested the hypothesis that intubation using GVL is faster than intubation with FOB.

**Methods:** 64 morbidly obese patients with predicted difficult intubation undergoing laparoscopic bariatric surgery were enrolled in this study. Patients were randomly assigned to receive awake oral intubation by either GVL or FOB. After airway topical anesthesia and sedation using target controlled remifentanil infusion to a Ramsay sedation scale of 3, we compared the two devices for time to intubate, successful intubation on first attempt, glottic view using Cormack and Lehane score system, response of the patient to scope, patients satisfaction and incidence of postoperative sore throat and hoarseness.

**Results:** Intubation time was 84±37.9 seconds and 73.6±31.1 seconds for FOB and GVL respectively. 75% of patients were successfully intubated on the first attempt with FOB compared to 80.6% with GVL. Grade I/II glottic view was reported with GVL in 96.7% of patients compared to 100% with FOB. The highest target concentration of remifentanil to maintain patients sedated during intubation was 2.4±0.6 ng/ml and 2.2±0.8 ng/ml in FOB and GVL respectively. No significant differences regarding maximum patient response to intubation, adverse effects or patient satisfaction were recorded between groups.

**Conclusion:** GVL can be used as a useful alternative to FOB in morbidly obese patients with predicted difficult intubation.

**Keywords:** Fiberoptic bronchoscope, Glidescope, Morbid obesity, Difficult airway, Awake intubation.

**Conflict of interest:** None

**Sources of financial support:** None

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Introduction

Anesthesia in obese patients is associated with difficult mask ventilation, rapid desaturation, and difficult intubation\(^1,2\). Practice guidelines for management of the difficult airway reported by the American Society of Anesthesiologists (ASA) advise that ‘multiple airway features should be assessed’\(^3\). EL-Ganzori simplified risk index (EGRI) combines and stratifies seven variables derived from parameters and observations individually associated with difficult intubation, a score more than 4 has been used as the definition of difficult intubation in different populations\(^4\).

In spite of the development of numerous airway devices in the past two decades, a recent British survey concluded that difficulty with tracheal intubation is the most common complication during anesthesia\(^5\).

Fiberoptic bronchoscope (FOB)-assisted tracheal intubation, a commonly utilized method to perform awake tracheal intubations, has limitations. FOBs are expensive, and their proper use requires extensive training and practice. The presence of edema, excess airway tissue, secretions, or blood in the pharynx or larynx makes FOB assisted intubation of the trachea difficult, or even impossible\(^6\).

The GlideScope® videolaryngoscope (GVL) has been in clinical use since 2003\(^7\). It has been shown to facilitate tracheal intubation by means of improving laryngeal view in several studies covering a wide spectrum of general surgical patients\(^7,8\). Furthermore, it has been proven superior to direct laryngoscopy in patients with predicted difficult intubation\(^9,10\).

The aim of the present study is to compare the efficacy of awake tracheal intubation by GVL to FOB in morbidly obese patients with predicted difficult intubation scheduled for laparoscopic bariatric surgery.

Methods

Patient selection and randomization

The study was approved from the human research committee (Security Force hospital, Riyadh, KSA) and written informed consent was obtained from all subjects prior to inclusion. Over one year, 64 patients undergoing laparoscopic bariatric surgery were enrolled in this prospective clinical trial.

Patients were allocated into two equal groups for awake intubation with either FOB (Olympus medical systems COROP, Tokyo-Japan; 4.9 mm diameter) (FOB group) or GVL (Veraton Medical Inc, Burnaby, BC, Canada) (GVL group) according to computer generated randomization technique. It was not possible for patients, investigators, or care providers to be blinded for treatment groups.

Inclusion criteria were a body mass index (BMI) over 40 kg/m\(^2\) and a potentially difficult airway as defined by El-Ganzori risk index (EGRI) score > 4\(^4\).

Exclusion criteria were age younger than 18 years or more than 60 years, ASA physical status of greater than four, severe mental disorder (psychotic or considered incapable of understanding the information), mouth opening less than 15mm, poor dental status, contraindications to any of the drugs used in the study or patient refusal.

Anesthesia and sedation

All patients were premedicated with glycopyrrolate 4-5µg/kg (maximum dose 0.4mg) 15 minutes before the procedure. The patient was taken to the OR, monitored using ECG, non-invasive blood pressure and pulse oximetry.

Topical anesthesia was applied using 5 mL of 2% lidocaine nebulized through a mouthpiece with oxygen at 8 l/minute given over 5 minutes, followed by 5 puffs of lidocaine 10% metered spray (10 mg per puff) applied directly on the mucosa of the oropharynx and faucets. The sufficiency of the pharyngeal and laryngeal analgesia was evaluated by the patients’ acceptance of an oral airway placed 1-2 minutes before an attempt of intubation.

In FOB group the airway anesthesia was supplemented by 2 injections of 3 mL of lidocaine 2% through the fiberscope channel: one directly on the glottis and one below the vocal cords. While in the GVL group, once a good view of the glottis was obtained, additional 3ml of lidocaine 2% was
administered under direct vision, using a MADgic® atomizer (Wolfe Tory Medical, Salt Lake City, UT, USA). A maximum dose of 5 mg/kg lidocaine was allowed to avoid toxic reactions.

The patient was placed in the sniffing position, head elevated by a ramp positioned under the shoulders, and O2 was given through a nasal catheter at 4 l/min.

Remifentanil was administered using target-controlled infusions (TCI) (Orchestra® Base Primea, Fresenius Kabi, Brezins, France) with the Minto pharmacokinetic model which adjusts for age, weight, and sex. Ramsay sedation scale (RSS) was used to assess the level of sedation of the patient. The target RSS was a score of 3 (responsive to commands only). The initial target concentration for Remifentanil was 1.5 ng/mL and titrated in 0.5 ng/mL increments according to RSS.

The response of the patient to introduction of the scope was graded as follow; 0 = no coughing or gagging, 1 = mild coughing or gagging that did not hinder intubation, 2 = moderate coughing and/or gagging that interfere minimally with intubation, 3 = severe coughing and/or gagging that made intubation difficult. If severe gagging or coughing was observed, the scope was removed and remifentanil titrated upwards and a waiting period of 90 seconds was allowed before reattempting intubation.

Tracheas were intubated with Flex-Tip tracheal tubes (Parker Medical, Highlands Ranch CO, USA) size 7.0 for women and size 7.5 for men. The tube was loaded over FOB in FOB group or fitted over a 60° hockey stick stylet in GVL group.

To minimize the effect of operator inexperience, intubation was performed by one of the two investigators who had more than 100 times successful intubation with either FOB or GVL. Two anesthetists were present during the procedure: one responsible for performing the awake intubation and the other for observation and data collection.

**Measurements**

The primary end point was the duration of intubation (defined as the time from introduction of the scope till confirmation of correct endotracheal tube placement with three waves end tidal capnography). We also recorded the number of intubation attempts, the best glottic view obtained using the Cormack and Lehane scoring system, the response of the patient to intubating device and the lowest saturation registered during the intubation. On the first postoperative day, patients were asked if they had post-operative hoarseness and/or sore throat and patient satisfaction was assessed according to the following score (excellent = 1, good = 2 and fair = 3).

An intubation attempt was considered unsuccessful if the intubating device was removed from the oral cavity due to coughing, gagging, decrease oxygen saturation or inability to view the vocal cords. After three attempts the procedure was considered a failure, the study protocol was stopped and endotracheal intubation under inhalational induction with FOB without neuromuscular blockade (plan B) is carried out and patients were excluded from the study.

**Statistical analysis**

Distribution of baseline variables was assessed by the Shapiro-Wilk W tests. Previous study showed intubation time with awake FOB to be 80±59. We calculated the sample size to be 60 patients in order to reach 80% power at 0.05 level of significance to detect a difference of 45 seconds or greater in intubation time between the two techniques, assuming a standard deviation of 60 seconds. To allow for subject dropout or protocol noncompliance, we planned to enroll at least 64 subjects. By using Statistical program for social science (SPSS) software for Windows, version 11 (SPSS Inc, Chicago, IL, USA), arithmetic mean and standard deviation values for different variables were calculated and statistical analyses were performed for each group. Independent sample t-test was used to compare continuous variables exhibiting normal distribution, and Chi-squared or Fisher exact test for non-continuous variables. P<0.05 is considered significant.

**Results**

A total of 64 patients were enrolled in the study. One patient in the GVL group was excluded from the
### Table 1

**Patient characteristics**

<table>
<thead>
<tr>
<th></th>
<th>FOB group n=32</th>
<th>GVL group n=31</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age in years (mean±SD)</td>
<td>37±14</td>
<td>34±13</td>
<td>0.39</td>
</tr>
<tr>
<td>Sex (M/F) (n)</td>
<td>12/20</td>
<td>10/21</td>
<td>0.66</td>
</tr>
<tr>
<td>Weight in kg (mean±SD)</td>
<td>135.5±29.7</td>
<td>139.3±33.6</td>
<td>0.64</td>
</tr>
<tr>
<td>Height in cm (mean±SD)</td>
<td>165.2±12.9</td>
<td>169.4±14.7</td>
<td>0.23</td>
</tr>
<tr>
<td>BMI in kg/m² (mean±SD)</td>
<td>47.3±6.5</td>
<td>49.2±7.1</td>
<td>0.27</td>
</tr>
</tbody>
</table>

Data are presented as mean±SD, number (n) or percent (%).

### Table 2

**Airway Assessment (EGRI score)**

<table>
<thead>
<tr>
<th></th>
<th>FOB group n=32</th>
<th>GVL group n=31</th>
<th>P-value</th>
</tr>
</thead>
</table>
| Mouth opening:  
>4 cm | 0 | 22 | 68.7% | 25 | 80.6% | 0.28 |
| <4 cm | 1 | 10 | 31.2% | 6 | 19.4% | 0.28 |
| Thyromental distance:  
>6.5cm | 0 | 12 | 37.5% | 15 | 48.3% | 0.38 |
| 6-6.5cm | 1 | 11 | 34.3% | 9 | 29.1% | 0.65 |
| <6cm | 2 | 9 | 28.1% | 7 | 22.6% | 0.61 |
| Modified Mallampati score:  
1(soft palate, fauces, uvula, and pillars seen) | 0 | 6 | 18.75% | 7 | 22.6% | 0.71 |
| 2(soft palate, fauces, and uvula seen) | 1 | 12 | 37.5% | 8 | 25.8% | 0.32 |
| 3(soft palate, base of uvula seen) | 2 | 10 | 31.25% | 13 | 41.9% | 0.38 |
| 4(soft palate not visible) | 2 | 4 | 12.5% | 3 | 9.7% | 0.72 |
| Neck movement:  
>90Kg | 0 | 22 | 68.75% | 19 | 61.3% | 0.53 |
| 80-90Kg | 1 | 8 | 25% | 10 | 32.2% | 0.53 |
| <80Kg | 2 | 2 | 6.25% | 2 | 6.5% | 0.97 |
| Ability to prognath:  
Yes | 0 | 20 | 62.5% | 22 | 70.97% | 0.48 |
| No | 1 | 12 | 37.5% | 9 | 29.03% | 0.48 |
| Body weight:  
<90 | 0 | 0 | 0% | 0 | 0% |   |
| 90-110 | 1 | 12 | 37.5% | 8 | 25.8% | 0.32 |
| >110 | 2 | 20 | 62.5% | 23 | 74.2% | 0.32 |
| History of difficult intubation:  
No | 0 | 22 | 68.75% | 19 | 61.3% | 0.53 |
| Questionable | 1 | 4 | 12.5% | 2 | 6.5% | 0.41 |
| Definite | 2 | 6 | 18.75% | 10 | 32.2 | 0.22 |
| Total score of EGRI (mean±SD) | 7.6±3.1 | 8.1±3.6 | 0.56 |

Data are presented as mean±SD, number (n) or percent (%).
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study due to severe gagging and coughing. After three attempts, this patient was successfully intubated by plan B.

There were no statistically significant differences between the patients’ demographics in the two groups [Table 1]. The individual criteria and the total score of EGRI showed no significant difference between the two groups [Table 2].

There was no significant difference between the two groups in terms of intubation time. Intubation success on the first attempt was 75% and 80.6% for FOB and GVL respectively. Using GVL, operators reported a grade I/II glottic view for 30 of 31 (96.7%). For one subject, only a grade III glottic view was obtainable. Using FOB operators reported a grade I/II glottic view for 32 of 32 subjects (100%) with no grade III or IV glottic view (Table 3).

There was no difference between post-operative hoarseness and throat pain exhibited by the patients in the two groups. In three patients in FOB group and one patient in GVL group, oxygen saturation fell below 90%. In both groups, the maximum patient response to scope was similar. The highest target concentration of remifentanil to maintain patients sedated during

| Table 3 | Time to intubation, number of attempts, laryngeal view, patient response to scope, remifentanil concentration, and complications in both groups. |
|---------|---------------------------------------------------------------------------------|---|---|---|
|         | FOB group                                                                 | GVL group                                                                 | P-value |
|         | n=32                                                                         | n=31                                                                      |         |
| Intubation time in seconds (mean±SD) | 84±37.9                                                                     | 73.6±31.1                                                                 | 0.24    |
| Number of attempts: (n)            |                                                                             |                                                                           |         |
| First  | 24                                                                           | 25                                                                        | 0.59    |
| Second | 6                                                                            | 5                                                                         | 0.78    |
| Third  | 2                                                                            | 1                                                                         | 0.57    |
| Cromack and Lehane score: (n)      |                                                                             |                                                                           |         |
| I: entire glottic opening          | 18                                                                           | 17                                                                        | 0.91    |
| II: partial view of the glottis, including arytenoids | 14                                                                           | 13                                                                        | 0.88    |
| III: only the epiglottis           | 0                                                                            | 1                                                                         | 0.31    |
| IV: no part of the epiglottis or glottis | 0                                                                            | 0                                                                         |         |
| Patient response to scope (mean ±SD) | 1.48±0.61                                                                   | 1.72±0.63                                                                | 0.13    |
| Maximum remifentanil target concentration (mean ±SD) (ng/ml) | 2.4±0.6                                                                     | 2.2±0.8                                                                  | 0.26    |
| Patients with O₂ saturation <90% (n) | 3                                                                           | 1                                                                        | 0.32    |
| Postoperative hoarseness and/or sore throat (n) | 11                                                                           | 13                                                                        | 0.54    |
| Patient satisfaction: (n)          |                                                                             |                                                                           |         |
| Excellent | 19                                                                           | 18                                                                        | 0.92    |
| Good      | 10                                                                           | 11                                                                        | 0.72    |
| Fair      | 3                                                                            | 2                                                                         | 0.67    |

Values are mean ±SD, number (n) or percent (%).
intubation was 2.4±0.6 ng/ml and 2.2±0.8ng/ml in FOB and GVL respectively. Patient satisfaction ranged between excellent and good and only three cases in FOB group and two cases in GVL group were recorded fair but no significant difference between groups was recored [Table 3].

Discussion

This study showed that GVL and FOB are comparable methods for awake intubation of morbidly obese patients with predicted difficult intubation. Only one patient in the GVL group could not be intubated using this technique and was successfully intubated with plan B.

Intubation time was shorter in GVL group, however this was not statistically significant. To our knowledge the two scopes have not been previously compared for awake intubation in morbidly obese patients with predicted difficult intubation. However, one study compared the two scopes with regard to their speed and efficacy in 75 obese patients for elective surgery after induction of general anesthesia and concluded that the intubation time was comparable and intubation required less than one min using either techniques. Xue et al. reported similar results regarding intubation time in their study of 56 patients, although the patients were healthy and not obese.

Rosenstock et al. in a randomized clinical trial showed no significant difference in time to awake intubation by experienced investigators using McGrath video laryngoscope (MVL), compared to FOB in difficult airway patients. Transtracheal injection of lidocaine was used in their study for airway anesthesia. This method carries more potential risk than topical anesthesia used in our study. More importantly, it can be difficult or even impossible to perform if the patient neck anatomy is troublesome to locate. In their study a total of seven patients were excluded because transtracheal injection was impossible.

Moore et al. in a study of 40 morbidly obese patients with suspected difficult intubation for awake intubation using GVL, recorded an intubation time of 201±158 seconds. The longer intubation time may be due to the study design, with each anesthetist providing airway anesthesia and sedation based on their own routine practice.

These results did not support the claim that FOB intubation is a time-consuming technique. Although FOB may be considered as a time consuming due to occasionally foggy view which is avoided with the technology of the camera of GVL, There is also a numerous reports for failed or delayed intubation with GVL related to positioning the tube in the trachea despite a good glottis view. Intubation success rate on the first attempt was 80.6% and 75% in GVL and FOB respectively with no statistically difference between the two groups. Our choice of a Parker tube could have contributed to the high incidence of first attempts successful intubations with FOB. Brull et al. reported that it can be difficult to advance conventional polyvinylchloride tubes over the FOB in up to 35% of patients undergoing FOB intubation, and others have reported even higher difficulty rates – up to 53%. It is likely that an ordinary tube increases impingement on the laryngeal structures secondary to the gap between the external surface of the FOB and inner surface of the tracheal tube. The use of styletted ETT with GVL increased first pass success rate. Van Zundert et al. reported that using a styletted ETT with the GVL increased first pass success rates in healthy adult patients (from 53% to 76%). Sun et al. found a first pass success rate of 94% when using the GVL with a styletted ETT.

Visualization of the larynx, either directly or indirectly, is the most important procedural step in the process of tracheal intubation. We chose to use the Cormack-Lehane grading score because of its familiarity to most anesthesiologists. The incidence of O2 desaturation was not significantly different in the both groups. The lower incidence of desaturation in our study compared to the previous studies may be attributed to the use of TCI remifentanil for sedation. TCI allows the user to achieve a chosen predicted concentration rapidly without overshooting. By maintaining stable concentrations over time, TCI allows precise titration of drug in the narrow therapeutic window between agitation and excessive sedation. All patients were cooperative throughout the procedure, and were able to breathe on demand when spontaneous respiratory rate decreased.
The incidence of sore throat was comparable in both groups. This incidence coincides with minor and severe laryngeal trauma previously reported with FOB\textsuperscript{35} and GVL\textsuperscript{27}.

A 2003 survey of anesthesiologist found that only 59\% of anesthesiologists reported having skills in fiber-optic tracheal intubation\textsuperscript{28} while GVL has proved to be easily learned by inexperienced operators\textsuperscript{7,29}. Rai et al.\textsuperscript{29} found that two investigators who did not have previous experience with intubation using the GVL, did not fail to intubate after the eighth patient. Therefore, inexperienced users may find awake GVL intubation easier than awake FOB in patients with a difficult airway.

To overcome bias in previous studies, we unify patient selection criteria, sedation technique and airway topical anesthesia. All patients were morbidly obese with predicted difficult intubation based on EGRI that has been used with high sensitivity and specificity. Awake intubation actually include two parts: airway topical anesthesia and subsequent intubation. When adequate airway anesthesia is obtained, subsequent intubation is usually easy.

This study had some limitations. There may have been bias, as it was impossible to blind the anesthesiologist to the device being used. Second, all intubations were performed by experienced anesthesiologists; therefore, results may differ in the hands of less experienced users.

In conclusion, there was no significant difference in time to awake tracheal intubation, number of intubation attempts and glottic view with the GVL compared to FOB in morbidly obese patients with predicted difficult airway. GVL can be used as a useful alternative to FOB in this group of patients.
References

COMPARISON OF Ilioinguinal / Iliohypogastric NERVE BLOCKS AND INTRAVENOUS MORPHINE FOR CONTROL OF POST-ORCHIDOPEXY PAIN IN PEDIATRIC AMBULATORY SURGERY


Abstract

Background: The present study is a prospective randomized double-blinded study that designed to evaluate and compare the effectiveness of postoperative pain control and incidence of complications between ilioinguinal/iliohypogastric nerve block and intravenous morphine in paediatric patients undergoing unilateral orchidopexy in day surgery unit.

Methods: Seventy patients aged 2-12 years were randomly allocated to two groups of thirty five. One group received intravenous morphine 100 microgram/kg before skin incision and the other group had ilioinguinal/iliohypogastric nerve block with 0.25ml/kg bupivacaine 0.5% also before skin incision. All patients have received standardized anaesthesia. Postoperative pain was assessed using 0 - 10 scale at 0, 1, 2, 3 and 4 postoperative hours, also the intraoperative fentanyl requirements, time to first postoperative analgesia, the total number of paracetamol doses and any extra analgesic requirements were recorded, side effects like respiratory depression, vomiting, itching, inguinal hematoma and lower limb weakness were assessed during the first 24 hours.

Results: Pain scores were significantly lower in the morphine group compared to the block group on admission and one hour after admission to the postanaesthesia care unit, no significant difference in pain score on 2nd, 3rd and 4th postoperative hours.

The total number of intraoperative fentanyl doses was significantly higher in the block group compared to morphine group, there was no significant difference in the duration of analgesia, number of total paracetamol doses, need for extra analgesics in both groups over the 24 postoperative hours.

None of the seventy patients experienced postoperative respiratory depression, inguinal hematoma or lower limb weakness, but significantly more patients in morphine group experienced vomiting and itching compared to the block group.

Conclusion: Ilioinguinal/iliohypogastric nerve block and intravenous morphine administered following general anaesthesia for unilateral orchidopexy in day surgery unit are safe and effective in controlling postoperative pain, morphine analgesia had a higher incidence of postoperative vomiting and itching.

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Keywords: Orchidopexy, pain, Ilioinguinal block, morphine.

Conflict of interest: All authors declare that there are no conflicts of interests.

Introduction

Orchidopexy is one of the procedures which is increasingly being performed in children on outpatient basis. It is considered as one of the common 1-day surgical procedure that requires additional analgesia in the 1-day surgery unit and at home. It is identified as the only procedure requiring orally administered narcotics for the control of postoperative pain following discharge. The incidence of postoperative pain after orchidopexy is reported to range from 30-60%.

Preoperative ilioinguinal / iliohypogastric nerve block is a common regional anesthetic technique for surgical procedures in the inguinal area. These nerve blocks are simple and quick but can be associated with serious side-effects and have a high failure rate.

Morphine is commonly used to treat postoperative pain in children. However, its administration can be associated with some side effects that can cause considerable distress and may restrict its use in 1-day surgery units in countries with limited paramedical facilities.

This study compares the use of intravenous morphine and ilioinguinal / iliohypogastric nerve block in pediatric patients undergoing unilateral orchidopexy in the day surgery unit with respect to analgesic efficacy and the incidence of side effects.

Methods

This prospective randomized double-blinded study was conducted at Jordan University Hospital, Amman, Jordan after obtaining the approval of the Scientific and Institutional Review Board committee (No 4/2011) on 5 April 2011. We studied seventy children aged 2-12 years admitted to the 1-day surgery unit for unilateral orchidopexy.

All children were of ASA-1 anesthesia risk class. Patients who had bilateral orchidopexy or had respiratory, blood clotting disorder or had a known allergy to the study drugs were excluded from the study.

On the day of operation, the study purpose and details were explained to the parents of the children, they were instructed on how to monitor their children for the next 24 hours after surgery for the need for analgesics and possible complications such as itching, vomiting or respiratory depression. A signed informed consent was then obtained for each patient.

On arrival to the operating room, standard patient monitoring was established which included ECG, noninvasive blood pressure, pulse oximetry and capnography. For all patients, general anesthesia was induced by inhalation of oxygen, air and sevoflurane. After securing the intravenous line, propofol (2mg/kg) and fentanyl (1 µg/kg) were administered to facilitate laryngeal mask insertion. Anesthesia was maintained through spontaneous breathing of 2-3 % sevoflurane, air and oxygen. Intraoperative fluid management was provided by the administration of Ringer’s lactate solution for necessary deficit volumes and maintenance rates.

Patients were randomly assigned to two groups of analgesia modalities. The first group (Group B) included patients who received a pre-incisional ilioinguinal / iliohypogastric nerve block (n=35), while the second group (Group M) received intravenous morphine analgesia (n=35).

Ilioinguinal and iliohypogastric nerve blocks in group B were performed by the anesthesiologist immediately after laryngeal mask insertion with 0.25 ml/kg Bupivacaine 0.5% administered using a short-beveled 23 G, 1.5 inch-long needle. Surgery was allowed to start at an average time of 10 minutes after the block. In group M, morphine (0.10 mg/kg) was administered intravenously and surgical incision was allowed after 10 minutes. Intravenous fentanyl of 1 µg/kg boluses were given if there is an elevation in blood pressure or heart rate of more than 20% of their baseline and the total number of additional fentanyl doses administered during the operation was recorded.

All the cases enrolled in the study had their surgery done by the same surgeon through inguinal and scrotal incisions and none of the operations lasted more than 45 minutes.
At the end of surgery, patients were transferred to the post anesthesia care unit (PACU) where they were monitored for 4 hours before discharge. Pain scores were recorded by specialized nurse on admission to PACU (0 minute), 1 hr, 2hrs, 3hrs and 4 hrs postoperatively using an objective pain score (OPS), which uses five criteria: localization of pain, movement, crying, agitation and posture. Each criterion is given a score between 0 and 2, with 2 being the worst, yielding to a total score between 0 and 10. OPS pain scores of more than 4 were managed with rectal paracetamol (30 mg/kg).

Postoperative complications such as vomiting, itching, respiratory depression (decrease in oxygen saturation less than 95% on room air) were recorded by the same nurse, vomiting were treated with iv ondansetrone 0.15 mg/kg.

After 4 hours of PACU, the child was assessed by an anesthesiologist and discharged home if the patient is having an Aldrete discharge score of 9 or 10. Parents were asked to assess the child regularly and to give acetaminophen syrup at a dose of 15 mg/kg, not more frequent than 4 hourly dosing limits if the objective pain score reached 4 or more and ibuprofen 5 mg/kg if the acetaminophen syrup was not adequate for pain control. Also the parents were asked to observe for vomiting, itching, inguinal hematoma and lower limb weakness.

After 24 hrs, parents were contacted by telephone by an anesthesiologist. In this interview, the time to first rescue analgesic dose, the total number of acetaminophen doses, the need for extra analgesics over 24 hrs and any complications (vomiting, itching, inguinal hematoma lower limb weakness) were recorded.

All the blocks were performed by the same anesthesiologist, the parents and all persons involved in postoperative management and data collection were blinded to the type of analgesia used.

**Statistical Analysis**

Statistical analysis was carried out using stat graphics centurion XV version 15.1.02 (statpoint Inc, USA). Values are expressed as either mean and standard deviations or number of observations and percentages. The demographic data of patients were studied for each of the two groups. Continuous covariates were compared using the t-test whereas for the categorical covariates, Fisher’s exact test was used to compare the frequency of occurrence of vomiting and itching between the two study groups. A P value of ≤ 0.05 was considered to be statistically significant.

**Results**

A total of seventy patients were enrolled in the study in two groups. The two groups were identical for age, weight and duration of surgery (Table 1).

<table>
<thead>
<tr>
<th>Demographic data*</th>
<th>Group B (N=35)</th>
<th>Group M (N=35)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>3.5 ±3.1</td>
<td>3.6 ±2.6</td>
<td>0.959</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>16.1±8.2</td>
<td>16.3±8.3</td>
<td>0.942</td>
</tr>
<tr>
<td>Duration of surgery (minutes)</td>
<td>41.9±8.2</td>
<td>42.5±10.5</td>
<td>0.776</td>
</tr>
</tbody>
</table>

* Data are presented as mean ± SD, Group B: Nerve block group, Group M: morphine group.
P<0.05 is considered significant.

Patients in the morphine group had a significant lower pain score than the block group on admission to the PACU and up to one hour after admission to the PACU (Table 2). There were no significant differences in pain scores between the two groups in the following 3 hour period of PACU stay (Table 2).

<table>
<thead>
<tr>
<th>Pain scores over 4 hours in postanaesthesia care unit in both groups</th>
<th>Time (minute)</th>
<th>Group B</th>
<th>Group M</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>1.6 ± 2.51</td>
<td>0.44 ± 1.18</td>
<td>0.015</td>
</tr>
<tr>
<td></td>
<td>60</td>
<td>1.54 ± 1.8</td>
<td>0.78 ± 1.1</td>
<td>0.035</td>
</tr>
<tr>
<td></td>
<td>120</td>
<td>1.66 ± 1.33</td>
<td>1.56 ± 0.84</td>
<td>0.70</td>
</tr>
<tr>
<td></td>
<td>180</td>
<td>1.83 ± 1.12</td>
<td>2.06 ± 0.59</td>
<td>0.29</td>
</tr>
<tr>
<td></td>
<td>240</td>
<td>2.46 ±1.09</td>
<td>2.44 ±1.08</td>
<td>0.96</td>
</tr>
</tbody>
</table>

* Data are presented as mean ± SD.
P<0.05 is considered significant.
None of the seventy patients experienced respiratory depression but significantly more patients in the morphine group experienced vomiting and itching compared with the nerve block group (Table 3).

Table 3
Frequency of complications observed during the first 24 postoperative hours*

<table>
<thead>
<tr>
<th>Complication</th>
<th>Group B N(%)</th>
<th>Group M N(%)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vomiting number</td>
<td>3(9%)</td>
<td>12(33%)</td>
<td>0.011</td>
</tr>
<tr>
<td>Itching number</td>
<td>0(0%)</td>
<td>6(17%)</td>
<td>0.012</td>
</tr>
</tbody>
</table>

* Data are presented as mean ± SD. P <0.05 is considered significant.

Intraoperatively, there were significantly more patients in the block group who required extra fentanyl doses than the morphine group (Table 4).

Table 4
Perioperative analgesic requirements*

<table>
<thead>
<tr>
<th></th>
<th>Group B</th>
<th>Group M</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of patients needed</td>
<td>34 %</td>
<td>8 %</td>
<td>0.007</td>
</tr>
<tr>
<td>extra fentanyl</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time to first analgesia</td>
<td>332 ± 255</td>
<td>431 ± 184</td>
<td>0.11</td>
</tr>
<tr>
<td>(Minutes)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of paracetamol</td>
<td>3.19 ± 1.06</td>
<td>2.96 ± 1.07</td>
<td>0.74</td>
</tr>
<tr>
<td>doses over 24 hours</td>
<td>1.06</td>
<td>2.96</td>
<td></td>
</tr>
</tbody>
</table>

* Data are presented as mean ± SD. P <0.05 is considered significant.

During the first 24-postoperative hours, the use of oral paracetamol as a rescue analgesic drug after discharge from the PACU showed no difference between the two groups as well as no significant differences in the time to first required postoperative paracetamol dose and in the total number of paracetamol doses received over 24 hours (Table 4). 30% of patients in both groups required ibuprofen and none of patients in the block group had inguinal hematoma or lower limb weakness.

Discussion

Our study showed that both pre-incisional administration of 100 µg/kg intravenous morphine or ilioinguinal-iliohypogastric nerve block with 0.5% bupivacaine are effective and comparable in their postoperative analgesic effect after unilateral orchidopexy in children. Both analgesia modalities spared the need for rescue analgesia for a time period that exceeded the PACU stay. Also, the number of doses of the rescue analgesic drug in the first 24-postoperative hours was also comparable.

These results are consistent with the results of many studies which showed that the ilioinguinal / iliohypogastric nerve block with a local anaesthetic produced effective postoperative analgesia after unilateral orchidopexy with little need for postoperative analgesics9,11. Intraoperatively, there was more need for fentanyl doses and this can be due to spermatic cord traction and testicular manipulations which was not adequately blocked by using the blind technique, however, in the adult population, several studies have demonstrated the benefit of spermatic cord block in inguino-scrotal surgery12, while in pediatric patients, Blatt et al suggested in their retrospective study that there is a benefit when adding spermatic cord block to the ilio-inguinal block in the standard inguinal orchidopexy13. In other studies, it was found that when using ultrasonography for ilioinguinal /iliohypogastric nerve blocks in children, the additional fentanyl doses were necessary only in 4% of patients compared to 34% of our patients who had the nerve block using the blind technique14.

Transient femoral nerve palsy15 has been reported as complication of the ilioinguinal /iliohypogastric nerve block technique. None of our patients had complications related to the block procedure that may affect the reliability of our findings.

Use of narcotics can be associated with many side effects which may limit its use in 1-day- case procedures. Khalil et al, compared fentanyl (2 µg/kg) and caudal blocks for orchidopexy and showed a decrease in oxygen saturation in the postoperative period in the opioid group, compared to children who received caudal analgesia16. However in our study, we used a smaller dose of fentanyl (1 µg/kg) and
morphine (100 µg/kg) during induction. None of our patients experienced a decrease in oxygen saturation in the postoperative period.

Vomiting was a common side effect of morphine in our study where more than third of the patients in the morphine group had postoperative emesis. In another study on pediatric patients with inguinal surgeries\textsuperscript{17}, it was found that the incidence of postoperative emesis after single dose of morphine (100 µg/kg) was 56%. This difference may be due to the difference in the anesthesia technique which was used where used nitrous oxide, halothane and neostigmine were used during the intraoperative period.

The limitation of the current study is that we did not assess the severity of post-operative pain at home due to practical difficulties. As a surrogate to home pain indicator, we used the number of doses of rescue analgesic drug consumed which depends on the parent’s observations and judgment. The two groups of patients in our trial were not different in their post-operative analgesia requirements at home in the first 24 hours and there was need for NSAID in a significant percentage of patients of both groups.

In conclusion, we found that ilioinguinal / iliohypogastric nerve block and intravenous morphine administered following general anesthesia for unilateral orchidopexy in 1-day surgery unit are safe and effective in controlling the postoperative pain. Morphine analgesia had a higher incidence of postoperative vomiting and itching.

**Acknowledgements**

We are grateful to the members of the nursing staff of the Day Surgery Unit, Jordan University Hospital, and to the anesthesiologist and surgeons who assisted in the collection of our data.
References

COMPARISON OF THE ‘SNIFFING THE MORNING AIR’ POSITION AND SIMPLE HEAD EXTENSION FOR GLOTTIC VISUALIZATION DURING DIRECT LARYNGOSCOPY

NUR HAFIZHOH A.H.* AND CHOY YIN CHOY**

Abstract

Background: This was a prospective randomized single-blinded clinical trial comparing the glottic views obtained during direct laryngoscopy between the ‘sniffing the morning air’ position and simple head extension.

Methods: A sample of 378 patients, aged 18 to 75 years old with ASA physical status I or II, scheduled for elective surgery under general anesthesia with endotracheal intubation, were randomized into 2 groups. Group A used the sniffing position during the first laryngoscopy while Group B was put in simple head extension position. Positions were then interchanged for the second laryngoscopy. Sniffing position was obtained by placing a 7 cm height non-compressible cushion under the patient’s head. In simple head extension, patient’s head was placed flat. Glottic visualization was assessed based on the Cormack & Lehane scale. Intubation was performed after second laryngoscopy and success rate of first attempt intubation was compared.

Results: The distribution of patients with different Cormack & Lehane scores between the two intubation positions were significantly different (p < 0.001). Changing over to the ‘Sniffing position’ resulted in improvement of the Cormack & Lehane scores in 109 (57.7%) patients, no change in 75 (39.7%) or worsening in 5 (4.8%) patients. Successful intubation at first attempt was better (p<0.05) with Group A: 156 (83.5%) while Group B: 121 (64.0%).

Conclusion: sniffting position provided better glottic visualization score and increased the successful rate of intubation as compared to simple head extension.

Key words: sniffing position, simple head extension, intubation, glottis view, Cormack & Lehane score.

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Introduction

Tracheal intubation is one of the routine procedures during administration of general anesthesia and usually carried out without difficulties. However, it may occasionally be difficult during elective cases and can be encountered when unexpected. Based on the American Society of Anesthesiologists (ASA) Closed Claims Project database, respiratory complication was a major cause of anesthesia related morbidity and mortality decades ago. Fortunately with advancement in research, improvement in airway management through education and the development of better airway devices, these risks have substantially decreased. Difficult laryngoscopy and intubation, repeated attempts and prolonged instrumentation with increasing forces are associated with dental and oropharyngeal soft tissue injuries, arterial desaturation, hemodynamic instability and unnecessary intensive care unit admissions. The incidence of difficult intubation is estimated to be approximately 1-4% and probably 0.05-0.35% of patients with seemingly normal airways would be impossible to be intubated. Being uncommon, studies of relevant factors had involved only small number of patients and comparison between such studies is compounded by the absence of an agreed standardized intubation position.

A good intubation position is expected to provide a complete glottic view during direct laryngoscopy for easy and smooth tracheal intubation. Sir Ivan Magill in 1936 first described his preferred intubation position as ‘the relative position of the airway passages instinctively adopted by a man as he scents the air or drinks a pint.’ In 1944, the ‘Three Axes Alignment Theory’ was the only valid theory introduced by Bannister and Macbeth who studied various intubation positions and concluded that the main determinant of good glottic visualization is by aligning the line of vision of operator with the mouth, pharynx and laryngeal axes which could be achieved with the head elevated on a pillow, resembling the ‘sniffing the morning air’ position. Since then, ‘sniffing the morning air’ position or sniffing position has long been advocated as the hallmark of recommended airway management for optimization of glottic visualization during direct laryngoscopy. In ‘sniffing the morning air’ position, the neck must be 35° flexed on the chest by elevation of the head with cushion under the occiput and extending the head at the atlanto-occipital joint at 15° as validated by Horton et al (1989) using an angle finder.

There appeared to be widespread acceptance of the ‘Three Axes Alignment Theory’ and the ‘sniffing the morning air’ position. However, the reliability of sniffing position as a gold standard intubation position was questioned by Adnet et al (2001) when his magnetic resonance imaging study failed to demonstrate that the three axes could be aligned in an awake patient put in the ‘sniffing the morning air’ position. He was unable to provide evidence to justify any significant advantage of ‘sniffing the morning air’ position over simple head extension for tracheal intubation. This new development triggered controversy and heated debates among anesthetists. Subsequent studies found that the ‘sniffing the morning air’ position is significantly better than simple head extension for direct laryngoscopy and beneficial in several situations: the setting of known difficult airway, obese patient and patient with obstructive sleep apnoea. Nevertheless, ‘sniffing the morning air’ position is still universally accepted despite the lack of any study to date that confirmed or refuted these claims.

The aim of this study was to compare the glottic views based on Cormack & Lehane score with patient placed either in the ‘sniffing the morning air’ position or simple head extension during direct laryngoscopy and the success of oral tracheal intubation at first attempt.

Methods

This was a prospective randomized single-blinded study conducted in operating theatres of Hospital Kuala Lumpur from December 2011 until April 2012. Prior approval was obtained from the Dissertation Committee of Department of Anaesthesiology and Intensive Care of HKL and UKMMC, Medical Research and Ethics Committee of UKMMC (Project code: FF 400-2011) and National Medical Research.

Three hundred and seventy eight patients, aged 18 to 75 years old with ASA physical status class I or II, scheduled for elective surgical procedures under general anesthesia requiring orotracheal intubation...
were enrolled. Patients were given a comprehensive explanation regarding the study and written informed consent was obtained prior to the operation day. Patient characteristics and airway assessment such as the Mallampati class, thyromental distance (TMD), range of motion of the head and neck and mouth opening were determined during preoperative assessment. Exclusion criteria included: known difficult airway or anticipated difficult airway (TMD less than 6 cm, limited neck mobility, limited mouth opening, Mallampati score III or IV, facial deformity and abnormality of mouth, larynx, pharynx or tongue), patients who required rapid sequence induction because high risk of aspiration, and morbidly obese patient with body mass index (BMI) > 35 kg/m².

Patients were randomized into Group A or B using a computer based randomization software. Group A patients were placed in ‘sniffing the morning air’ position during initial laryngoscopy (L1) followed by simple head extension position for the second laryngoscopy (L2). Group B patients were placed in simple head extension during L1 and then changed to ‘sniffing morning air’ position during L2. The ‘sniffing the morning air’ position was obtained by insertion of a standard 7 cm height non-compressible cushion under the patient’s head to avoid the variable degree of cervical flexion caused by compressibility of a regular cushion. The cushion was then removed to provide the simple head extension position. Patients were blinded regarding the sequence of the intubation positions.

Patients were fasted for at least 6 hours prior to surgery. Oral midazolam 3.75-7.5 mg, depending on age and weight of the patient, was given as night sedation as well as premedication 1 hour prior to surgery. In the operating theatre, patient was positioned supine with the head placed according to the study protocol. The operating table was set at the same level as the investigator’s anterior superior iliac spine. Standard baseline monitoring included: non-invasive blood pressure, electrocardiograph, heart rate and pulse oximetry. For anesthetic induction, intravenous fentanyl 2 mcg/kg, followed by propofol 2 mg/kg was titrated until loss of verbal responses. Intravenous rocuronium 0.6 mg/kg was given for neuromuscular block. Mask ventilation was carried out for 3 minutes with 2-4% sevoflurane in 100% oxygen to achieve adequate anesthetic depth of 1.0-1.2 minimal alveolar concentration.

Laryngoscopies, either L1 or L2 were performed using a size 3 Macintosh laryngoscope blade to obtain the best view of the glottis without external laryngeal manipulation. Before L2 was conducted patient was mask ventilated for another 30 seconds. Grading of glottic visualization during L1 and L2 without external laryngeal manipulation was assessed based on the Cormack & Lehane scale. Direct laryngoscopies were conducted by multiple operators, each having over three years experience in anesthesiology, and competent in airway management. Direct vision endotracheal intubation was done after L2.

An appropriate oral endotracheal tube (ETT) was selected accordingly. Sizes used were 7.0-7.5 mm for female and 7.5-8.0 mm for male patients. A stylet was inserted into each of the ETT to facilitate intubation. When difficulty was encountered, any modified technique necessary to achieve better glottic visualization, successful intubation and securing the airway would be used. The number of intubation attempts and any modified technique to improve glottic view required were recorded. In the event of an unanticipated difficult intubation, the anesthetist in-charge of the operating theatre was informed and airway management was conducted based on Difficult Airway Society guidelines 2004¹⁷.

The sample size was calculated based on ‘Power and Sample Size Calculations’ by Casagrande and Pike formula inclusive of 10% dropout and was 378. The alpha error value was set at 0.05, power of study at 90%; and beta value was 0.1¹³. Data were analysed by using parametric and Chi-square test of SPSS version 20.0 software as appropriate. A p-value of <0.05 was considered to be statistically significant.

**Results**

A total number of 378 patients were included in the study, 189 patients were assigned to each group. Patient demographic parameters were statistically comparable in both groups (Table I) with regards to age, gender, race, ASA physical status classification, BMI and Malampati scores.
Laryngoscopies were successful for all patients. The distribution of Cormack & Lehane scores for the initial and subsequent changed over assessment in the ‘sniffing the morning air’ position and simple head extensions are listed in Table II and III respectively. There was a statistically significant difference of Cormack & Lehane score I-III between sniffing position and simple head extension.

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Changing over to the ‘sniffing the morning air’ position from simple head extension and in the reverse resulted in improvement of Cormack & Lehane scores in 109 (57.7%) patients, no change in 75 (39.7%) or worsening in 5 (4.8%) patients as shown in table IV and V.

### Table I

Demographic characteristics of studied patients, values expressed as mean ± SD and numbers (percentage) where appropriate.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Group A (n = 189)</th>
<th>Group B (n = 189)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>44.6 ± 14.7</td>
<td>44.0 ± 16.0</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male n (%)</td>
<td>70 (37%)</td>
<td>84 (44.4%)</td>
</tr>
<tr>
<td>Female n (%)</td>
<td>119 (63%)</td>
<td>105 (55.6%)</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Malay n (%)</td>
<td>111 (58.7%)</td>
<td>106 (56.1%)</td>
</tr>
<tr>
<td>Chinese n (%)</td>
<td>30 (15.9%)</td>
<td>33 (17.5%)</td>
</tr>
<tr>
<td>Indian n (%)</td>
<td>40 (21.2%)</td>
<td>41 (21.7%)</td>
</tr>
<tr>
<td>Others n (%)</td>
<td>8 (4.2%)</td>
<td>9 (4.8%)</td>
</tr>
<tr>
<td>ASA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class 1 n (%)</td>
<td>99 (52.4%)</td>
<td>95 (50.3%)</td>
</tr>
<tr>
<td>Class 2 n (%)</td>
<td>90 (47.6%)</td>
<td>94 (49.7%)</td>
</tr>
<tr>
<td>BMI (Kg/m²)</td>
<td>25.0 ± 4.0</td>
<td>25.3 ± 4.3</td>
</tr>
<tr>
<td>Malampati score n (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class I n (%)</td>
<td>97 (51.3%)</td>
<td>96 (50.8%)</td>
</tr>
<tr>
<td>Class II n (%)</td>
<td>92 (48.7%)</td>
<td>93 (49.2%)</td>
</tr>
</tbody>
</table>

### Table II

Distribution of glottic visualization based on Cormack & Lehane score during first laryngoscopy (L1) (values expressed as number, percentage).

<table>
<thead>
<tr>
<th>Cormack &amp; Lehane Score n (%)</th>
<th>Group A (n = 189)</th>
<th>Group B (n = 189)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>142 (75.1)</td>
<td>51 (26.9)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>II</td>
<td>41 (21.7)</td>
<td>122 (64.6)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>III</td>
<td>6 (3.2)</td>
<td>16 (8.5)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>IV</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td></td>
</tr>
</tbody>
</table>

All patients were successfully intubated after L2, with 277 (73.3%) patients being intubated at first attempt regardless of the intubation position. Successful intubation at first attempt was greater with Group A: (156; 83.5%) versus Group B (121, 64.0%); p<0.05. Tracheal intubation was successful at second attempt for the rest of the 101 (26.7%) patients as shown in Table VI.
COMPARISON OF THE ‘SNIFFING THE MORNING AIR’ POSITION AND SIMPLE HEAD EXTENSION FOR GLOTTIC VISUALIZATION DURING DIRECT LARYNGOSCOPY

Table V
Outcome of Cormack & Lehane Score before and after change of position at L1 and L2 for Group B. Values expressed as number (percentage).

<table>
<thead>
<tr>
<th>Cormack &amp; Lehane’s Score changes</th>
<th>Group B N=189</th>
</tr>
</thead>
<tbody>
<tr>
<td>I to I</td>
<td>47 (24.9)</td>
</tr>
<tr>
<td>I to II</td>
<td>4 (2.1)</td>
</tr>
<tr>
<td>II to I</td>
<td>94 (49.7)</td>
</tr>
<tr>
<td>II to II</td>
<td>27 (14.2)</td>
</tr>
<tr>
<td>II to III</td>
<td>1 (0.6)</td>
</tr>
<tr>
<td>III to II</td>
<td>15 (7.9)</td>
</tr>
<tr>
<td>III to III</td>
<td>1 (0.6)</td>
</tr>
<tr>
<td>III to IV</td>
<td>0 (0.0)</td>
</tr>
</tbody>
</table>

Table VI
Number of intubation attempt in ‘sniffing the morning air’ position and simple head extension, values expressed as number (percentage).

<table>
<thead>
<tr>
<th>SUCCESSFUL INTUBATION</th>
<th>Sniffing position n = 189</th>
<th>Simple head extension n = 189</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st attempt</td>
<td>156 (83.5)</td>
<td>121 (64.0)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>2nd attempt</td>
<td>33  (16.5)</td>
<td>68  (36.0)</td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>

Discussion

Current teaching for tracheal intubation stresses the importance of the head position, and in particular of the ‘sniffing the morning air’ position, as the single most important factor in cases of difficult laryngoscopy\(^2\). Common intubation positions used during direct laryngoscopy include: ‘sniffing the morning air’ position, simple head extension, combined head and neck extension, as well as the head elevated laryngoscopy position or ramped position. In contrary to studies done by Adnet \(et\ al\) (2001) and Prakash \(et\ al\) (2011), which failed to demonstrate the superiority of ‘sniffing the morning air’ position over simple head extension in anaesthetized patients\(^13,18\), our study showed that ‘sniffing the morning air’ position has significantly improved Cormack & Lehane scores as compared to simple head extension. This is consistent with many other previously published studies and strongly supports the ‘sniffing the morning air’ position as the ideal intubation position for direct laryngoscopy\(^14-16\).

Adnet \(et\ al\) (2001), using magnetic resonance imaging, found that it was not possible to achieve the required anatomic alignment of the laryngeal, pharyngeal, and the mouth axes based on the three axes alignment theory neither in the neutral, simple head extension, nor the ‘sniffing the morning air’ position\(^11\). Takenaka \(et\ al\) (2007) in his radiological study showed that the ‘sniffing the morning air’ position provided greater occipito-alanto-axial extension angle, increased the submandibular space and facilitated vertical alignment of the mandible, tongue base, and larynx\(^19\). However, these two studies involved non-anesthetized volunteers, and laryngoscopy was not performed. Placing the patient in the ‘sniffing the morning air’ position does not align the anatomic airway axes, and application of a force via the laryngoscope blade is required to achieve alignment of the oral, pharyngeal and laryngeal axes to facilitate direction vision for the laryngoscopist\(^19\). The anterior and caudad force exerted by a laryngoscope blade on the oropharyngeal structures with the head in the ‘sniffing the morning air’ position required the least forces to displace the soft tissues of the oropharyngeal cavity and to align the laryngoscopic axes resulting in good visualization of the vocal cords\(^5,18,20\). Therefore it was not a surprise that in our study, 83.5% successful first intubation were achieved with the ‘sniffing the morning air’ position compared to only 64.0% in simple head extension position. These effects would be further improved if the pillow height was elevated especially in cases of difficult direct laryngoscopy\(^21,22\). Park \(et\ al\) demonstrated that laryngoscopic view obtained with the ‘sniffing the morning air’ position using a 9 cm pillow was significantly superior to that of the 6 cm pillow\(^21\). However, use of single standard pillow size did not always provide optimal cervical flexion for all patients because of modest variation in weight, head circumference and length of the neck\(^19\).
In non-obese patients, the optimal ‘sniffing the morning air’ position is achieved by raising the occiput 7 cm from the bed. This produces approximately 35° of flexion of the lower cervical spine on the chest. However, this degree of neck flexion cannot be achieved by a 7 cm pillow maneuver in morbidly obese patients. Their anatomy requires stacking to achieve not only 35° of neck flexion on the chest, but also 90° of extension of the head on the neck at the atlanto-occipital joint so that a parallel imaginary line can be drawn from the external auditory meatus to the sternal notch\textsuperscript{23,24}. It is possible that stacking an obese patient produces the same alignment of the axes of intubation that the ‘sniffing the morning air’ position produces in normal weight patients\textsuperscript{24}.

There were several limitations noted in this study. Firstly, despite standard anesthetic induction and use of muscle relaxant before direct laryngoscopy, there was no neuromuscular monitoring device used to monitor the depth of neuromuscular blockade to confirm that the pharyngeal and laryngeal muscles were adequately relaxed and optimal intubation condition had been achieved. Secondly, it was impossible to blind the laryngoscopist to the intubation position or the sequence of which laryngoscopy was to be conducted. This could have introduced bias in the amount of extension performed by the laryngoscopist. Preferably, the glottic view had been photographed and the picture analyzed by an independent assessor to grade the Cormack & Lehane score. Thirdly, the laryngoscopies were conducted by several laryngoscopists. This would contribute to an observational bias and inconsistency of the Cormack & Lehane scored. In relation to intra-rater and inter-rater reliability of Cormack & Lehane score, Levitan \textit{et al} and Jeremiah \textit{et al} conducted a clinical trial involving an airway assessment by using percentage of glottic opening (POGO) score instead of Cormack & Lehane score. POGO score has significantly better inter and intra-rater reliability compared to Cormack & Lehane score\textsuperscript{26-27}. However those studies were conducted among the emergency medicine personals. Ochroch \textit{et al} compared reliability of both scoring systems amongst the anesthetists and came to similar conclusions\textsuperscript{28}. However, in this study Cormack & Lehane scoring system was still used to score the glottis visualization because of its familiarity amongst the laryngoscopists. To reduce any observational mistake, the Cormack & Lehane score figures were attached in the data collection form for a quick reference and the laryngoscopists were limited to those who had 3 years experience in anesthetic practice. In conclusion this study showed the sniffing position when compared to simple head extension had provided a better glottic visualization score and increased the success rate of tracheal intubation.
COMPARISON OF THE ‘SNIFFING THE MORNING AIR’ POSITION AND SIMPLE HEAD EXTENSION FOR GLOTTIC VISUALIZATION DURING DIRECT LARYNGOSCOPY

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23. BENUMOF LJ: Comparison of intubating positions: the end point for position should be measured. Anesthesiology; 2002, 97:750.
COMPARATIVE STUDY BETWEEN ULTRASOUND DETERMINATION AND CLINICAL ASSESSMENT OF THE LUMBAR INTERSPINOUS LEVEL FOR SPINAL ANESTHESIA

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Abstract

Background: The aim of the current study is to compare the accuracy of the ultrasound (US) versus clinical assessment for determination of the spinal level, using X-ray as the Gold Standard for control.

Methods: 200 patients were randomized into two equal groups. Patients in the Clinical Group were examined by landmarks to assess the Assumed Clinical Tuffier’s Line, and then by fluoroscopy to determine the True Clinical Tuffier’s Line. Patients in the Ultrasound Group were examined by the ultrasound to determine the Ultrasound Tuffier’s Line. The results of both groups were compared in relation to the plain X-ray, done for each patient, which determined the Radiological Tuffier’s Line.

Results: In the Clinical Group, the True Clinical Tuffier’s line met the Assumed Tuffier’s line in only 12% of the patients. In the remaining patients, wrong leveling ranged from one space above in 80% to 2 spaces above in 7% and in 1% of patients the line was at L2. In the Ultrasound Group, wrong leveling occurred in 22% of patients. The Ultrasound misidentification was less than one level in 17% and one level in 5% of patients. Ultrasound examination had a true limitation of 2% of patients.

Conclusion: Ultrasound examination of the spine is recommended in patients planned for spinal anesthesia, as it is superior to clinical assessment in identification of the interspinous levels. This will decrease the hazard of spinal cord trauma.

Keywords: Clinical - Determination - Spinal level - Subarachnoid block - Ultrasound.

Conflict of interest: None.

Sources of financial support: None.

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Introduction

Neuraxial anesthetic techniques can be challenging because of inter-individual anatomic variability, and imprecise determination of the level of vertebral interspace by physical examination alone which is inaccurate in 70-80% of the time\(^1\,^2\). Spinal needle insertion and local anesthetic injection at the wrong lumbar interspace, which is too cephalad, may have been implicated in previously reported injuries to the conus medularis\(^3\). Permanent neurologic injury is a devastating complication after spinal anesthesia. In a large prospective survey, 0.03% neurologic complication rate was reported, 25% of them were cauda equina\(^4\). Similar complication rates after spinal anesthesia were reported and the authors concluded that imaging guidance might improve accuracy and safety of needle placement during neuraxial blocks\(^2\).

The aim of the present study is to compare clinical assessment of the spinal level with ultrasound determination for subarachnoid block.

Methods

This is a prospective, randomized and controlled study. It included 200 adult patients, of both genders and of all ASA classes.

After approval of the Local Ethics Committee, patients were randomized into two equal groups. Patients less than 18 years of age, pregnant ladies, those with apparent deformity of the spine and unable to give written consent were excluded from the study.

Group C (Clinical Group)

Patients in this group underwent a plain X-ray of their lumbosacral region and were scheduled for surgery in which fluoroscopy would be utilized. They were examined clinically by an anesthesiologist who was blind to the X-ray findings.

Group U (Ultrasound Group)

All patients in this group also had a plain X-ray of their lumbosacral region. They were examined with ultrasound by the radiologist to identify the different interspinous spaces. The radiologist was blind to their plain X-ray findings.

Examinations

All clinical and US examinations were done in the sitting position, while fluoroscopic examination was done in the supine position.

Plain X-ray of the lumbosacral region (AP view) was used as the “Gold Standard” in the study to determine the level of the intercrestal line, “Radiological Tuffier’s Line” (RTL).

The anesthesiologist performed the clinical examination using the highest points of the iliac crests as landmarks. A line was drawn extending between these 2 points (Intercrestal Line). This line, “Assumed Clinical Tuffier’s Line” (ACTL), intersected either a spinous process or an interspinous space. The intersection was considered as L4 spinous process or L4-5 interspace, respectively\(^5\,^7\). A radio opaque marker was placed in the midline of the ACTL. Fluoroscopic examination of all patients was performed to identify the level of the marker which represented the “True Clinical Tuffier’s Line” (TCTL). This fluoroscopic view was examined by a radiologist who was blinded to the whole procedure.

Either the General Electric (Logic 9), Siemens (Antaris) or Aloka (Alfa 10) devices, curved array 2-5MHz, and/or Linear array 5-10 MHz probes were used. Scanning was performed in transverse axis beginning from the buttock crease moving up in cephalad direction to identify the upper end of the sacrum. The spinous processes and intervertebral spaces of the lumbar spines were counted until the point of crossing of a transverse (intercrestal) line drawn on the back of the patient. This line was determined by ultrasound-guided identification of the highest point of both iliac crests “Ultrasound Tuffier’s Line” (USTL). The lumbar spinous process or the intervertebral space opposite this crossing point was identified as the ultrasound level of the intercrestal line. If the upper end of the sacrum could not be conclusively identified, the probe was moved caudally from the level of 12th dorsal spine, using the last rib defined by the US, to determine the USTL.
Statistics

Numerical data were expressed as mean ± standard deviation (M±SD), percentages (%) and numbers. P values <0.05 were considered as statistically significant. SPSS version 11.01 (SPSS Inc., Chicago, IL) was used in the analysis.

Results

The demographical data is presented in Table 1. No statistically significant difference between the 2 groups was noted. All cases of US group were urological. The majority of cases in the clinical group were urological that necessitated intraoperative fluoroscopy.

Table 1
Demographic Data

<table>
<thead>
<tr>
<th>Clinical Group (Group C) (n=100)</th>
<th>Ultrasound Group (Group U) (n=100)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (Yrs.)</td>
<td>39 ± 12</td>
</tr>
<tr>
<td>Gender (M/F)</td>
<td>94/6</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>164.2 ± 4.3</td>
</tr>
<tr>
<td>Body Weight (Kg)</td>
<td>72.6 ± 9.8</td>
</tr>
<tr>
<td>Operations:</td>
<td></td>
</tr>
<tr>
<td>Urological</td>
<td>94</td>
</tr>
<tr>
<td>Non-urological</td>
<td>100</td>
</tr>
<tr>
<td>Operations:</td>
<td></td>
</tr>
<tr>
<td>Urological</td>
<td>6 (2 Discectomies, 2 intramedullary nail femur and 2 other fractures)</td>
</tr>
<tr>
<td>Non-urological</td>
<td></td>
</tr>
</tbody>
</table>

Vertebral Level

Clinical Group (Group C):

Clinical examination of the 100 patients in Group C (Table 2), showed that only 12% of them met the Assumed Tuffier’s Line (L4). In the remaining patients, True Clinical Tuffier’s Line ranged from one space above in 80% of patients (67% in L3-4 and 13% in L3), to two spaces above (L2-3) in 7%, and 1% of patients had their line at L2 (Fig.1). Examination of the plain x-rays of the same group showed that the ATL matched with the RTL (61% in L4 and 25% in L4-5). Plain films of this group showed congenital anomalies in 16% of the patients. Of them, 8% were spina bifida, 4% sacralization, 1% lumbarization, and transitional vertebra in 3%.

Table 2
Distribution of patients of Group C at different spinal levels in Assumed, True and Radiological Tuffier’s Lines (n=100).

<table>
<thead>
<tr>
<th>Spinal level</th>
<th>Assumed Clinical Tuffier’s line</th>
<th>True Clinical Tuffier’s line</th>
<th>Radiological Tuffier’s line</th>
</tr>
</thead>
<tbody>
<tr>
<td>L2</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>L2-3</td>
<td>0</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>L3</td>
<td>0</td>
<td>13</td>
<td>3</td>
</tr>
<tr>
<td>L3-4</td>
<td>0</td>
<td>67</td>
<td>10</td>
</tr>
<tr>
<td>L4</td>
<td>69</td>
<td>12</td>
<td>61</td>
</tr>
<tr>
<td>L4-5</td>
<td>31</td>
<td>0</td>
<td>25</td>
</tr>
<tr>
<td>L5</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

Ultrasound Group (Group U):

In this group, 22 patients showed wrong determination of the spinal level when compared with their plain X-rays. It was less than one level in 17 patients and one level in 5 patients (Table 3 & Fig.2). Out of them, 2 had no obvious cause representing true limitation for US determination, 5 were obese with markedly limited US resolution and 15 patients...
had anatomical abnormalities of the spine mostly congenital. Among the abnormalities, 8 were spina bifida, 5 sacralization, one lumbarization, and one laminectomy.

Table 3
Location of Tuffier’s Line at different spinal levels by US (USTL) and plain X ray (RTL) in Group U.

<table>
<thead>
<tr>
<th>Spinal level</th>
<th>Ultrasound Tuffier’s line</th>
<th>Radiological Tuffier’s line</th>
</tr>
</thead>
<tbody>
<tr>
<td>L2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>L2-3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>L3</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>L3-4</td>
<td>16</td>
<td>11</td>
</tr>
<tr>
<td>L4</td>
<td>58</td>
<td>69</td>
</tr>
<tr>
<td>L4-5</td>
<td>20</td>
<td>14</td>
</tr>
<tr>
<td>L5</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

Discussion

The spinal cord terminates below L1 in 19% of people. This, together with the risk of wrong selection of higher interspace for intrathecal injection implies that the spinal cord is more likely at risk of trauma. This is particularly important as clinical experience did not show to improve accuracy of identification of spinal level.

The current study showed that 88% of patients had their True Clinical Tuffier’s Line higher than the Assumed Tuffier’s Line and it was one level above in 80% of the cases. The reason might be due to the original assumption of the clinical assessment which was based on the Radiological Tuffier’s Line. Also, the hands of the examiner are not directly on the bone but varying thickness of skin, subcutaneous and muscular tissues is in between. These results were in agreement with those of Broadbent and co-workers who found that in 51% of the times the actual interspinous level was one space above which the anesthetist believed it to be and accuracy was unaffected by patient’s position either sitting or lateral decubitus.

Comparison of the wrong identification of the spinal level between ultrasound (22%) and clinical assessment (88%) showed that US-guided determination was a better method. Secondly, there was a considerable number (15%) of wrong leveling of two or more levels with clinical assessment, while only one level or less in the case of ultrasound-guided assessment which might decrease the potential hazard to the spinal cord. This was confirmed by a study by Schottbeck and co-workers in which patients were re-examined by ultrasound to determine the clinical puncture level for spinal anesthesia given previously. The authors found that it was as assumed in 36.4% of the patients and in almost 50% of patients it was more cephalad. Factors including, level of anesthetist’s experience, BMI, and spinal pathology did not seem to

Fig. 2
Location of Tuffier’s Line at different spinal levels by US (USTL) and plain X ray (RTL) in Group U.
influence the frequency of errors.

In a disagreement with Schotterbeck et al., the main reason for US misidentification in the current study was congenital anomalies. Spina bifida was the most common. Wrong leveling was due to the wide separation of the spinous elements and/or absent spinous processes. Although the anomaly can be identified by US, still a wrong identification of the spinal level occurred in 1% of cases. Sacralization and lumbarization of the lumbar vertebrae were the second common cause of wrong leveling, as fusion or separation of L5 and S1-S2 spinous processes lead to misplacing of the intercrestal line. Morbid obesity occupied the third common cause of US-guided misidentification because of the technical difficulty in identifying the spinous processes. In the current study, it formed 18% of the wrongly identified spaces which accounted 4% of the whole series. Studies demonstrated that lumbar landmarks could be correctly identified using the ultrasound in about 76% of the time when they were difficult to palpate in the morbidly obese. Wrong identification by the ultrasound without any anatomical or technical explanation was met in 2% of our cases, which constituted true limitation. In cases with identified congenital anomalies, the ultrasound technique may be modified using the ala of the sacrum as the landmark for S1. This modification may be still misleading in cases of fusion abnormalities, namely, sacralization and lumbarization.

A limitation of this study was the few number of female patients shared. A study including more females is needed due to the difference in shape of the iliac bone than that of the android one.

In conclusion, US examination is recommended in patients planned for spinal anesthesia as it is superior in determining the spinal level to avoid inadvertent trauma to the spinal cord. Further studies of the role of US in evaluating the implications of congenital anomalies on US-guided lumbar puncture are encouraged.
References


CURRICULUM DEVELOPMENT FOR AN ADVANCED REGIONAL ANESTHESIA EDUCATION PROGRAM: ONE INSTITUTION’S EXPERIENCE FROM APPRENTICESHIP TO COMPREHENSIVE TEACHING

JEAN-PIERRE P. OUANES*, DEBORAH SCHWENELG**, VINEESH MATHUR**, OMAR I. AHMED** AND MARIE N. HANNA**

Abstract

Results of recent attitude survey studies suggest that most practicing physicians are inadequately treating postoperative pain. Residents in anesthesia are confident in performing lumbar epidural and spinal anesthesia, but many are not confident in performing the blocks with which they have the least exposure. Changes need to be made in the training processes to a comprehensive model that prepares residents to perform a wider array of blocks in postgraduate practice. Here, we describe one institution’s approach to creating a standardized, advanced regional anesthesia curriculum for residents that follows the six core competencies of the ACGME. Residents received training in anatomy dissection, ultrasound-guided regional anesthesia, traditional nerve stimulation techniques, problem-based learning and simulation sessions, oral board presentation sessions, and journal club sessions. Residents kept a detailed log for their use of peripheral nerve block procedures. We have now redesigned and implemented an advanced regional anesthesia program within our institution to provide residents with experience in regional anesthesia at a competent level. Resident’s knowledge in regional anesthesia did improve after the first year of implementation as reflected in improvements between the pre- and post-tests. As the advanced regional anesthesia education program continues to improve, we hope to demonstrate levels of validity, reliability, and usability by other programs.

Conflict of interest: None.

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** MD.

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**Introduction**

Pain management is an important aspect of high-quality postoperative care. Multimodal analgesia techniques that include regional anesthesia and analgesia are essential to providing effective postoperative pain management with minimal side effects. However, results of recent attitude surveys suggest that most practicing physicians are inadequately treating postoperative pain.

Among the reasons that postoperative pain is undertreated are inadequate education in pain management for healthcare professionals and lack of adequate exposure and proficiency in peripheral nerve blocks for residents. In one national study, most third-year clinical anesthesia residents felt confident in performing lumbar epidural and spinal anesthesia. However, many are not confident in performing blocks for which they have less exposure, such as peripheral nerve blocks. Changes are needed in the training processes to enable residents to graduate with enough confidence to perform a wide variety of blocks in clinical practice.

Deficiencies in resident training have led some programs to develop innovative methods to increase their residents’ exposure to regional anesthesia and peripheral nerve block procedures. The Accreditation Council for Graduate Medical Education (ACGME) has also made attempts to improve resident education by implementing standardized education performance objectives (i.e., competencies) and establishing minimum regional block numbers for anesthesia residents.

Currently, there are no set educational standards or curricula for regional anesthesia training, but guidelines have been published for fellowship programs. Until 2009, our institution did not have a didactic educational curriculum in regional anesthesia education for residents. Since that time we have redesigned and implemented an advanced regional anesthesia program within our institution to help residents graduate with a greater proficiency in regional anesthesia techniques. This article describes our institution’s approach to resident education in regional anesthesia.

**Methods**

With the support of the department chair and protected nonclinical time given by the division chief, we embarked on a 10-month faculty development longitudinal program to help develop a comprehensive and advanced educational program. We surveyed 26 existing regional anesthesia fellowship programs in the United States and Canada and asked the faculty basic questions regarding their own institutional experience (Table 1). The goal of this survey was to develop a short list of basic block techniques that we could focus on for the start of our curriculum. Individuals from only 11 programs completed the survey. Based on the survey results, we identified the six anesthesia blocks most often performed at their institution. We also identified the average number of blocks performed and the techniques most commonly used to perform the blocks. Most of the 11 programs identified interscalene, infraclavicular, supraclavicular, femoral, Labatt or subgluteal sciatic, and popliteal sciatic as the six most frequently used blocks. The average number of blocks performed varied among the programs and ranged from 100 to 800 per year for each block, with variability based on the size of the institution and volume of surgical procedures. The common techniques used were nerve stimulators and ultrasound techniques. An extensive literature search with the help of the librarian revealed very limited information regarding didactic educational regional anesthesia programs for fellows and residents.

**Table 1**

*Survey Questions Sent to Faculty of Adult Regional Anesthesia Fellowship Programs*

1. What do you feel are the top 6 non-neuraxial blocks that are absolutely necessary for regional anesthesia fellows to learn during their year of training? (Upper and Lower extremity)
2. What is your best estimate, from your experience, of the minimal number of blocks a fellow needs to do to achieve proficiency for each of those blocks?
3. Currently, what modality/modalities are you teaching fellows to utilize (US, NS, Paresthesia, trans-arterial, loss-of-resistance, etc) for each of those 6 basic blocks?
4. How many of each block are you currently doing?

Curriculum Goals and Objectives

The newly designed advanced regional anesthesia curriculum is a one-year educational program customized with graduated responsibility for clinical anesthesia year 1 (CA1), CA2, and CA3 residents. The goals of the program are to (1) provide a standardized and advanced regional anesthesia curriculum for residents that follows the six core competencies of the ACGME (Table 2), (2) improve quality and patient safety by encouraging nontraditional training in a simulated environment, and (3) enhance communication and pain education within and between the departments of anesthesiology and surgery. The underlying focus was on improving patient-centered outcomes, quality of recovery, and patient satisfaction. The ultimate goal was to have residents graduate with greater proficiency in performing regional anesthesia by the end of their three years of training.

Table 2
Components of the Advanced Regional Education Program and ACGME Competencies

<table>
<thead>
<tr>
<th>Advanced Regional Education Program Component</th>
<th>ACGME Core Competency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anatomy dissection and workshop</td>
<td>MK, PC</td>
</tr>
<tr>
<td>Nerve stimulator workshop</td>
<td>MK, PC</td>
</tr>
<tr>
<td>Simulation sessions</td>
<td>MK, PC, ICS, P, PBL</td>
</tr>
<tr>
<td>Oral board preparation sessions</td>
<td>MK, PC, ICS, P</td>
</tr>
<tr>
<td>Journal club sessions</td>
<td>MK, PBL</td>
</tr>
<tr>
<td>Web-based lectures</td>
<td>MK, PC, ICS, P, SBP, PBL</td>
</tr>
<tr>
<td>Problem-based learning practice</td>
<td>MK, SBP, PBL</td>
</tr>
<tr>
<td>Clinical and laboratory research</td>
<td>MK, SBP, PBL</td>
</tr>
<tr>
<td>Teaching responsibilities</td>
<td>MK, PC, ICS, P, SBP, PBL</td>
</tr>
</tbody>
</table>

MK, medical knowledge; PC, patient care; PBL, practice-based learning and improvement; ICS, interpersonal and communication skills; P, professionalism; SBP, systems-based practice.

Curriculum planning and implementation

The novel educational program that our institution began allows for two fully protected education days (or “college” days) per month. Residents are subdivided into colleges (groups of 18–19 residents) in which nontraditional interactive teaching methods are used. All six ACGME core competencies are taught in this curriculum. Faculty members with expertise in regional anesthesia plan and teach advanced regional anesthesia to the residents on the college days. Most of this curriculum was adopted for the 2009–2010 academic year, with further expansion in the following years. The curriculum for the first year included the following 10 interactive sessions.

A) Anatomy dissection:

Regional anesthesia is the practice of applied anatomy. Therefore, anatomy dissection and hands-on workshops are essential components of our regional anesthesia education program. A four-station anatomy workshop moderated by regional anesthesia educators, fellows, and anatomy lab experts covered the brachial, lumbar, and sciatic plexus as well as neuraxial and paravertebral dissections. The residents were divided into three groups according to their level of training (CA1, CA2, CA3), and each group was subsequently divided into smaller groups to facilitate hands-on practice.

B) Ultrasound-guided regional anesthesia (UGRA):

UGRA became very popular in the last decade because it is thought to increase block efficacy and block duration, decrease block performance times, and improve patient safety and satisfaction10-12. We have incorporated ultrasound physics and sonography scanning into our teaching sessions. Residents practice these techniques on human and phantom gel models. The ultrasound mapping sessions provide hands-on practice with live models for the upper and lower extremity blocks.
C) Nerve stimulators and traditional techniques:

Familiarity with traditional techniques such as nerve stimulators and loss-of-resistance is encouraged despite the availability of ultrasound. We organized workshops to teach these traditional techniques by reviewing surface anatomy and identifying potential needle insertion points on live models.

D) Simulation sessions:

Simulation education improves patient safety and physician training by exposing residents to high-fidelity preclinical experiences that use advanced technology15-16. Each college of residents was divided into small groups to carry out scenarios in our well-equipped simulation center. Using high-fidelity manikins, Sim Man® 3G and HAL® S3201 Adult simulator, the groups practiced handling situations of local anesthetic toxicity, including seizure, cardiac arrest, and high-level spinal. Residents practiced other regional anesthesia scenarios, such as postoperative nerve injury, using standardized patients. Residents were given a detailed debriefing after every scenario by regional anesthesia faculty.

E) Oral board preparation sessions:

We used nontraditional classroom exercises, such as a question-and-answer format, to teach a variety of topics, including regional anesthesia in medically challenging cases, local anesthetics, and neuraxial pharmacology.

F) Journal club sessions:

The journal club part of our educational program was moderated by a regional anesthesia expert, while residents presented recently published articles related to regional anesthesia. Additionally, we have a monthly journal club for acute pain and regional residents, separate from the college day’s curriculum, in which they discuss recent literature and controversies in the field of regional anesthesia and acute pain management.

G) Web-based lectures, e-learning:

During the residents’ acute pain service rotation, daily lectures (16 lectures and four case studies) were presented by regional anesthesia faculty who cover the pain service. Advanced educational lectures in regional techniques and pain management were added every year and made available online. A Web-based program is currently developed to incorporate all of these lectures and is expected to play an important role within the curriculum.

H) Problem-based learning practice:

In problem-based learning sessions, residents are encouraged to identify defects in clinical practice and develop a strategy to solve these problems with the guidance of a dedicated faculty member. As an example, a group of residents (CA1, CA2, and CA3) with an interest in regional anesthesia identified a premature discontinuation of thoracic epidurals in the intensive care units secondary to hypotension. They took on this issue as their problem-based learning project and formulated a plan to resolve it. Others are looking at ways to facilitate block performance in everyday practice.

I) Clinical and laboratory research:

Our residents are encouraged to present their research projects at national meetings such as the annual meeting of the ASRA. Nine posters, including oral presentations, were presented by residents and fellows at the 2010 ASRA meeting; 6 presentations were made at ASRA 2011.

J) Clinical case log:

A monthly case log and passport is already used by residents rotating through the acute pain service and advanced regional rotation to ensure that the clinical exposure of residents is diverse and of high quality.

We evaluated the efficacy of this educational program by asking the residents to take a test before and after the advanced education program. Twenty-five multiple choice questions (MCQ) and an objective structured clinical examination (OSCE) pretest were given before the start of the educational program. The post-test was given one month after the last regional anesthesia teaching session. In addition, the residents were asked to provide their opinions of the program itself.
Results

Pretest and post-test results for both the MCQ and the OSCE were compared by using a paired t-test for statistical means. Post-test results were significantly improved ($P < 0.05$) across all clinical anesthesia years and for both the MCQ and OSCE (Table 3) examinations. Post-test results were also significantly improved ($P < 0.05$) across all CA years for each of the three sections of the OSCE. The residents have rated the experience of the anatomy dissection and ultrasound life-model workshop as excellent and have requested that it be repeated.

Table 3
Summary of Pretest and Post-test Means for Multiple-Choice Question Examination and Objective Structured Clinical Examination.

<table>
<thead>
<tr>
<th>Year</th>
<th>MCQ Pretest (95% CI)</th>
<th>MCQ Post-test** (95% CI)</th>
<th>OSCE Pretest (95% CI)</th>
<th>OSCE Post-test** (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8.32 (1.40)</td>
<td>16.68 (1.05)</td>
<td>31.21 (5.83)</td>
<td>69.74 (6.29)</td>
</tr>
<tr>
<td>2</td>
<td>10.86 (1.03)</td>
<td>20.32 (1.15)</td>
<td>48.09 (6.07)</td>
<td>90.32 (4.22)</td>
</tr>
<tr>
<td>3</td>
<td>12.87 (1.24)</td>
<td>22.07 (0.82)</td>
<td>57.27 (5.19)</td>
<td>93.60 (2.87)</td>
</tr>
</tbody>
</table>

CA, clinical anesthesia; MCQ, multiple choice questions; OSCE, objective structured clinical examination.
** All differences between pretest and post-test scores were significant at $P < 0.001$ for both MCQ and OSCE.

Discussion

Future advances in regional anesthesia and pain management are greatly dependent on the level of education in our residency program. In the last decade, interactive teaching has become more effective. After one year of implementation of the advanced regional curriculum, we were able to show that our new interactive educational program is superior to what it replaced. Results of the post-tests and OSCE at the end of the year showed great improvement in resident’s regional anesthesia knowledge (Table 3). Resident satisfaction with their regional anesthesia educational experience was also greatly improved.

Some barriers were encountered during the planning and implementation of our educational program. For example, the increased demand for regional anesthesiologists in private practice is making it difficult for our institution and other academic hospitals to retain regional anesthesia faculty. The recent developments in regional anesthesia alongside the required skills needed to perform UGRA restrict practice to providers who have advanced training. With a limited number of qualified regional anesthesia faculty members, it is difficult to maintain efficient clinical coverage while providing instructors to teach the regional curriculum to the residents. We overcame this problem by hiring more regional anesthesia fellowship-trained faculty in the following years.

Another constraint is that the residents in the regional anesthesia rotation do not have the autonomy to perform enough regional procedures to enhance their clinical experience. In the last two years, we have created an advanced regional anesthesia rotation in which the rotating resident was dedicated to doing regional anesthesia without being required to also providing anesthesia in the operating room. Another challenge we encountered was a culture among many surgeons at our institution to reject the use of regional anesthesia. Surgeons may believe that the quality of blocks lacks consistency or that nerve blocks interfere with the start time of surgical cases and the efficiency of the operating room. We have since facilitated the regional anesthesia process by having dedicated regional faculty members.

Additionally, implementation of a new training program for the residents does not allow for a prospective control group. It would be ideal to study resident confidence levels before and after the implementation of the new curricula. As the advanced regional anesthesia education program improves and develops, we hope to demonstrate levels of validity, reliability, and usability by other programs.
References

IMPROVED RESIDENTS’ KNOWLEDGE AFTER AN ADVANCED REGIONAL ANESTHESIA EDUCATION PROGRAM

VICENTE GARCIA-TOMAS*, DEBORAH SCHWENGE*, JEAN-PIERRE P. OUANES**, SARAH HALL* AND MARIE N. HANNA*

Abstract

Background: Although residents in anesthesia are confident in performing neuraxial anesthesia, many are not confident in performing peripheral nerve blocks. The purpose of this study was to evaluate the effectiveness of a structured regional anesthesia teaching program in a large academic medical center.

Methods: Residents participated in regional anesthesia didactics that took place in a unique resident education program scheduled during two fully protected teaching days a month. The curriculum included hands-on cadaver workshops in the anatomy lab, hands-on ultrasound workshops, hands-on nerve stimulator and surface anatomy workshops, and simulator sessions related to complications of regional anesthesia. Before beginning the formal regional anesthesia teaching program, residents completed a pretest composed of 25 multiple choice questions (MCQ) and a three-section observed standardized clinical examination (OSCE). Seven months later, approximately 1 month after completion of the regional anesthesia curriculum, the residents were evaluated again with the exact same tests. Pretest and post-test results for both the MCQ and the OSCE were compared by using a paired t-test for statistical means.

Results: Post-test results were significantly improved ($P < 0.05$) across all clinical anesthesia (CA) years and for both the MCQ and OSCE examinations. Post-test results were also significantly improved ($P < 0.05$) across all CA years for each of the three sections of the OSCE.

Conclusion: The formal regional anesthesia teaching program developed by the departmental faculty was effective in improving resident knowledge.

Conflict of Interest: None.
Introduction

As the need for adequate postoperative pain control has increased tremendously in the past few decades, the need to incorporate regional anesthesia as part of multimodal analgesia has become a necessity\(^1\)\(^-\)\(^3\). Consequently, regional anesthesia training has been identified as an area for improvement in resident education\(^4\). The paradigm in anesthesia medical education has evolved from an apprenticeship model to a competency-based training model. Recently, recommendations for education and training in ultrasound-guided regional anesthesia (UGRA) were established through a joint committee effort of the American Society of Regional Anesthesia and the European Society of Regional Anesthesia\(^5\).

The Accreditation Council for Graduate Medical Education (ACGME) has established a set of core competencies to promote the training of capable physician specialists that includes the minimum number of regional anesthesia procedures required to graduate from a residency training program\(^6\). In recognition of these needs, many anesthesia training programs are improving their teaching modules in regional anesthesia and acute pain management\(^7\)\(^-\)\(^9\).

Our institution's educational curriculum has evolved from a traditional to an interactive model that incorporates the six ACGME core competencies. Traditional teaching took the form of didactic lectures in regional anesthesia and one anatomy workshop every year. Starting in August 2009, we began to divide our residents into small groups, or colleges, that meet during two protected academic days per month in a program termed “college days.” Interactive teaching during college days includes simulation sessions; hands-on workshops; small learning groups; quality improvement projects; oral and written board exam practice; journal clubs; and training sessions in ethics, business, communications, fatigue-impairment, and conflict resolution. The Division of Regional Anesthesia and Pain Management redesigned its educational program to an interactive advanced regional anesthesia program (ARAP) based on the ACGME core competencies and incorporated the program into the residents’ college days. The instructors tested its utility on a cohort of residents using a validated tool to measure the residents’ knowledge in regional anesthesia and pain medicine before and after the curriculum change. Skills and knowledge were tested by an objective, structured clinical examination (OSCE). OSCEs used in the published medical literature have been well validated\(^10\)\(^-\)\(^14\).

We have demonstrated previously that a short, structured regional anesthesia course given to fourth-year medical students improves their knowledge and skills in regional anesthesia and pain management\(^15\). Similar education efforts through ARAP are required to improve anesthesia residents’ knowledge and skills in regional anesthesia and postoperative pain management. The purpose of this study was to evaluate whether an ARAP that uses innovative and interactive methods improves anesthesia residents’ knowledge and skills in regional anesthesia and postoperative pain management as compared to the previous traditional teaching method.

Methods

Institutional review board (IRB) exemption was obtained before initiation of the study. Anesthesiologists at Johns Hopkins developed an advanced regional anesthesia education program that was based on the ACGME core competencies and included interactive modalities. The revised regional anesthesia teaching program was conducted over a 6-month period as part of the residents’ college program. Before the beginning of the ARAP, all residents answered multiple-choice questions (MCQs; Fig. 1) and an OSCE (Fig. 2). The OSCE was given by four regional anesthesia faculty members and graded independently. The tests were repeated 7 months later, 1 month after completion of the regional anesthesia teaching program. The content of the questions and OSCE was developed by a group of regional anesthesiologists and agreed upon by consensus. The ARAP was taught to all residents [clinical anesthesia year 1 (CA1), CA2, and CA3] and consisted of: 1) Hands-on anatomy workshops with three stations that demonstrated relevant structures of brachial, lumbar, and sacral plexus. 2) UGRA stations where all residents practiced scanning the upper and lower extremity blocks on live models. 3) Simulation sessions that used high-fidelity mannequins on which
residents practiced different regional anesthesia complication scenarios, such as seizure and cardiac arrest resulting from local anesthetic toxicity and high spinal and postoperative nerve injury. After the scenarios, regional anesthesia faculty provided detailed debriefing. 4) Oral board preparation sessions and nontraditional classroom teaching that used Jeopardy game-show formats and problem-based learning sessions. 5) Journal club sessions in which residents and faculty discussed recent literature and controversies in the field of regional anesthesia and pain management. 6) Problem-based learning or evidence-based practice projects in which residents worked in small groups to identify defects in clinical practice and implement improvement projects (including regional anesthesia and pain management). Before the institution of the college days program, regional anesthesia was taught by a traditional approach that consisted of didactic and Web-based lectures and one anatomy lab workshop per year at which attendance was limited by clinical commitments.

To evaluate the effectiveness of the ARAP, we administered a post-test to the residents that consisted of the same 25 MCQs (Fig. 1) and OSCE (Fig. 2) as those given before the start of the program. The MCQs tested the same concepts as those of the pretest. The OSCE used a patient with significant comorbidities who was scheduled for shoulder arthroplasty. The OSCE was divided into three sections. The first section (OSCE A; questions 1-6) evaluated residents’ choices of anesthesia and analgesia and assessed their knowledge of potential regional anesthesia complications. The second section (OSCE B; questions7A-7F) evaluated residents’ knowledge of regional anesthesia techniques, anatomic landmarks, elicited motor response, and local anesthetic choices. In this section the residents were also evaluated on their speed and confidence. The third section (OSCE C; questions 8-11) evaluated residents’ knowledge in postoperative pain management and ability to manage postoperative challenges.

In addition, statistical means for pretest and posttest results for each section of the OSCE (A, B, and C) were compared by using a two-tailed paired t-test for dependent samples. Results were also analyzed by level of training. A P-value < 0.05 was considered significant for all analyses.

![Image of a chart](image-url)

**Fig. 1**

Multiple-choice questions.

<table>
<thead>
<tr>
<th>Date:</th>
<th>CA=</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resident Name:</td>
<td></td>
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</tbody>
</table>

Regional Anesthesia Multiple Choice Questions

A) **Choose the best Answer:**

1. Which of the following approaches to the sciatic nerve will most reliably block the posterior aspect of the Thigh?
   a. The anterior approach  
   b. Subgluteal approach  
   c. Labatt approach  
   d. Popliteal approach

2. For femoral nerve block the end point motor stimulation is?
   a. Sartorius muscle contraction  
   b. Vastus lateralis contraction  
   c. Vastus medialis contraction  
   d. Quadriceps muscle contraction  
   e. Biceps femoris contraction

3. ASRA consensus for therapeutic BID dose LMWH?
   a. Contraindicate the use of interscalene indwelling catheters  
   b. Contraindicate the use of femoral indwelling catheters  
   c. All (A&B)  
   d. None of the above

4. 65 year old male s/p prostatectomy under spinal anesthesia. Next day c/o of severe low back pain radiating down his legs. What is the most likely reason?
   a. TNS (Transient neuropathy)  
   b. Residual motor block  
   c. Epidural hematoma  
   d. Epidural abscess

5. What is your management if patients referred to in Q=4 have no other symptoms besides Back pain and legs pain?
   a. Order an MRI  
   b. Obtain neurology consultation  
   c. Order non steroidal anti-inflammatory  
   d. Order Gabapentine

6. Site of action of IVRA (intravenous regional anesthesia)
   a. At the nerve axon  
   b. At the distal Nociceptors  
   c. By retrograde diffusion of local anesthetics  
   d. By perfusing the vasa nervorum

7. Drug of choice for IVRA (intravenous regional anesthesia)?
   a. 1% mepivacaine with epinephrine 1/200k  
   b. 1% chloroprocaine  
   c. 0.5% lidocaine with epinephrine 1/200k

M.E.J. ANESTH 22 (4), 2014
8. Common complication of Lumbar Plexus block
a. Seizure
b. Retroperitoneal hematoma
c. Neuraxial block
d. Psoas abscess
9. Anatomical Landmarks for femoral nerve block are except
a. Femoral artery
b. Anterior superior iliac spine
c. Inguinal ligament
d. Quadriceps femoris
e. Inguinal crease
10. Absolute contraindication of infraclavicular block?
   a. Severe COPD
   b. Contralateral hoarseness
c. Ipsilateral congenital Horner syndrome
d. All of the above
e. None of the above
11. Nerve commonly missed in interscalene block
   a. Median
   b. Ulnar
c. Radial
d. Musculocutaneous
12. Reason for adding epinephrine to LA. For nerve blocks
   a. To prolong the duration of analgesia
   b. To detect IV injection
c. To promote density of a block
d. To reduce LA plasma concentration.
e. All of the above
13. Removal of epidural in a patient on BID doses of LMWH
   a. 12hs after last dose of LMWH.
   b. 22hs after last dose of LMWH
c. 28hs after last dose of LMWH
d. 3 days after last dose of LMWH

K-Type questions:
A (1, 2, 3). B (1, 3). C (2, 4). D (4). E (1, 2, 3, 4)
14. Surgical anesthesia of the ankle could be provided by more than one of the following?
   1. Blocking the sciatic nerve at the popliteal region
   2. Blocking the femoral nerve at the inguinal region
   3. Blocking the Saphenous nerve
   4. Ankle block
15. Block for surgical anesthesia in ORIF of RT wrist?
   1. RT interscalene block
   2. LT supraclavicular block
   3. Rt postcervical block
   4. Rt infraclavicular block
16. Common side effects of interscalene block?
   1. Recurrent laryngeal nerve block
   2. Pneumothorax
   3. Hemidiaphragmatic paralysis
   4. Intravascular injection
17. Nerves commonly missed in Axillary block
   1. Median nerve
   2. Intercostals T1-T2
   3. Axillary nerve
   4. Musculocutaneous nerve
18. Ropivacaine compared to bupivacaine
   1. Chemically similar to Bupivacaine
   2. Less motor block than Bupivacaine
   3. Less cardio toxicity than Bupivacaine
   4. Shorter onset than Bupivacaine
19. Peripheral nerve catheters for postoperative pain
   1. Induction could be with short or long acting LA
   2. Maintenance with low conc LA (0.2% Ropi)
   3. No need to add epinephrine
   4. Use multimodal analgesia
20. Subgluteal approach of the sciatic
   1. Used for below knee procedures
   2. Used for thigh procedures
   3. Used for Achilles tendon repair procedure
   4. Calf muscle contraction when used Nerve Stimulator.
21. Anatomy of Popliteal Sciatic nerve
   1. The nerve is in the popliteal fossa
   2. It consists of 2 separate nerve trunks
   3. Division of the nerve 50-100mm above the popliteal crease
   4. Peroneal division is larger than Tibial division
22. Only sensory nerves
   1. Saphenous
   2. Lat nerve of the thigh
   3. Sural
   4. Obturator
23. Combined spinal epidural can be done
   1. At T10 level
   2. In hemiplegic patient
   3. On patients taking Ticlid (Ticlopidine)
   4. On patients taking aspirin
24. Methadone
   1. Acts on different receptors than morphine
   2. Acts at the NMDA receptors
   3. Acts at alpha-2 receptors
25. Treatment of PDPH (post dural puncture headache)
   1. Hydration
   2. Epidural blood patch
   3. Caffeine
   4. Narcotics
Fig. 2

Objective structured clinical examination (OSCE).

Date: CA= _____ Residents name: ___________________

Regional Anesthesia and Acute Pain Management OSCE

Case
A 74 year old male 280 lbs (BMI=40) with past medical history of HTN and obstructive sleep apnea scheduled for RT shoulder arthroplasty. Patient and family are concerned about postoperative pain control. Labs are within normal limits. EKG showed sinus rhythm with right bundle branch block. Patient is taking (HCTZ, propranolol and MVI)

1. **What type of anesthetic would you offer to this patient?**
   a. G/A - ET tube 5 points
   b. Nerve catheter 5 points
   c. Nerve catheter + G/A 10 points Max = 10 points

2. **Will you use regional anesthesia for this case?**
   a. Yes 5 points
   b. No 0 points Max = 10 points

3. **What type of regional anesthesia?**
   a. Interscalene catheter 5 points
   b. Brachial plexus catheter 5 points
   c. Brachial plexus block 0 points Max = 5 points

4. **Will you do Brachial Plexus analgesia above or below Clavicle?**
   a. Above 5 points
   b. Below 0 points Max=5 points

5. **What are the complications of brachial plexus blocks?**
   a. Vascular puncture 2 points
   b. Epidural or intrathecal injections 2 points
   c. Pneumothorax 2 points
   d. Hoarseness (recurrent laryngeal nerve block) 2 points
   e. Ptosis(Horner Syndrome) 2 points
   f. Phrenic nerve paralysis 2 points Max = 10 points

6. **Is there any advantage in placing an interscalene catheter vs. single shot in this case?**
   a. Yes 5 points
   b. No 0 points
   c. Why 5 points Max = 10 points

7. **You decide to do an US post interscalene catheter for post operative pain control. Can you position the patient, and show me the landmark?**
   
   **7A**
   Patient Position and Sedation
   a. Lateral or semi lateral 2 points
   b. Minimal sedation or 1 mg versed 3 points Max = 5 points

   **7B**
   Anatomical Landmarks for NS
   a. Posterior border of sternocleidomastoid 2 points
   b. Interscalene grove between the anterior and middle scalene muscles 2 points
   c. Cricoid cartilage at C6 2 points Max = 5 points

   **7C**
   Appropriate NS response
   a. Deltoid muscle contraction (axillary nerve) 2 points
   b. Anterior component of arm (musculocutaneous nerve) 2 points
   c. Posterior component of arm (radial nerve) 2 points
   d. 2 points Max = 5 points

   **7D**
   Confidence and speed
   a. Confident and fast 5 points
   b. Confident and slow 2 points
   c. Hesitant 0 points Max = 5 points

   **7E**
   What type of LA, Conc and Volume will you use as a bolus in this case?
   a. 10 - 30 cc of 0.2% Ropivacaine, 0.25% Bupivacaine, 1% Lidocaine, or 1% Mepivacaine 5 points
   b. Any high conc LA 0 points Max = 5 points

M.E.J. ANESTH 22 (4), 2014
What type of L.A. Conc and rate will you order for this patient interscalene catheter?

a. 0.2% Ropivacaine 6/4/20 or 8/3/20
b. Any other

5 points

Does this patient need a monitored bed postoperatively?

a. Yes
b. No
c. Why

2 points

Max = 5 points

Patient is comfortable in the ICU but complains of hoarseness of his voice. What is the reason for hoarseness?

a. Recurrent laryngeal nerve block

5 points

Max = 5 points

What is the treatment of hoarseness in this situation?

a. Reassurance

5 points

Max = 5 points

Next morning surgeons asked you to remove the catheter so they can start the patient on lovenox (enoxaparin) 40 mg SC. BID. Will you remove the catheter?

a. Yes
b. No
c. Why

0 points

5 points

5 points

Max = 10 points

Total Points = 100

OSCE A= Questions 1-6
OSCE B= Questions 7A-7F
OSCE C= Questions 8-11

All testing materials were identical for the pretest and post-test, except that the post-test included five additional MCQs to further evaluate the residents’ pain management knowledge (MCQ 26-30). These extra questions were not included in the statistical analysis. Only residents who completed both pre- and post-tests were included in the analyses.

Additionally, the residents anonymously evaluated the anatomy and ultrasound workshops (Fig. 3). Responses to questions relating to both workshops were gathered by an ordinal data rating scale. The survey queried the residents about the value of the workshops to anesthesia training, anatomy knowledge, and future practice and about the quality, organization, and overall usefulness of both sessions. Residents were asked to pick from five responses that ranged from strongly disagree to strongly agree.
**Statistical analysis**

All statistical analyses were performed by using statistical functions included in Excel 2010 (Microsoft, Redmond, WA). Statistical means for pretest and post-test results (for both the multiple choice test and OSCE) were compared by using a paired t-test for dependent samples. Results were analyzed by level of training.

**Results**

Of 75 residents in the program, 56 completed the study (CA1=19/25, CA2=22/25, and CA3=15/25), representing nearly 75% (56/75) of our residency program. Post-test results were significantly improved ($P < 0.001$) across all CA years and for both the multiple-choice test and OSCE (Table 1). Table 3 in the manuscript (Curriculum Development for an Advanced Regional Anesthesia Education Program: One Institution’s Experience from Apprenticeship to Comprehensive Teaching) shows the pretest and post-test means for the MCQ and OSCE evaluations with the associated $P$-values by CA training years. Baseline values, as evidenced by pretest scores, were higher with increasing years of training. The difference between pretest and post-test values was significantly different across all training levels. Further examination of the different sections of the OSCE showed that post-test results were also significantly improved ($P < 0.001$) across all CA years for each section of the OSCE (Table 1).

For the eight-question survey, we collected 168 responses from the CA-1 class, 145 from CA-2, and 124 from CA-3. Residents’ evaluations for the anatomy and ultrasound workshops are shown in Figure 3. Over 90% of residents agreed or strongly agreed to all positive survey questions except for one. Only 78% of residents thought that time allotted for the anatomy lab workshop was adequate.

**Discussion**

The ARAP, which consisted of interactive and nontraditional classroom teaching, significantly improved anesthesiology resident understanding and knowledge in regional anesthesia and postoperative pain management. All residents performed better in the post-program multiple choice test and OSCE than they did on the pretests. All residents performed significantly better in all OSCE sections after the ARAP program than they had at baseline. These results might help to evaluate the interactive teaching of the ARAP and to identify areas of improvement in the teaching program.

Advancement in regional anesthesia and acute pain medicine will be highly dependent on the quality of regional anesthesia training over the next decade. In recognition of these needs and their implications, many anesthesia training programs, including ours, have developed structured regional anesthesia education that focuses on graduating residents who are competent in regional anesthesia and pain management. A group of experts in regional anesthesia, along with other experts in simulation, audiovisual technology, and anatomy, developed and organized the ARAP for our
residents. The use of multimedia, simulation, and hands-on applied anatomy provides excellent realism for improved training and teaching purposes\textsuperscript{16,17}.

In this study, we used multiple choice and OSCE pretests and post-tests as measuring tools to evaluate the residents’ knowledge gain in the program. The OSCE, which was first described by Harden et al.\textsuperscript{18}, has become a widely used and accepted method to evaluate clinical competence in various fields\textsuperscript{15,19}. The reliability and validity of the OSCE test has been well documented. It provides information about a student’s “clinical abilities that is not available through traditional testing”\textsuperscript{20}. Based on these studies, we felt that using an OSCE would accurately evaluate the clinical knowledge that the residents have gained through the ARAP.

All residents performed better in all parts of the post-program OSCE (Table 1) than they did in the pre-test. Even CA-2 and CA-3 residents (all previously exposed to traditional regional anesthesia teaching methods) had statistically significant gains in knowledge. Differences between pretest and post-test scores in all OSCE sections were significant ($P<0.001$) across all CA years and included improved knowledge in OSCE A (regional anesthesia choices and complications), OSCE B (hands-on techniques and confidence), and OSCE C (postoperative pain management and challenges). These results reflect the effectiveness of our novel teaching curriculum.

We excluded residents who were unable to complete both the pretest and post-test. Fewer senior residents (CA3) completed the post-test than residents in other classes. This difference probably resulted from CA3 residents being more likely than others to be away for activities such as job/fellowship interviews and rotations at off-site locations.

In addition to the increased knowledge demonstrated by the significant improvements in post-test scores, the unique educational modalities of the hands-on workshops were well received. Over 90% of residents agreed or strongly agreed to nearly all positive survey questions. Only 78% of residents thought that time allotted for the anatomy lab workshop was adequate. Additionally, residents have requested that the workshops be repeated periodically; some have requested to expand time allocated to cadaver dissections in the future.

One limitation of this study was that we measured improved knowledge and skills only through MCQs and an OSCE; we did not measure improved clinical outcome and number of blocks successfully performed by residents. Additionally, the specific OSCE that we used in this study was not validated. All four examiners did not evaluate the residents, and we did not assess variability between graders. Another limitation is that we used the same OSCE and MCQs for the pretest and post-test. Although the two tests were 7 months apart, this practice could limit the conclusion we can make about the effectiveness of the ARAP. However, the magnitude of the scoring differences between the pretest and post-test was so large that it is unlikely to be the result of residents recalling the answers from the pretest questions. Finally, the post-test was performed shortly after completion of the ARAP, so we do not have data on how well the information is incorporated.

Using a control group in this study composed of residents who would not attend the multiple hands-on workshops (cadaver workshops, ultrasound workshops, nerve stimulator and surface anatomy workshops) and simulator sessions would potentially put these residents at a disadvantage. We considered it best to have all residents in our training program receive the additional training in regional anesthesia.

An obstacle we faced in implementing this teaching module was that the program required a substantial commitment from the Division of Regional Anesthesia, which has only a limited number of faculty members. Hence, finding enough individuals to cover clinical duties and participate in teaching was extremely difficult. Instituting the program requires the faculty to be flexible and willing to incorporate new interactive teaching techniques. As the program is further developed, we hope to demonstrate levels of validity, reliability, and usability by other residency programs.

In summary, our findings suggest that incorporation of didactic and interactive teaching, such as hands-on cadaver workshops, live-model ultrasound workshops, simulation scenarios, and board preparation sessions, is a more effective instructional method than the traditional teaching modality. We believe that focused college days have a unique potential to substantially
improve residents’ base knowledge and technical skills in multiple clinical specialties in anesthesia as well as in other medical fields. We also believe that interactive teaching methods may be associated with clinical excellence and better learning outcomes in any clinical discipline.

References


CASE REPORTS

BACK PAIN AFTER LABOUR UNDER EPIDURAL ANALGESIA

Serpil Z. Ustalar Ozgen*, Serdar Ozgen**, Reyhan Celiker***, Feyzi Toraman****, and Nigar Baykan****

Abstract

In this case report we have discussed a parturient patient who had epidural analgesia during childbirth and then presented with back pain 50 days postpartum as well as the causes of postpartum back pain.

Keywords: Analgesia, Epidural, Pain, Back pain, Musculoskeletal Diseases, Bone diseases, Metabolic, Osteoporosis.

Introduction

Back pain, chemical backache, postdural puncture headache (PDPH), and neurological deficit may all be reported after the use of regional anesthesia in childbirth. Epidural analgesia during labour has been associated with a higher incidence of backache. Although osteoporosis associated with pregnancy and lactation is a rare condition, it causes one or more vertebral fractures with severe, prolonged back pain.

In this case report, a parturient who had epidural analgesia during childbirth and presented with back pain is discussed.

Case Report

A twenty-three year old primiparous patient at 38 weeks gestation was admitted to the hospital discharging amniotic fluid. On admission her blood pressure was 112/68 mmHg, pulse rate 74/min, \( \text{SpO}_2 \) 100, breath rate 18/min. Her body weight was 74 kg and she was 152 cm tall. The cervix was found to be 3-4 cm dilated and 60% effaced on examination. Fetal heart sounds were positive and reactive. The patient had irregular contractions. She had no previous vertebral operations nor fractures nor any other operations on her back. Epidural analgesia was planned and after patient approval, a 20G epidural catheter was inserted through an 18G Touhy needle at L4-5 level when

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the patient was 4-5cm dilated. Epidural analgesia was started using Bupivacaine 0.0625% and Fentanyl 1mcg/ml 12ml/hour. The labour lasted 3 hours and the epidural analgesia continued uneventfully throughout. At the end of labour, the epidural catheter was removed without any problems. The patient was referred to the anesthesia clinic 50 days postpartum. She was complaining of backache at rest and she could not rise up from lying without assistance. She had tenderness around her thoracic vertebrae but was comfortable in the lumbar region on examination. In her history, she had lifted a heavy bed with holding her baby in one arm. A neurosurgical examination was carried out. Other than osteoporotic changes, no pathological changes were observed at her lumbosacral and dorsal vertebra on direct radiological examination. On MRI examination, compression fractures secondary to osteoporosis were found at levels T6-L2 (being more pronounced at T6), and slight bulging was observed at L4-5. No instability was noted (Fig. 1). Her laboratory tests were within normal limits, except for a decrease in thyroid stimulating hormone, a slight anemia, an elevated alkaline phosphatase and a decrease in her ergocalciferol. (Table 1). Her parathormone was at the lowest limit of the laboratory normal level. She was assessed by physical therapy and rehabilitation.

**Table 1**

<table>
<thead>
<tr>
<th>Laboratory examinations</th>
<th>Result</th>
<th>Reference values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemoglobin</td>
<td>14.7</td>
<td>11.5-15.5 g/dl</td>
</tr>
<tr>
<td>Hematocrit</td>
<td>38.8</td>
<td>%</td>
</tr>
<tr>
<td>Platelets</td>
<td>371</td>
<td>150-400 K/mL</td>
</tr>
<tr>
<td>Thyroid peroxidase anticor-anti-TPO</td>
<td>&lt;5.0</td>
<td>0-35 IU/ml</td>
</tr>
<tr>
<td>Thyroglubin anticor-anti-Tg</td>
<td>12.87</td>
<td>0-115IU/ml</td>
</tr>
<tr>
<td>Thyroidotiron, free- FT3</td>
<td>4.84</td>
<td>2.8-7.1 pmol/l</td>
</tr>
<tr>
<td>Thyroxin,free- FT4</td>
<td>15.51</td>
<td>10.3-23.2pmol/L</td>
</tr>
<tr>
<td>Thyroid stimulating hormone-TSH</td>
<td>0.203</td>
<td>0.4-4.2uIU/ml</td>
</tr>
<tr>
<td>TSH receptor anticor-TRAK</td>
<td>&lt;0.1</td>
<td>&lt;1.0 IU/L</td>
</tr>
<tr>
<td>Calcium</td>
<td>9.8</td>
<td>8.6-10.0 mg/dL</td>
</tr>
<tr>
<td>Alkalen phosphatase</td>
<td>119</td>
<td>42-98 U/L</td>
</tr>
<tr>
<td>Vitamin D2-Ergocalciferol</td>
<td>&lt;1.0</td>
<td>2-7ng/ml</td>
</tr>
<tr>
<td>Parathormone-PTH, intact</td>
<td>15.74</td>
<td>15-65 pg/mL</td>
</tr>
</tbody>
</table>

A young, healthy puerperant who had epidural analgesia during labour and presented with back pain 50 days postpartum is presented in this case report.

Postpartum back pain may occur in up to 44% of women after childbirth. The increasing use of epidural analgesia during labour over the past 35 years has led many women and some doctors to attribute postpartum back pain to the increase in epidural analgesia. Such suggestions, if unfounded, may undermine parturients’ confidence in epidural analgesia. However, the outcome of recent, randomized studies clearly shows that epidural analgesia does not cause back pain. Concern has been expressed that epidural analgesia in labour may be associated with a higher incidence of backache. A prospective randomized trial investigating the effect of epidural analgesia on the outcome of labour in nulliparae was carried out. Epidural analgesia in labour was not associated with an increase in the prevalence or incidence of backache. In a review discussing the long term effects of analgesia in labour, it was stated that the most frequently reported maternal effects of epidural or spinal analgesia are prolonged

**Discussion**
symptoms of headache, backache and neurological sequelae. Prospective studies have not confirmed any causal relationship between epidural analgesia and backache. Neurological complications are five times more common after childbirth itself than after regional nerve blockade.

Back pain, chemical backache, PDPH, and neurological deficit may all be reported after regional anesthesia in childbirth. Back pain is common during pregnancy but epidural analgesia during labor does not increase the incidence of long-term back pain.

Low-back and buttock pain is a common complaint during pregnancy and the postpartum period. In a study reviewing eight postpartum sacral stress fractures it was recommended that sacral fracture during pregnancy and the postpartum period should be considered as a diagnostic possibility. Pregnancy and lactation-associated osteoporosis (PLO) is an uncommon condition characterized by the occurrence of fracture(s) during late pregnancy or the puerperium. The aetiology is uncertain and its management and natural history is poorly defined. PLO is therefore associated with significant morbidity, a high prevalence of recognized risk factors for osteoporosis and a risk of recurrence in subsequent pregnancies. Women with a positive family history of osteoporosis or low trauma fractures may be susceptible to PLO. PLO should be considered when back pain occurs during pregnancy and/or lactation as it can lead to vertebral or peripheral fractures.

The onset of idiopathic osteoporosis after delivery is called “Post-Pregnancy Osteoporosis” (PPO). Back pain and vertebral collapse are the most frequent features and individuals with back pain during, or immediately after, pregnancy are suspected of PPO. This disease usually occurs in the first pregnancy but does not recur. However, the mechanisms of the disease remain to be elucidated. In the first weeks of pregnancy, the calcium intestinal absorption rises and reaches a maximum in the last trimester. Hypercalciuria can be observed until lactation is stopped. During lactation, calcium that is present in maternal milk, results from the lowering of maternal calcium excretion and an increasing of bone resorption. Plasma 1,25 (OH)\textsuperscript{2} D\textsuperscript{3} levels increase two-fold in early pregnancy due to high placental 1-alpha-hydroxylation activity. These levels remain high until delivery and decline to normal values during lactation. Estrogen, prolactin and placental lactogen, which are involved in calcium absorption, increase at the same time. Normal or even low levels of parathyroid hormone (PTH) can be detected during pregnancy. In exceptional circumstances the abovementioned changes can lead to generalized or regional osteoporosis. It is suggested that in patients with post-pregnancy osteoporosis, there may have been a transient failure of the usual changes in calcitropic hormones such as 1,25-(OH)\textsubscript{2}D, calcitonin and parathyroid hormone (PTH) to prepare the maternal skeleton for the stress of childbirth. PPO presents in late pregnancy or within 3 months postpartum. Common criteria for PPO include back pain, spinal fractures, late diagnosis of the condition, occurrence within the first pregnancy or during lactation, loss of height, low bone density, pre-existing osteopenia and where the patient’s mother is osteoporotic. There is some recovery of bone mass over time. Calcium, active vitamin D analogues and anti-resorptive agents (biphosphonate or calcitonin) are the suggested therapies.

**Conclusion**

Postpartum back pain has several causes one of which has been stated as epidural analgesia. Osteoporosis due to pregnancy and lactation is a very rare condition but has to be suspected when back pain or vertebral fractures occur during this period. In this case report we discuss a patient who was admitted to hospital with back pain thought to be caused by epidural analgesia but who was instead found to have vertebral fractures due to osteoporosis.
References

PULMONARY ARTERY RUPTURE IN A PATIENT RECEIVING AN ORTHOTOPIC HEART TRANSPLANT AFTER TOTAL ARTIFICIAL HEART EXPLANT

KOICHI NOMOTO*, MENACHEM M. WEINER**
AND ADAM EVANS***

Abstract

Our case illustrates a patient who suffered a pulmonary artery rupture despite previous total artificial heart implantation and replacement with orthotopic heart transplant. Pulmonary artery rupture during or following cardiac surgery has been reported to occur due to both pulmonary artery catheter use and surgical technique. Our case is the first to demonstrate the occurrence of this complication in the total artificial heart patient population.

Conflict of interest: none.

Sources of financial support: Intramural departmental funding.

Introduction

Pulmonary artery (PA) rupture is well-recognized and devastating complication that can occur during or following cardiac surgery. The occurrence of PA rupture in a patient who had an orthotopic heart transplant and had previously undergone total artificial heart (TAH) implantation has not been previously reported.

Case Report

A 55-year-old male with history of infective endocarditis, congestive heart failure, hypertension, chronic kidney disease status post re-operative mitral valve replacement, aortic valve replacement and tricuspid valve repair complicated by recurrent perivalvular leakage of the mitral and aortic prostheses, underwent TAH implantation. (SynCardia Systems, Inc, Tucson, AZ). Three months later he was deemed a candidate for heart and kidney transplantation.

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A suitable donor was identified and he was admitted to the cardiothoracic ICU with a femoral pulmonary artery catheter (PAC) after combined orthotopic heart and kidney transplant and explant of TAH. An intra-aortic balloon pump was placed in the operating room to support end-organ perfusion and was discontinued on POD 2. Continuous veno-veno hemodialysis was initiated on POD 3. The tip of femoral PAC was located at the right main PA confirmed by daily chest X-ray, and was removed on POD 4.

On POD 5, he was successfully extubated to nasal cannula in the morning, but refused to take anything orally. In the evening, a nasogastric tube was placed and associated with mild coughing during the maneuver. This was complicated by sudden onset of increased mediastinal tube output (>1L) and hemodynamic instability. He was emergety intubated and aggressive resuscitation maneuvers were initiated. Transesophageal echocardiogram (TEE) performed immediately at the bedside confirmed the diagnosis of cardiac tamponade. He was taken to the operating room emergently and underwent re-exploration with cardiopulmonary bypass. The bleeding source was identified from a 1cm hole at the left main PA distal to the transplant anastomosis and repaired via pericardial patch. He was transferred back to the ICU in critical but stable condition on high doses of pressors and inotropes.

On POD 7, he developed acute liver failure that required maximum doses of multiple inotropes and pressors. Extracorporeal membrane oxygenation was placed at the bedside in an attempt to salvage the situation. On POD 10, care was withdrawn after multiple discussions of his poor prognosis. His family members refused autopsy.

Discussion

Our patient developed acute postoperative shock from massive bleeding following nasogastric tube placement. The differential diagnosis for the acute onset of shock included aortic dissection, cardiac tamponade, hypovolemia, left and/or right ventricular dysfunction, valvular dysfunction, intra-cardiac thrombus or vegetation and pulmonary thromboembolism. TEE in the ICU setting has been increasingly used to aid diagnosis and management of patients with acute hemodynamic instability. Wake et al. published a retrospective review of post-cardiac surgery patients who received urgent TEE. They indicated that in only 41.5% of cases the presumed clinical diagnosis agreed with the TEE diagnosis. Furthermore, clinical management was changed as a result of TEE findings in 58.5% of patients. If the change in management was a surgical intervention, mortality was significantly lower than pharmacological therapy.

The pulmonary artery catheter (PAC) has been widely used as a diagnostic and hemodynamic monitoring tool since it was first introduced in 1970. However, several studies have demonstrated that the PAC does not improve outcome and is prone to various complications. PA rupture is probably the most disastrous complication associated with the use of PAC. The incidence of PA rupture is 0.01-0.47%, but the mortality rate is 50-75%. The initial presentation may be massive pulmonary hemorrhage, subtle cough with minimal hemoptysis, or may even be totally asymptomatic. Survivors of an initial episode of hemoptysis might develop a pulmonary artery false aneurysm (PAFA) where the tip of PAC was located. Delayed pulmonary hemorrhage occurs in 30-40% of cases of a PAFA induced by PA rupture. This recurrence can be fatal in nearly all cases. Re-bleeding can occur from 2 weeks to 7 months after the initial event. However, PAFA has also been reported to resolve spontaneously. Thus, the incidence of PAFA and PA rupture is probably underestimated since hemoptysis episodes or radiologic infiltrations associated with PAC use are not fully investigated.

The PA rupture in our case was in the left distal PA despite daily chest X-ray confirmation of the tip of PAC located at the right PA. The left PA could have been predisposed to injury from previous PAC use or adhesions from prior surgeries. The coughing during nasogastric tube placement increased his intrathoracic pressure. This was subsequently complicated by PA rupture and cardiac tamponade. The patient could have developed left main PAFA induced by previous PAC placements into left main PA from his two prior cardiac surgeries. On the other hand, one might argue that the surgical technique was associated with PA rupture.
Implantation of a TAH removes the native ventricles and ativoventricular valves but leaves remnants of the atria, pulmonary artery and aorta for anastomoses. However, this is unlikely as the perforation site was beyond the anastomosis area of any of the previous surgeries.

The TAH has been approved by the Food and Drug Administration as a bridge to transplantation since 2004 and for destination therapy since 2012. With expanded indications for its use, the frequency of implantation is expected to rise. Thus, familiarization with the device and complications that can arise is important. Complications that have already been published include compression of the vena cavae and pulmonary veins. This is the first report of a PA rupture following implantation and then explantation of a TAH.

In conclusion, our case illustrates a patient who suffered a PA rupture following previous TAH implantation and replacement with orthotopic heart transplant. Since PA rupture is a potentially iatrogenic and fatal complication of PAC, the use of PAC should be judicious and limited by proper patient selection. Furthermore, one must remain vigilant to this complication in the TAH patient population.
References


ANESTHESIA CHALLENGE IN DENTAL ABSCESS INDUCED TRISMUS: A CASE REPORT

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Introduction

Trismus is the inability to normally open the mouth. Inflammation of soft tissue around impacted third molar tooth is the most common cause of trismus. Other causes include tetanus, inflammation of muscles of mastication, peritonsillar abscess, temporomandibular joint disorders, as a temporary side effect of many stimulants of the sympathetic nervous system and some recreational drugs. Trismus is an anesthetic challenge particularly for airway management. If general anesthesia is induced, difficult ventilation and/or intubation may lead to morbidity or mortality 1-5. We present the case of a patient with a trismus who was in need of incision and drainage and tooth extraction. The case report has been approved for publication from the IRB (HMC, DOHA, QATAR).

Conflict of interest: None.

Sources of financial support: None.

Case scenario

A 44 years old patient had a trismus because of dental abscess. The patient was scheduled for incision and drainage (I&D) and tooth extraction under general anesthesia. The huge abscess was extending into left submandibular area, left cheek and left half of floor of the mouth which was indurated with a limited mouth opening of less than 1 cm. ETT was expected to be difficult, therefore, remifentanil infusion plus local xylocaine adrenaline were successfully used to allow perfect abscess drainage. Dental extraction was delayed to be done under local anesthesia at another date. The patient was saved the risk of general anesthesia and difficult airway.

Discussion

A 44 years old male patient was admitted through HMC Emergency Department due to a submandibular swelling of the left side of the neck (Figure 1). The swelling had been progressively

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increasing in size over the last 4 days. Symptoms started with toothache in the left side with difficulty and pain when swallowing, but there was no breathing difficulty. Examination showed that a trismus with a small mouth opening of less than 1 cm, and neck swelling involving submandibular, sublingual and submental area on the left side with fever of 38.5°C. Orthopantamogram (OPG) x-ray showed a decayed bed of 3.7 and 3.8 tooth (Figure 2). The case was diagnosed as Ludwig angina of dental origin. An emergency abscess incision and drainage and tooth extraction under general anesthesia were planned. The anesthesiologist described the risks of general anesthesia and airway management to the surgeon and the patient.

In the present case, there were no respiratory symptoms which most probably exclude upper airway involvement. In other situations when an upper airway involvement or deep abscess near big vessels in the neck that needs careful drainage, securing airway with a cuffed endotracheal tube is recommended. In such cases, awake flexible fiberoptic nasal intubation under local anesthesia is the safest way to secure the airway before induction of general anesthesia. When mouth opening is so limited, it is difficult to advance laryngeal mask airway, the blade of McIntosh laryngoscope, glidescope, Bullard scope or Bonfils retromlar scope. As the surgeon is operating on the mouth, it is preferable to resort to nasal intubation. Unfortunately, the flexible fiberoptic intubation was not available. Likewise, because of limited mouth opening as well as hard floor of mouth, general anesthesia was excluded. The problems of general anesthesia included difficult airway maintenance as well as difficult intubation. Repeated trials could end with cannot intubate cannot ventilate life threatening problem. Rupture of the abscess into the oral cavity could compromise the airway or pollute the lungs with pus. Local abscess examination showed a stretched skin over the cheek. Therefore, the anesthesiologists raised the idea of abscess incision and drainage using local anesthesia and remifentanil analgesic sedation. The decrease in abscess size would release pus tension and decrease the chance of abscess rupture inside the mouth. This possibly would help mouth opening and decrease hardness of the floor of the mouth. Thereafter, general anesthesia could be induced under better conditions with nasal intubation. Fortunately, the surgeon and the patient were cooperative. The patient was monitored with standard monitors and an oxygen nasal catheter and end-tidal carbon dioxide catheter were applied. Remifentanil infusion was started and titrated according to the patient’s respiratory rate to be between 10 and 15 breaths/minute, pain level and sedation score. Four millilitres of 2% xylocaine with adrenaline were injected by the surgeon at skin incision site. With this remifentanil/xylocaine technique, the surgeon could incise, drain, dissect deep tissue planes and fix a drain at the end. The patient was happy and smiling during the procedure, with normal SpO2. Antibiotics and analgesics were prescribed after the operation and the patient was discharged home after a few days. Another appointment for tooth extraction under local anesthesia was arranged.

Local anesthesia is not so efficient in the presence of pus because of acidotic pH. Therefore, a potent analgesic is needed to augment the effect of the local anesthetic to allow deep tissue dissection. Remifentanil is a strong ultra-short acting mu-agonist which has been used for analgesia and sedation as well as a component of balanced anesthesia. It has also been used as a sole analgesic for patient controlled analgesia during labor. With proper dose titration and careful monitoring of respiratory rate, oximetry, end tidal carbon dioxide and talking to the patient, remifentanil could be used safely. These precautions are important in similar difficult airway cases to avoid respiratory depression. In the present case, naloxone
0.4 mg mixed with normal saline up to 10 ml, was prepared to be used in case of unintentional respiratory depression, however, it was not needed. The sedative effect of remifentanil is mild and patients can answer questions during the procedure. There is no cumulative effect when remifentanil is used. Remifentanil has been used to supplement multiple loco-regional anesthetic techniques. In the present case, the abscess was successfully drained using local anesthesia and remifentanil analgesic sedation. Due to the severe trismus, it was not possible to remove the decayed tooth bed. Postoperatively the patient was treated with i.v. antibiotics for the following 4 days and then discharged with marked improvement. The swelling completely subsided and mouth opening was more than 2 cm. In the OPD department, after complete recovery, the decayed tooth bed was removed under local anesthesia. Reviewing the literature, we could not find a similar case report. This anesthetic technique and the two stage surgery can be used for similar cases, and can be the subject of a prospective study.

**Conclusion**

In cases of trismus caused by a rather superficial dental abscess with no airway involvement, we recommend the use of this two stages procedure. The first stage is to perform incision and drainage under local anesthesia and remifentanil infusion and the second stage would involve dental extraction under local anesthesia at a later date. This definitely saves the patient the risk of morbidity or even mortality.
References

ERRATUM

The name of the co-author: Dr. Fouad Souki should appear as Souki F instead of Souki M in the following article, published in Vol. 21, No. 6, October 2012 issue:

NALOXONE VERSUS METOCLOPRAMIDE FOR THE TREATMENT OF ESTABLISHED POSTOPERATIVE NAUSEA AND VOMITING IN PATIENTS FOLLOWING GENERAL ANESTHESIA WITH FENTANYL SUPPLEMENTATION - PILOT STUDY -

Dabboos A*, Souki F**, Baraka A*, Jabbour-Khoury S*

Vol. 21, No. 6, October 2012
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