ANESTHESIA-RELATED COMPLICATIONS IN CHILDREN

N.P EDOMWONYI [*], I.T EKWERE [*],
R. EGBEKUN[*] AND B. ELUWA[*]

Summary

Background: Careful preoperative assessment and adequate planning of an appropriate anesthetic are the cornerstones safe pediatric anesthetic practice. A prospective study was carried out in pediatric surgical patients to identify and quantitate both intra-operative and post anesthesia recovery room complications, management and outcome.

Methods: Two hundred and seventy children, aged day 1-16 years who had surgery over twelve months period were recruited in the study. There were 151 males (56%) and 119 females (44%). There were 15 neonates (5.5%), 69 infants below 1 year (25%), 99 (36.7%) toddlers and younger children (1-5 years); older children >5 years were 87 (32.2%). Anesthetists managing the patients were free to use drugs and technique they considered appropriate for each patient. A standardized form was used to collect patient's details, type of surgery, technique of anesthesia, duration of anesthesia and surgery. The incidence of intra-operative and post-anesthesia recovery room complications was determined.

Results: Twenty five intraoperative complications were recorded in 14 (5.1%) patients while forty postoperative complications were recorded in 25 (9.25%) patients.

The incidence of intraoperative complications was 9.3% while that

* Dr.
From Department of Anaesthesia University of Benin Teaching Hospital.
Correspondence: Dr. NP Edomwonyi, Department of Anaesthesia, U.B.T.H, P.M.B 111, Benin City, Edo State, Nigeria.

of postoperative complications was 14.8%. There were no statistically significant differences.

P = 0.0635, Odds ratio = 0.5867, 95% CI: 0.3449 – 0.9981. Intraoperative adverse events were mainly cardiovascular and respiratory. After cardiovascular complication, pain was the second commonest postoperative complication observed in the recovery room. Occurrence of complication was not related to ASA physical status but the outcome of management of complications was directly related to ASA status. Three preterm infants weighing 1.6 kg, 1.9 kg and 2 kg respectively were transferred to Intensive Care Unit for ventilatory support. Neonates and infants < below 12 months old had the highest rate of adverse events both intraoperatively and in the postanesthesia recovery room. There were two cases of cardiac arrest. Mortality rate was 0.34%.

Conclusion: Preterm infants are more prone to developing respiratory complications. Anesthesia-related morbidity and mortality can either be minimized or avoided with early identification and prompt management of any complication.

Keywords: Pediatric Anesthesia; complications, intraoperative, postanesthesia, recovery room, outcome.

Introduction

Major differences in anatomy and physiology in the small infant have important consequences in many aspects of anesthesia. The physical disparity between the adult and child diminishes at 10-12 years of age although major psychological differences continue till adolescence. Pediatric patients differ in their drug requirements because of their smaller body size, differences in body composition and handling capacity of drugs. Usually dosages are based on body weight, because it correlates so intimately with body water compartments.

Pediatric anesthesia morbidity and mortality in the perioperative period has been studied by Cohen et al[1]. An incidence of 35% was reported by the same author. In another multicenter study, complications

related to anesthesia in infants and children were also reported[2]. A study carried out in Nigeria revealed an incidence of 10% adverse events in pediatric surgical emergencies[3].

The purpose of this study is to identify both anesthesia-related and postanesthesia recovery room complications in pediatric patients, management and outcome.

Patients and Methods

After approval by Research Ethics Committee of the University of Benin Teaching Hospital (UBTH), children between the ages of day 1 and 16 years who had mainly elective surgery were included in the study. It was a prospective study over a period of twelve months.

Anesthetists in the Department were free to use drugs and techniques they considered appropriate for each patient. The practice of having a consultant-anesthetist or senior registrar as the head of anesthetic team has since gained popularity in our center. A standardized form was used to collect data. The data included age, sex, ASA status, premedication indication and type of surgery, technique of anesthesia, induction agents and agents used for maintenance of anesthesia, analgesics, status of surgeons and anesthetists, intraoperative and recovery room complications, management and outcome.

In the recovery room, the unconscious patients were nursed in the lateral position. Standard observations included conscious state, colour, respiration, pulse and blood pressure. Patients were discharged to the ward 45 minutes after arrival and with stable vital signs. In case of any complication, the attendant anesthetist was notified and prompt action taken to assess and manage accordingly. Those patients who would benefit from intensive care management were transferred to Intensive Care Unit after adequate stabilization.

The data was entered into Excel spreadsheet and presented as frequency and percentages. Statistical analysis was done using Instat Graph Pad tm. $P < 0.05$ was considered statistically significant.

Results

A total number of 270 pediatric patients were included in the study (94.4% elective cases, 5.6% emergencies). There were 15 neonates (5.5%), 1-12 months – 69, 99 young children (1-5 years), 10-16 years – 48 (Table 1).

Table 1

Age distribution of patients

Age	Female	Male	Total
1 day – 1 month	9	6	15
1 month + –12 months	28	41	69
1 year + –5 years	38	61	99
5 years + –10 years	17	22	39
10 years + –16 years	27	21	48
TOTAL	**119 (%) (44)**	**151 (56)**	**270**

Table 2 shows distribution of patients in relation to ASA status. 88.9% patients had general anesthesia.

Table 2

Distribution of patients in relation to ASA status

ASA status	No.
ASA 1	196
ASA 2	52
ASA 3	19
ASA 4	2
ASA 5	1
Total	**270**

Table 3 shows the distribution of surgical procedures.

Table 3

Distribution of Surgical Procedures

Surgical Procedures	No.	Percent
1. General Surgery	148	54.8%
2. Orthopedics	19	7.03%
3. ENT	50	18.5%
4. Maxillofacial	25	9.25%
5. Ophthalmic	20	7.4%
6. Cardiothoracic	8	3%

TOTAL	**270**	**100%**

Table 4 shows choice of techniques of anesthesia.

Table 4
Choice of Techniques of Anesthesia

Technique	No.	Percent
1. General anesthesia	240	88.9%
2. General anesthesia with caudal block	12	4.4%
3. Subarachnoid block	3	1.1%
4. General anesthesia with local infiltration (using plain bupivacaine hydrochloride 0.25%)	15	5.5%
TOTAL	**270**	

Table 5 shows distribution of complications/frequency. Total frequency of complications recorded was 65.

Table 5
Intra & Postoperative frequencies of complications

Complication		System	Frequency	Total
Intraoperative Complications	Bradycardia	CVS	5	18 (27.7%)
	Tachycardia		5	
	Hypotension		3	
	Hypertension		1	
	Dysrrhythmia		1	
	Cardiac arrest		1	
	Bronchospam	RS	3	7 (10.8%)
	Laryngeal spasm		1	
	Hypoventilation		2	
	Apnoea		1	
Postoperative Complications	Prolonged unconsciousness	CNS	3	12 (18.5%)
	Restlessness		1	
	Pain		5	
	Shivering		3	
	Tachycardia	CVS	16	20 (30.8%)
	Hypotension		2	
	Hypertension		1	
	Hemorrhage		1	
	Hypoventilation	RS	2	6 (9.23%)
	Respiratory arrest		1	
	Laryngospasm		1	
	Bronchospasm		2	

Vomiting	GIT	1	2
Nausea		1	(3%)
		60	

Twenty five intraoperative complications were recorded in 14 (5.1%) patients while forty postoperative complications were recorded in 25 (9.25%) patients. The incidence of intraoperative complications was 9.3% while that of postoperative complications was 14.8%. There were no statistically significant differences. P = 0.0635, Odds ratio = 0.5867, 95% CI: 3449-0.9981. A combination of two or more complications was observed in some patients. Majority of patients that had complications were classified ASA 1.

The intraoperative adverse events were mainly cardiovascular (27.7%) and respiratory (10.8%) (Table 5). With regard to cardiovascular complications in the intraoperative and postoperative periods, there were no statistically significant differences. P = 0.1205. Odds ratio = 2.571, 95% CI: -0.8812-7.504 using approximation of Wolf. The incidence of respiratory complications in the intraoperative and postoperative periods was also similar, no statistically significant differences. P = 0.2207, Odds ratio = 2.204, 95% CI: 0.6433-7.549.

Infants less than 1 month old had a higher incidence of adverse events 26.7% both intraoperatively and postoperatively respectively (Figs. 1 and 2). The adverse events observed in the neonates and infants mainly occurred at induction of anesthesia.

Figure1: Age distribution of patients wi intraoperative complications

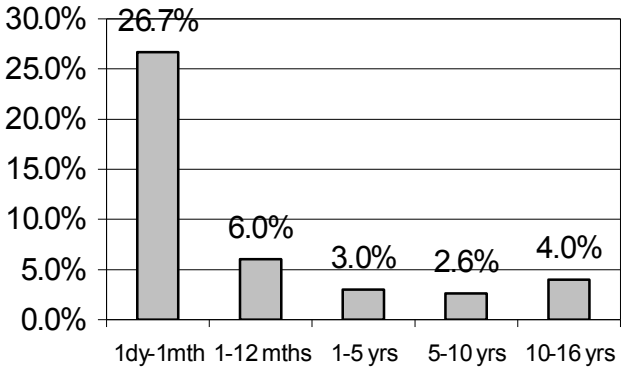
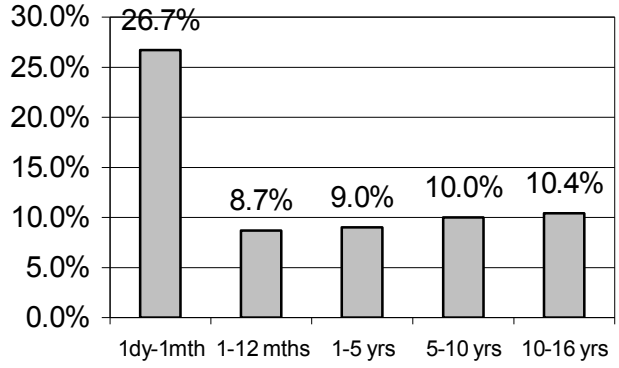


Figure2: Age distribution of patients with post- operative complications



There was 1 case of cardiac arrest at induction and one during the intraoperative period. A 3-year old child who presented with inhaled foreign body for tracheostomy developed cardiac arrest. The second case of cardiac arrest was a 4 years old male classified ASA 5, he presented with severe respiratory distress due to massive empyema of the anterior neck and upper thorax. Oxygen saturation was <80% despite

administration of 100% oxygen. He had emergency tracheostomy. Performing a tracheostomy and insertion of tracheostomy tube were very difficult for the ENT surgeon. The patient developed cardiac arrest and resuscitation was unsuccessful.

Complications occurring in the postoperative period were mainly cardiovascular (30.8%) and central nervous system (18.5%), respiratory complications (9.23%) and G.I.T (3%) (Table 5). Three patients weighing 1.6 kg, 1.9 kg and 2 kg were transferred to the Intensive Care Unit following either hypoventilation or respiratory arrest in the recovery room. All were preterms infants and all females. One was a 17 day-old female weighing 1.6 kg for congenital umbilical hernia repair. The second was a 34 days old female, weighing 1.9 kg with Hirschprungs disease for colostomy. And the third case was a 2 day old female, weighing 2 kg for exploratory laparotomy with multiple congenital anomalies.

More than 80% of the patients were anesthetized by a consultant-anesthetist and a senior registrars. About 90% of the cases were done by consultant-surgeons and the other 10% by senior registrars.

Discussion

In order to reduce the morbidity and mortality associated with pediatric anesthesia, the anesthetist should have a sound knowledge of the physiologic, anatomic and pharmacologic peculiarities of each developmental stage of childhood.

Majority of the children in our studied group were healthy, with no preoperative medical diseases. Our study showed higher incidence of complications in infants less than 1 month of age both intraoperatively (26.7%) (Fig. 1) and in the postanesthetic recovery room (26.7%) (Fig. 2). They were mainly cardiovascular and respiratory complications. A similar observation was made by Cohen et al[1] in their study.

Adverse events observed in neonates less than 1 month mainly occurred at induction of anesthesia. There was no direct relationship between ASA physical status and the incidence of perioperative

complications, but the outcome of management was directly related to ASA status.

Standard monitoring is essential in pediatric anesthesia care particularly for early detection and prevention of dangerous complications such as bradycardia, hypotension, hypoxia and adverse temperature changes. The hallmark of pediatric anesthesia has always been the precordial stethoscope because it allows constant monitoring of breath sounds, along with the heart sounds, rate and rhythm. Changes in clinical status happen quickly in the newborn with only subtle signs heralding serious alterations in the patient's clinical status.

Difficulty of intravenous cannulation is sometimes encountered especially in the preterm neonates, overweight babies and when most peripheral veins had been ruined from withdrawal of blood sample for laboratory investigations and intravenous therapy. This problem was sometimes solved with the help of pediatricians or rarely the surgeons who perform venous cut downs.

The commonest respiratory problems observed in this study were bronchospasm, laryngospasm, hypoventilation and apnea. Upper respiratory tract infection (either due to viral or bacteria) is common in pediatric age group. The two cases of bronchospasm were treated with administration of 100% oxygen and intravenous aminophylline. Three preterm infants weighing 1.6 kg, 1.9 kg and 2 kg respectively, were transferred to the Intensive Care Unit for ventilatory support. Patients with upper respiratory tract infection are usually not accepted for elective surgery. This is the commonest cause of cancellation of pediatric cases.

Children aged less than 1 year appear to have an increased incidence of airway complications as do those anesthetized by less experienced anesthetists and those undergoing airway surgery[4,5]. Tracheal intubation may also increase the likelihood of an intraoperative respiratory event but the reported incidence of these complications varies considerably. In Cohen and Cameron's study[1], cough, laryngospasm, bronchospasm and decrease in oxygen saturation were reported to be increased 2-7 times in

children with upper respiratory tract infection undergoing anesthesia and by 11 times if intubation of trachea was required[4].

A major concern for all anesthetists is when is it safe to anesthetize the child with an upper respiratory tract infection[6]. A running nose of recent onset, pyrexia or abnormal physical signs in the chest, are reasons to defer elective surgery. If the surgery is urgent, the anesthetist must be aware of increased risk of bronchospasm[7]. Cardiovascular insability in the form of tachycardia, bradycardia and hypertension can be due to pain, hypoxia, hypercarbia and hemorrhage.

Complications arising at induction of anesthesia in neonates and small infants in our study, were mainly respiratory and cardiovascular. They may manifest as apnea, bronchospasm, laryngospasm, cyanosis, bradycardia and cardiac arrest. These are likely to be due to stimulation of the larynx during laryngoscopy and tracheal intubation at light planes of anesthesia. Neonates and infants have very active airway reflexes and therefore require adequate depth of anesthesia for laryngoscopy and tracheal intubation. The preterms infants are more prone to developing postoperative respiratory complications as evidenced by our study. In neonates, if bradycardia is not promptly treated with 100% oxygen, they readily develop hypoxic cardiac arrest. Hypoxia and dysrrhythmia are the commonest causes of cardiac arrest in neonates and infants. Neonates and infants have high oxygen consumption 7 mg/kg BW as against that of adult 3 ml/kg BW. The period of laryngoscopy and intubation should be as brief as possible so as to prevent dangerous level of oxygen desaturation. Cyanosis is one of the early signs that herald serious complication in newborns and infants. Cyanosis in this age group is reliable because they have high hemoglobin level.

In order to avoid or minimize these complications occurring at induction to the barest minimum, a consultant anesthetist or an experienced anesthetist must always be in attendance to handle difficult cases. The practice has gained popularity in our center. This recommendation is born out of past experiences. Our study showed that consultant-anesthetist was in attendance during anesthesia and surgery for

about eighty percent of cases.

The anesthetist is responsible for fluid selection as well as determining the rate at which the fluid is administered. This is important in order to provide adequate fluid maintenance, prevent hypovolemia and subsequent hypotension. Intravenous fluid administration is calculated on weight and hourly basis as maintenance and replacement of fluid is based on blood loss. Adequacy of fluid therapy is judged by clinical signs and urine output. Replacement of blood is considered when there is blood loss of more than 5%-10% of blood volume. A controlled infusion set (e.g. Pedatrol, Buretrol) must be used to administer fluids in suitable aliquots. An infusion pump should be used for infants to prevent sudden accidental infusion of large amounts.

One of the problems of pediatric anesthesia is the control of body temperature particularly in the neonate and in small babies. It is thought that babies have poor temperature regulating mechanisms and because of their large body surface area compared to their weight, they tend to loose heat to cold surroundings[8,9]. Anesthesia, because of its depression on metabolism and dilatation of cutaneous vessels, tends to cause a progressive fall in body temperature[10,11]. This effect is worse in children and consequently there is tendency to hypothermia. Mean body core temperature of infants and children undergoing prolonged surgery tends to decrease because heat loss often exceed heat production[12]. Children who are hypothermic after operation tend to shiver, as non-shivering thermogenesis is largely replaced by shivering at about 1 year of age[13]. Measures taken to prevent hypothermia are the use of electric heating blanket, head wraps, warming of intravenous infusion and blood, and by switching off the air conditioner in the theatre.

In the recovery room, pain was treated with opioid analgesics after excluding other causes of crying and discomfort. Our study showed a similar finding. The presence of pain implies inadequate analgesia following surgery. There have been a number of myths and misunderstandings related to pain in children which has led to historically inadequate treatment of pediatric pain[14]. Many anesthetists express

profound fear about the use of opioids in children because of the complication of respiratory depression.

It has been recognized that infants and children require adequate pain management and if not received may actually adversely affect patient outcome[15]. Age-appropriate pain assessment is essential and both subjective and objective assessment tools may be utilized depending on patient age and clinical status. Many pain assessment scales have been develop to assess pain in children[16]. The most reliable form of pain assessment is self-report.

Infants less than 1 month old have the highest rate of adverse events both intraoperatively and in the recovery room. The overall mortality rate of 0.4% compared to 35.5%[15] and 60%[16] from earlier reports, is no doubt an improvement in the developing society with all the limitations[17,18,19.20].

Conclusion

The cornerstones of safe pediatric anesthetic practice include: careful preoperative assessment and optimization of patients, strict adherence to the ideal requirements of pediatric anesthesia and the presence of an experienced senior and dedicated anesthetist.

Acknowledgement

We would like to thank the staff in the Post Anaesthesia Recovery Room for their co-operation and also Uwadiae Ima-Edomwonyi (a-600 level Medical Student) for his assistance in preparing this manuscript.

References:

1. COHEN MM, CAMERON CB, DUNCAN PG: Paediatric Anaesthesia morbidity and mortality in the perioperative period. *Anesthesia Analgesia*; 7:160-7, 1990.
2. TIRET L, NIVOCHE Y, HATTON F, DESMONTS JM AND VOURC'H G: Complications related to Anaesthesia in infants and children. A prospective survey of 40240 Anesthetics. *Br J Anaesth*; 61:263-269, 1988.
3. BAMGBADE OA, SOYANNWO OA, SANUSI AA: Anaesthesia for Paediatric Surgical Emergencies in Ibadan. *Afr J of Anaesth and Intensive Care*; 3:35-37, 1997.
4. COHEN MM, CAMERON CB: Should you cancel the operation, if the child has an upper respiratory tract infection? *Anesth Analg*; 72:282-288, 1991.
5. SHREINER MS, O'HARA I, MARKAKIS DA, POLITIS GD: Do children who experience laryngospasm have an increased risk of upper respiratory tract infection? *Anesthesiology*; 85:475-480, 1996.
6. TAIT AR, REYNOLDS PI, GUTSTEIN HB: Factors that influence an anesthesiologist's decision to cancel elective surgery for the child with an upper respiratory tract infection. *J Clin Anesth*;7:491-9, 1995.
7. ANNEKE E.E: In *Basic Consideration of Paediatric Anaesthesia*. 1st edition. WFSA Manual 1992; 41-43.
8. STEWARD DAVID J (1979): *Physiology of temperature homeostasis manual of Paediatric Anaesthesia*. Churchill Livingstone, 17.
9. MATHIAS JA: *Paediatric Anaesthesia* – A Practice of Anaesthesia 4th edition, 1978; 142b.
10. FELDMAN S (1978): Neurological disease in relation to Anaesthesia – *A Practice of Anaesthesia* 4th Edition 937.
11. ROE CF (1970): *Temperature Regulation in Anaesthesia*. Physiological and Behavioural Temperature regulation.
12. ANTTONEN H, PUHAKKA K, NISKANEM J, RYHANEN P: Cutaneous heat loss in children during anaesthesia. *Br J Anaesth*; 74:306-310, 1995.
13. BOOKER PD: Equipment and monitoring in paediatric anaesthesia. *Br J Anaesth*; 83:78-90, 1999.
14. COTE CJ, PAEDIATRIC ANAESTHESIA: In *Anesthesia* Miller R.D. 1990, Churchill Livingstone. 3rd Edition, vol. 2: 1897-1926.
15. ANAND KJS, HICKEY PR: Pain and its effects in the human neonates and fetus. *N Engl J Med*; 317:1321-1392, 1987.
16. MAUNUKSELA E, OLKKOLA KT, KORPELA R: Measurement of pain in children with self reporting and behavioural assessment. *Clin. Pharmacol Ther*; 42:137, 1987.
17. FAMEWO CE: Neonatal Anaesthesia: Practice and Problems in a Developing Country. *Nig Med Journal*; 19(2):59-62, 1989.
18. ODUNTAN SA: Anaesthetic Management of Atresro of the Oesophagus in the New-born. *West Afr Med J*; 18:109, 1969.
19. WISBORG T, GRAVEM PE: Paediatrio Anaesthesia in a Developing Country. *Tropical Doct*; 20(2):60-62, 1990.
20. LUNN JN: Anaesthesia and Developing Countries. *Editorial Anaesthesia*; 38:727-728, 1983.