

East African Medical Journal Vol. 81 No. 11 November 2004

ANAESTHESIA FOR NEONATAL SURGICAL EMERGENCIES IN A SEMI-URBAN HOSPITAL, NIGERIA

A.F. Faponle, BSc, MBChB, FNMC, FWACS, Consultant Anaesthetist, Department of Anaesthesia, O.A. Sowande, BSc, MBChB, FWACS, Consultant Paediatric Surgeon and O. Adejuyigbe, MBBS, FWACS, Consultant Paediatric Surgeon, Department of Surgery, Obafemi Awolowo University Ile-Ife, Nigeria

Request for reprints to: Dr. A.F. Faponle, Department of Anaesthesia, Obafemi Awolowo University, Ile-Ife, Nigeria

## ANAESTHESIA FOR NEONATAL SURGICAL EMERGENCIES IN A SEMI-URBAN HOSPITAL, NIGERIA

A.F. FAPONLE, O.A. SOWANDE and O. ADEJUYIGBE

### ABSTRACT

**Objective:** To establish the techniques of anaesthesia for neonatal surgical emergencies in a semi-urban hospital in Nigeria, assess their adequacy and make recommendations to improve our practice.

**Design:** Retrospective study.

**Setting:** Obafemi Awolowo University Teaching Hospital, Ile-Ife, Nigeria, from January 1990 to December 2000.

**Subjects:** One hundred neonates aged one to twenty eighty days.

**Results:** One hundred neonatal surgical emergencies were operated but only 76 case notes were available for review. Three hundred and fifty eight elective neonatal surgeries were done during the same period. The ASA classification were: ASA IE=10, 2E=25, 3E=28, 4E =12 and 5E=1. The mean weight was 2.66+/- 0.52 kg. Over 95% of the cases were done under general anaesthesia. Anorectal malformations and intestinal obstruction were the most common indications for surgery (64.5%). Nurse anaesthetists gave over 50% of the anaesthetics. Peri-operative adverse events such as tachycardia, respiratory distress, aspiration and hypothermia were recorded in 11.8% of the cases. Mortality was 39.2%.

**Conclusion:** General anaesthesia is still the main technique of anaesthesia and mortality following surgery is still high. Efforts should be made to train appropriate personnel to provide improved care and thereby reduce morbidity and mortality.

### INTRODUCTION

Providing safe anaesthesia for the neonate is a challenge because of their peculiar anatomic, physiologic and pharmacological features which should be taken into consideration(1). Most surgical emergencies at this age group are due to life threatening conditions that increase the risk of anaesthesia and surgery. Reports indicate that the outcome of neonatal surgeries has improved in the developed countries(2). Better understanding of neonatal features, availability of improved diagnostic, monitoring and support facilities have enhanced surgical outcome in developed countries. In developing countries, the outcome is however still poor mainly because of limited facilities and personnel.

In this paper we review our experience in the Obafemi Awolowo University Teaching hospital, a tertiary hospital which has been providing surgical care for neonates and older children since its inception over 23 years ago. At the beginning, there were no organised facilities for neonatal surgical care in both Surgery and Anaesthesia departments. The hospital was not accredited for Postgraduate training of doctors in Anaesthesia during the period of this review. Currently patients are managed in a full fledged paediatric surgical unit with a consultant surgeon and residents. Anaesthesia is still

being provided mainly by nurses with varying levels of experience. The objective of this paper is to establish the techniques of anaesthesia for neonatal surgical emergencies in our hospitals assess their adequacy and make recommendations to improve our practice.

### MATERIALS AND METHODS

In this hospital, most newborns with surgical problems are managed in the paediatric surgical ward which has no facilities for neonatal intensive care (NIC). Anaesthetists with particular experience in neonatal anaesthesia were not available. Preoperative evaluation was largely clinical, supported by biochemical (electrolytes, urea, glucose and bilirubin estimations)and simple haematologic and radiologic (plain and contrast X-rays) investigation.

The case notes of all emergency neonatal surgical patients operated in the paediatric surgical unit of the Obafemi Awolowo University Teaching Hospital, Ile-Ife, Nigeria from January 1990 to December 2000 were identified from the operation register and reviewed. The age at admission, sex, weight, diagnosis, surgery performed, Packed Cell Volume (PCV), American Society of Anaesthesiologists (ASA) physical status grading, blood loss, status of anaesthetist, intra-operative blood transfusion and outcome of surgery were reviewed. Associated congenital anomalies of anaesthetic importance could not be identified from this retrospective review. A database was created using Epi- Info package version 6.04. Analysis was carried out using the Statistical

Package for Social Sciences (SPSS) frequency distribution of the variables were produced and related to the outcome of surgery. The risk of death according to age factor was estimated by the Odd's ratio for each of the variables. The category of the variables with the lowest risk was taken as reference in each calculation.

A logistic regression model was filled in order to see if any of the variables could predict mortality. Statistical significance was determined at a probability level of  $p < 0.05$ .

## RESULTS

One hundred neonates aged 1- 28 days, constituting 21.8% of all neonatal surgery procedures (100/358) were operated during the period, as emergencies. Only 76 case notes could be retrieved for review. Over seventy-five percent (78.7%) of the patients were aged one week and below. There was a male preponderance with a sex ratio of almost 2:1. The major diagnoses are as shown in Table 1.

The mean weight of the patients reviewed was 2.66kg + /- 0.52 (range 1.3kg -3.75 kg). The American Society of Anaesthesiologists (ASA) classification of physical status is as shown in Table 3. The PCV ranged between 28% and 52% with a mean value of 44.1%+/- 8.68. Preoperative laboratory investigations were not available in nine patients (11.8%). Status of Anaesthetists present at surgery is as shown in Table 3. Over 95%, of the anaesthetics was administered by first year residents in anaesthesia and nurse anaesthetists.

*Technique of anaesthesia:* Seventy-two patients (95%) had general anaesthesia while the rest had local infiltration for surgery. General anaesthesia was induced with halothane. The Ayre's T-piece breathing system was used to administer general anaesthesia with the inhaled agents being nitrous oxide, oxygen and halothane in appropriate concentrations.

Fifty nine babies (81.9%) had endotracheal intubation with intermittent positive pressure ventilation while 13(18.05%) had face mask anaesthesia and spontaneous ventilation. Tracheal intubation was facilitated with suxamethonium in only ten cases (13.2%). Pancuronium bromide was administered in three babies (3.9%) who had exploratory laparotomy. The Consultant Anaesthetist administered anaesthesia in these three cases.

Intra-operative analgesia was provided with dipyrone in only three cases (3.9%). These cases were done during the last year of the review.

Four babies (5.3%) presenting for colostomy and gastrostomy were operated using local anaesthetic infiltration of xylocaine 1%- 1.5%, as shown in Table 4.

**Table 1**

*Surgical diagnoses in patients presenting for emergency surgery*

Diagnosis	Total (%)
Anorectal malformations	29 (38.2)
Intestinal Obstruction	20 (26.3)
Tracheo-oesophageal fistula	10 (13.2)
Exomphalos	6 (7.9)
Gastrochisis	3 (3.9)
Hirschprung's disease	3 (3.9)
Obstructed hernia	2 (2.6)
Biliary atresia	1 (1.3)
Annular pancreas	1 (1.3)
Sacroccocygeal tumour	1 (1.3)
Total	76 (100)

**Table 2**

*ASA classification of 76 neonates presenting for emergency*

ASA	No. of Cases	(%)
1	10	(13.1)
2	25	(32.9)
3	28	(36.8)
4	12	(15.8)
5	1	(1.3)
Total	76	(100)

**Table 3**

*Status of Anaesthetists at surgery*

Anaesthetist	No. (%)
Physician/Residents	3 (3.9)
Residents/ Nurses	33 (43.4)
Nurses only	40 (52.6)

**Table 4**

*Details of four neonates operated under local anaesthesia*

Diagnosis	Wt (Kg)	Type of surgery	Age	ASA
Tracheo-oesophageal fistula(TOF)	1.3	Gastrostomy	4/7	4E
Anorectal Malformation	2	Colostomy	1/7	4E
Anorectal Malformation	3.7	Colostomy	2/7	3E
Anorectal Malformation	2.5	Colostomy	10/7	3E

Table 5

ASA versus mortality within 24 hours and 14 days of surgery in emergency neonatal surgery

ASA	No. of Cases	Mortality	
		24 hours	14 days
1E	10	-	-
2E	25	-	4
3E	28	6	6
4E	12	3	9
5E	1	1	-
Total	76	10	19

Table 6

Details of deaths within 24 hours of surgery

Diagnosis	Anaesthetist	Type of Surgery	ASA	Age	Weight (Kg)	Type of Anaesthesia
TOF	D/N	Repair of TOF and anastomosis	3E	3/7	2.95	ETT+IPPV
Intestinal obst	D/N	ExPlo Lap	3E	3/7	1.75	ETT+IPPV
Annular Pancreas	D/N	Expl Lap	4E	1/7	2.2	ETT+IPPV
Ruptured omphalocele	N	Repair	5E	2/7	2.5	ETT+IPPV
Imperforate anus	N	Colostomy	3E	3/7	2.6	Face mask
Ruptured omphalocele	N	Closure	4E	4/7	2.75	Face mask
Ruptured exomphalos	N	Closure	4E	4/7	2.75	Face mask
Intestinal obst	D/N	Right hemicolect	3E	3/7	2.4	ETT+IPPV
TOF	D/N	Thoracotomy	3E	3/7	2.7	ETT+IPPV
Intestinal obst.	D/N	Explo Lap	3E	4/7	2.6	ETT+IPPV

\*D = Doctor, N = Nurse

*Perioperative course:* There was poor critical incident documentation in all cases. Adverse events noted peri-operatively included tachycardia (heart rate > 160) in two babies, post-operative respiratory distress (three babies), aspiration at induction (two babies), post-operative twitching(1), and intraoperative hypothermia (temperature <36°C) in one baby.

Three of the ASA three and four patients developed post-operative respiratory distress and died within 24 hours of surgery. The baby who was twitching was found to be hypoglycaemic (random blood sugar 2mg%). The two patients who aspirated at induction were scheduled for exploratory laparotomy and thoracotomy respectively. They both died within 48 hours of surgery in the paediatric surgical ward. The patients needed respiratory support post-operatively but there was no paediatric ventilator in the hospital during the period. No patient died on the operating table. The ASA 2 patients that died succumbed to anaesthesia unrelated problems more than 48 hours after surgery.

Table 6 shows the details of the ten babies who

died within 24 hours of surgery. By fourteen days of surgery, twenty-nine babies had died, giving a mortality of 38.2 per 1000. The outcome of surgery could not be determined in two neonates as their case notes were not conclusive on this fact.. The death rate of neonates one week and below was higher than others (41.4% versus 33.3%,  $p>0.1$ ). There was no statistically significant difference in the mortality between the sexes (38.8% versus 33.3%),  $p>0.1$ . None of the variables assessed to predict mortality such as age in days, blood loss, packed cell volume, type of surgery and status of the anaesthetist reached statistical significance even at 10% level.

## DISCUSSION

The neonate presenting for surgery presents increased anaesthetic risks because of the peculiar anatomic, physiologic and pharmacologic features which differentiate him from an adult(1). Anaesthetic problems

which may be encountered include prematurity, which predisposes them to frequent apnoeic attacks, hypoglycaemia and hypothermia as they are vulnerable to heat loss, since they have less insulatory subcutaneous tissue. Thus the anaesthetist must be prepared to take all these features into consideration in order to provide safe anaesthesia. The neonate must not be treated as a small adult. Because of these peculiar problems of the paediatric patient, the subspecialty of paediatric anaesthesia has developed. Currently the paediatric anaesthesiologist is the appropriate personnel to handle the neonate presenting for surgery.

Neonatal surgical problems present with symptoms early. Majority of the babies in this study presented with symptoms and signs suggestive of intestinal obstruction following various gastro-intestinal anomalies within one week of life. Anorectal and abdominal malformations formed more than seventy percent of cases done in this review. Patients having anaesthesia for surgeries with large amounts of exposed bowel such as in intestinal obstruction pose two special problems in supportive therapy(3). Conservation of body heat is especially difficult and requires the cooperation of all individuals attending the infant and the use of every possible method for keeping the infant warm. These methods include increasing the ambient temperature in the operating room (which is the most effective), the use of heated humidified anaesthetic gases, circulating warm water mattress, a wrap for the head and extremities and radiant heater lamps. Careful monitoring of the temperature should therefore be done during surgery. One of the babies reported had hypothermia intra-operatively.

Extensive fluid loss from the bowel can be expected to occur as a result of evaporation and traslocation. Large amount of balanced salt solutions (15-25 ml/kg) may thus be required to maintain circulatory blood volume. We often use the "bureto!" to regulate fluid infusion during surgery.

Eleven per cent of the patients did not present for anaesthesia with results of laboratory investigations in this series. The anaesthetist thus had to depend on clinical examination alone to determine the fitness for surgery. In our centre, logistic problems sometimes delay the provision of required laboratory services. Surgeons would want to operate quickly because of the urgent nature of the cases and are therefore ready to use any available anaesthetic service offered. The nurse anaesthetists are usually more readily available during call hours. This may mean that a proper anaesthetic review may not be done.

General anaesthesia was the main technique used for surgery in our centre. This is mainly because the staff are not experienced with regional blocks. Regional anaesthesia with a spinal, caudal or lumbar epidural has been found to be effective in neonates(4). The technique can be used for surgery of the perineum, lower extremities and lower abdomen. Availability of trained

paediatric anaesthetists will ensure increased use of the technique.

Expert management of the airway is essential for the safe and effective administration of general anaesthesia. The peculiar anatomical features of the neonate result in a higher difficulty in intubating the trachea of this group of patients. The newborn has smaller nares, relatively large tongue, small mandible, abundant lymphoid tissue, increased antero-posterior diameter of the head and a short neck. These increase the susceptibility to upper airway obstruction(5,6). The long, narrow, omega-shaped epiglottis and more cephalad vocal cords add difficulty to the anatomy, making intubation using a straight blade the preferred method. Also, the newborn responds to hypoxaemia by a short period of hyperpnoea, followed by hypoventilation. This response is exaggerated in the presence of hypothermia. There is also decreased responsiveness to carbon dioxide. Adequate preoperative evaluation enables one to anticipate "problem intubation" and to make adequate preparation for dealing with it. The incidence of difficult intubation could not be ascertained from this retrospective review. Face mask anaesthesia, as carried out in some of these cases, should be discouraged in neonatal surgical emergency. This is because of the associated risks of vomiting, regurgitation with subsequent aspiration pneumonitis.

General anaesthesia with rapid sequence intubation is the common method of airway management(7), for emergency surgery. Awake intubation or sedated awake intubation with topical anaesthesia may be safer than rapid sequence induction in emergency cases in which there is a potential for airway difficulty or in critically ill neonates(7). However awake intubation has been associated with the known risks of sympathetically mediated hypertension and raised intracranial pressure(8) in neonates and it was not used for any patient in this series.

Patients with a "full stomach" such as those scheduled for emergency surgery, intestinal obstruction and tracheo-oesophageal fistula stand a risk of vomiting or regurgitation with subsequent aspiration pneumonia following inhalational induction. The mortality following aspiration at induction is usually high. Hence inhalational induction is not advocated for such patients. The two babies who were noted to have aspirated at induction actually died within forty eight hours of surgery as they needed neonatal intensive care facilities for their subsequent management and this was not available. Three of the patients who also died within twenty four hours of surgery had face mask anaesthesia for closure of ruptured exomphalos and colostomy. They developed respiratory distress post-operatively. The babies ought to have been intubated and intermittent positive pressure instituted to facilitate proper airway protection.

The neonate has less plasma and tissue protein binding drugs, a larger volume of distribution, lesser fat and muscle depots, large distribution of cardiac output to

vessel rich tissue and decreased liver and renal function compared to older children. It is imperative to be careful in intravenous drug administration in them. There is a greater variation amongst neonates in their response to non-depolarising relaxants. It is usually advised that a scaled down dose of non-depolariser be used in them(9).

Suxamethonium is still used in our centre without adverse effects, particularly when rapid onset of muscle relaxation is required. Such cases include patients with intestinal obstruction when patients stand the risk of aspirating at induction of anaesthesia as a result of a "full stomach". Considering the high incidence of such cases in this series, suxamethonium should have been used more and a rapid sequence induction carried out with a cricoid pressure applied during the process to prevent regurgitation and aspiration during induction.

Controlled ventilation, with light levels of anaesthesia but with doses of muscle relaxants, is usually advocated for surgery in the neonate(6). The neonate should not be allowed to breathe spontaneously under anaesthesia for any length of time; the inefficient respiratory system is easily depressed and the presence of a small tracheal tube greatly increases resistance. Ventilation was however controlled in only four per cent of these cases. This may be because most of the cases were handled by inexperienced anaesthetists.

Standard monitors are indicated during neonatal anaesthesia. The most important monitor is however, the constant presence of the anaesthesiologist. Constant observation of the patient and the operation along with considerations of the trends in the vital signs, fluid loss and gain and anaesthetic drugs, aid in the appraisals of the patient's status.

Blood pressure measurements are not reliable measure of volume in the neonate(7). A chest stethoscope, which allows for constant monitoring of breath and heart sounds, is always used in our centre. Pulse oximeters became available in our hospital in the last year of the review. This was found to increase the standard of care particularly during induction of anaesthesia.

A balanced anaesthetic technique using appropriate doses of hypnotic, analgesic and muscle relaxant was not generally used in this series. The use of only halothane, nitrous oxide and oxygen for anaesthesia during surgery is to be condemned as this does not afford the patient the benefit of other agents which all act in consonance to control the stress response of surgery. Good anaesthetic practice, with attention to physiological and pharmacological issues, are important in neonatal anaesthesia.

Important determinants of adverse outcome did not reach statistical significance levels in this study. The parameters tested are those which are known to determine outcome. For instance, it did not matter whether a paediatric anaesthetist or a nurse anaesthetist gave the anaesthetic. This may be a reflection of the poor critical incident documentation already noted in this study. Adverse

events were documented in only 11.8% of the cases.

Neonates have been shown to have the highest rate of adverse events both intra-operatively and in the recovery room among all paediatric surgical cases(10). Cohen and others showed that the main problem in this age group were cardiovascular and respiratory systems depression(10). Also, another study looking at adverse respiratory events in anaesthesia found inadequate ventilation (38%), oesophageal intubation (18%), and difficult intubation (17%) as the commonest adverse respiratory mechanisms of injury(11).

Inhalational agents are associated with a decreased minimal alveolar concentration for preterm and full term infants, faster uptake of inhalational agents and decreased therapeutic index related to the cardiovascular system(7). Careful titration is required to avoid anaesthetic overdose which can result in a bradycardia and subsequent cardiac arrest. Halothane causes depression of both systems in a dose dependent manner(7). A balanced anaesthetic technique enables the use of minimal doses of halothane and thereby minimise side-effects. The use of halothane as the main agent for anaesthesia in this series could have contributed to the high mortality because of the high dose that would have had to be used to maintain anaesthesia. However, we could not determine its exact contribution in this retrospective review.

Availability of other inhalational agents apart from halothane may improve the standard of care. Sevoflurane offers an advantage because of its reduced solubility, which results in a more rapid elimination. It may also produce less cardiovascular depression than halothane(7). Isoflurane, which is now available in Nigeria, has a myocardial depressant effect in the neonate that is similar to halothane(7).

Intra-operative analgesics were not generally used in this series. It has been shown that neonates do feel pain and its improper management may increase morbidity(8). It is also known that the neonate is sensitive to CNS depressants(12). Even small amounts may depress respiration for prolonged periods. Generally though, opioids are well tolerated by neonates, even critically ill ones(7).

The high mortality recorded is significant. It is believed that the unavailability of a paediatric intensive care unit contributed to the high mortality in this series. Critically ill neonates should be managed postoperatively in such a facility. The high mortality may also be a reflection of the poor prognosis associated with many congenital malformations. This is more so since death was more common in the first week of life. The mortality is similar to reports from earlier studies in Ibadan in 1989 which showed a mortality of 35.5%(13). Ameh and other(2) in Zaria, Nigeria, gave reasons for the high mortality of 31% in their series to be due mostly to late referral and presentation, inadequate resuscitation during transport, a lack of anaesthetic personnel with adequate experience in neonatal anaesthesia, and a lack of facilities

for neonatal intensive care and total parenteral nutrition. The situation described is quite similar to what obtains in Ile-Ife. The mortality rate of 39% still reflects the limitations of anaesthetic and surgical practice in our developing world.

In conclusion, anaesthesia for emergency neonatal surgery is still associated with a lot of problems in our centre. There is a need for provision of improved facilities and appropriate anaesthetic personnel to manage neonates presenting for surgery. As neonatal surgical skills are being improved, anaesthetic services should also be improved in order to improve surgical morbidity and mortality.

#### ACKNOWLEDGEMENTS

To the Association of Paediatric Surgeons of Nigeria (APSON) Annual Scientific meeting, Enugu, Nigeria, 27-28 November 2003.

#### REFERENCES

1. Bamgbade, O.A., Soyannwo, O.A. and Sanusi, A.A. Anaesthesia for paediatric surgical emergencies in Ibadan. *Afr J. Anaes. Inter. Care.* 1997; **3**:35-37.
2. Ameh, E.A., Dogo, P.M. and Nnadu, P.T. Emergency neonatal surgery in a developing country. *Paediatr Surg. Int.* 2001; **17**:448-451.
3. Hall, S.C. Neonatal Surgical emergencies. *Advances Anaes.* 1985; **9**:27-64.
4. Gallagher, T.M. Regional anaesthesia for surgical treatment of inguinal hernia in preterm babies. *Arch Dis Child* 1993 **69**:623-624.
5. Palahniuk, R.J. Anaesthesia for neonatal surgical emergencies. *Can. J. Anaesth.* 1989; **36**:549-552.
6. Brown T.K. Safe Paediatric anaesthesia. *Can. Anaesth Soc. J.* 1985; **32**:522-523
7. Wheeler, M. Practical Anesthetic management for neonatal surgical emergencies - American Society of Anaesthesiologists (ASA) *Refresher course Lectures* 2002; **116**.
8. Anand, K.J.S. and Hickey P.R. Pain and its effects in the human neonate and fetus. *New Eng. J. Med.* 1987; **317**:1312-1292.
9. Brandon B.W. Muscle relaxants in infants and children-How they differ from adults. American Society of Anaesthesiologists (ASA) *Annual Refresher Course Lectures.* 2002; 224.
10. Cohen, M.M., Cameron, C.B. and Durcan, P.G., Paediatric anaesthesia morbidity and mortality in the perioperative period. *Anaesth Anal* 1990; **70**:160-167.
11. Caplan R.R., Posner K.L, Ward R.J. and Cheyney F.N. Adverse respiratory events in anaesthesia. A closed claims analysis. *Anaesthesiology* 1990; **72**:828-833.
12. Anand, K.J.S., Sippell, W.G. and Aynsley- Green A. Randomised trial of fentanyl anaesthesia in preterm neonates undergoing surgery: effects of the stress response. *Lancet* 1987; 234-248.
13. Famewo, C. E. Neonatal Anaesthesia: Practice and problems in a developing country. *Nig. Med. J.* 1989; **19**:59-62.