Original Article

Access this article online
Website: www.afrjpaedsurg.org
DOI: 10.4103/0189-6725.120886
Quick Response Code:

Pattern, outcome and challenges of neonatal surgical cases in a tertiary teaching hospital

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ABSTRACT

Background: Globally, the major causes of neonatal deaths are birth asphyxia, prematurity and severe infections. Little attention is paid to deaths contributed by surgically amenable conditions. This study was undertaken to determine the burden and types of surgical problems encountered in the neonatal period, their outcome and challenges encountered. **Patients and Methods:** This was a retrospective study. The case notes of all neonates admitted into the newborn unit of our centre between April 2002 and March 2010 with surgical conditions were retrieved and the following information extracted: Sex, diagnosis, age at presentation, surgical intervention and outcome. **Results:** Out of 7,401 neonates admitted within the study period, 460 (6.2%) had a surgical condition. Of the 1,657 babies that died within the same period, 196 (11.8%) of them were those with surgical conditions. Congenital abnormalities accounted for 408 (88.7%) of all the surgical cases. Intestinal obstruction 129 (31.6%), neural tube defects 101 (24.8%) and anterior abdominal wall defect 58 (14.2%) were the commonest congenital abnormalities, while fracture of the long bones following birth trauma 15 (28.8%) and perforated NEC 14 (26.9%) were the commonest acquired conditions. Surgery was performed in 166 (36.1%) and 98 (59%) had postoperative complications. Significantly, more deaths occurred in preterms than in term babies ($P = 0.003$) and in those delivered outside the hospital than in in-born babies ($P = 0.02$). The major cause of death was infection in 92 (47%). **Conclusion:** Neonatal surgical conditions contributed significantly to both neonatal admissions and overall neonatal mortality and thus highlights the need for investments in newborn surgical care in developing countries.

Key words: Congenital abnormality, neonate, outcome, surgical conditions

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INTRODUCTION

The major causes of neonatal deaths are birth asphyxia, prematurity and severe infections.[1-3] Little is known about the burden of neonatal surgical conditions on the overall neonatal mortality. In developed countries, outcome of neonatal surgical cases is favourable because of availability of antenatal diagnosis, improved surgical skills and technologies, sophisticated neonatal intensive care unit, availability of total parenteral nutrition and adequate staff.[4,5] In developing countries, however, neonatal surgery is still fraught with a lot of problems including late presentation and lack of medical facilities and human resources,[6,7] thereby, making newborn surgery to be associated with unacceptably high morbidity and mortality. Due to the burden of other neonatal and childhood diseases in developing countries, neonatal surgery is often considered low priority in healthcare budget planning and allocation. The aim of this study was to provide an insight on the burden and types of surgical problems encountered in our newborn unit as well as the outcome.

PATIENTS AND METHODS

This was a retrospective analysis of all neonates admitted into the newborn unit with a surgical problem between 1st April 2002 and 31st March 2010. The unit provides care for neonates with both medical and surgical conditions. It has an in-born and out-born section and is manned by two neonatologists and an average of three nursing staff per shift. The average monthly admission is 75 babies. The surgical cases were initially handled by the general surgeons and later by paediatric surgeons and a neurosurgeon. Available facilities include 10 incubators, 20 cots, five phototherapy units and two radiant warmers. The unit lacked ventilators, continuous positive airway pressure (CPAP) and had no access to total parenteral nutrition.

The case notes and the admission records in the newborn unit were used to extract the following information: Sex, age at presentation, gestational age at delivery, weight at birth or at presentation, place of delivery, antenatal care and diagnosis, diagnosis on admission/surgery, type of surgical intervention and outcome of management. Only cardiac defects confirmed by echocardiography are included. Congenital abnormalities like anencephaly which are not amenable to surgery were excluded. Data was entered in an Excel spread sheet and analysed using Epi Info version 3.5.1. Categorical data were analysed using the Chi-square test and a *P*-value ≤0.05 was regarded as significant.

RESULTS

A total of 7,401 neonates were admitted within the period made up of 4,191 (56.6%) males, 3,203 (43.3%) females and seven (0.1%) with ambiguous genitalia. Four hundred and sixty (6.2%) had a surgical condition made up of 265 (57.6%) males and 188 (40.9%) females, giving a male to female ratio of 1.4:1. Seven (1.5%) had ambiguous genitalia. The male preponderance, however, was not statistically significant ($\chi^2 = 0.5$; df = 1, $P = 0.48$). The mean age on admission was 120.29 hours ± 146.47 hours (range 30 minutes-27 days) and the mean weight was 2,900 g ± 2,200 g (range 900-5,600 g).

The total deaths within the period was 1,657 (22.4%) out of which 196 (11.8%) of them were those with surgical problems made up of 113 (57.7%) males, 79 (40.3%) females and four (2.0%) with indeterminate genitalia. The difference in the deaths among males and females was not significant ($\chi^2 = 0.01$; df = 1, $P = 1.0$). Table 1 shows the general characteristics of the neonates. Two hundred and sixty-four (57.4%) of the mothers had antenatal care. Of the 125 (47.3%) mothers that had ultrasound done in pregnancy, only in 11 (8.8%) cases was the surgical condition diagnosed in the antenatal period and include omphalocoele (three), polycystic kidney (two), lumbosacral meningomyelocoele (two), congenital hydrocephalus (two), obstructive uropathy (one) and occipital encephalocoele (one). One hundred and forty (30.4%) of the neonates presented within 24 hours of life and were mainly babies with obvious defects.

Table 2 shows the types of neonatal surgical conditions and the systems involved. The commonest surgical conditions were due to congenital abnormalities in 408 (88.7%), whereas acquired causes constituted 52 (11.3%) of all the surgical cases. The systems most commonly affected were the digestive system 201 (43.7%), and the central nervous system 116 (25.2%). In 20 (4.3%), the abnormalities were multiple involving three or more systems. Congenital intestinal obstruction, neural tube defect and anterior abdominal wall defect accounted for 129 (31.6%), 101 (24.8%) and 58 (14.2%), respectively, of all the congenital surgical abnormalities, while fractures of the long bones following birth trauma and perforated necrotising enterocolitis (NEC) accounted for 15 (28.8%) and 14 (26.9%), respectively, of all acquired surgical conditions.

Table 1: General characteristics of the neonates with surgical conditions

Characteristics	Admitted No. (%)	Died No. (%)
Total	460	196 (42.6)
Male	265 (57.6)	113 (57.7)
Female	188 (40.9)	79 (40.3)
Indeterminate	7 (1.5)	4 (2.0)
Male:Female	1.4:1	1.4:1
Congenital conditions	408 (88.7)	182 (92.9)
Acquired conditions	52 (11.3)	14 (7.1)
Had antenatal care	264 (57.4)	104 (53.1)
No antenatal care	196 (42.6)	92 (46.9)
Inborn	95 (20.7)	25 (12.8)
Outborn	365 (79.3)	171 (87.2)
Low birthweight	130 (28.3)	63 (32.1)
Normal birth weight	330 (71.7)	133 (67.9)
Preterm	41 (8.9)	34 (17.3)
Term	419 (91.1)	162 (82.7)
Had surgery	166 (36.1)	80 (40.8)
No surgery	294 (63.9)	116 (59.2)

Table 3 shows the management and outcome. Death occurred in 196 (42.6%). Two hundred and ninety-four (63.9%) did not have surgery and 116 (39.5%) of them died (15 of them were considered ineligible for surgery because of their very poor clinical state and 101 of them while still being stabilized for surgery). A hundred and sixty-six (36.1%) had surgical intervention and 80 (48.2%) of them died after surgery, with 40 (50.0%) of the deaths occurring by the second day postoperatively. There was no significant difference in the number of deaths between those that had surgery and those that did not have surgery ($\chi^2 = 1.12$; $P = 0.3$). Surgery was done more for digestive system conditions and most of the deaths as well occurred in neonates that had surgery for a digestive system disorder. The commonest congenital abnormalities requiring surgery were anorectal malformation, small intestinal atresia (obstruction), neural tube defects and omphalocoele. The commonest surgical interventions were laparotomy with intestinal resection and anastomosis (either for small intestinal atresia or ruptured NEC) 46 (27.7%), colostomy 23 (13.9%), repair of neural tube defects

Table 2: Types of neonatal surgical conditions and the systems involved

System	Congenital conditions (*n*=408) No. (%)	Acquired conditions (*n*=52) No. (%)
DS	*Neonatal intestinal obstruction 120 (29.4)	Perforated NEC 14 (26.9)
	†Anterior abdominal wall defect 58 (14.2)	
	Oesophageal atresia with TOF 9 (2.2)	
CNS	Neural tube defects 101 (24.8)	Post-meningitic hydrocephalus 4 (7.7)
	Congenital hydrocephalus 11 (2.7)	
MSS	Talipes 5 (1.2)	Fracture of long bones 15 (28.9)
	Polydactyly/ Syndactyly 5 (1.2)	Multiple abscesses 8 (15.4)
	Ectropion 2 (0.5)	Septic arthritis 6 (11.5)
	Sternal cleft 1 (0.2)	Burns 2 (3.9)
		Ulcer left foot 1 (1.9)
UGS	Extstrophy of the bladder 9 (2.2)	
	Posterior urethral valves 8 (2.0)	
	Polycystic kidney 5 (1.2)	
	Hypospadias 4 (1.0)	
	Ovarian cyst 1 (0.2)	
Orofacial Cleft lip and palate 19 (4.7)		
	Dental cyst 2 (0.5)	
CVS	Congenital heart defects 19 (4.7)	
RS	Diaphragmatic hernia 2 (0.5)	Foreign body aspiration 1 (1.9)
	Choanal atresia 1 (0.2)	
HS	Haemangioma 3 (0.7)	
	Cystic hygroma 3 (0.7)	
Multiple 20 (5.0)		
Total	408 (100)	52 (100)

(DS=digestive system, CNS=central nervous system, MSS=musculoskeletal system, UGS=urogenital system, CVS=cardiovascular system, RS=respiratory system, HS=haematological system, NEC=necrotising enterocolitis, TOF=Tracheo-oesophageal fistula), *The neonatal intestinal obstruction include imperforate anus 44 (10.8%), jejunoileal atresia 30 (7.4%), Hirschsprung disease 16 (3.9%), dueodonal atresia 12 (2.9%), strangulated inguinal hernia 10 (2.5%), Pyloric web 6 (1.5%), Gastric mucosal web 1(0.2%) and Annular pancreas 1(0.2%). †The anterior abdominal wall defect include omphalocoele 41 (10) and gastroschisis 17 (4.2)

Table 3: Management and outcome of neonatal surgical cases

Intervention	No. (%)	Male	Female	Ambiguous	Discharged	Died	‡DAMA
Had surgery	166	94	70	2	78	80	8
(%)	(36.1)	(20.4)	(15.2)	(0.4)	(17.0)	(17.4)	(1.7)
No surgery	294	171	118	5	157	116	21
(%)	(63.9)	(37.2)	(25.7)	(1.1)	(34.1)	(25.2)	(4.6)
Total	460	265	188	7	235	196	29
(%)	(100)	(57.6)	(40.9)	(1.5)	(51.1)	(42.6)	(6.3)

‡DAMA discharged against medical advice

19 (11.5%) and closure of abdominal wall defect 17 (10.2%) [Table 4].

Postoperative complications were seen in 98 (59%) and include infection in 68 (69.4%), anastomotic leak in nine (9.2%), burst abdomen in six (6.1%), enterocutaneous fistula in four (4.1%), short bowel syndrome in four (4.1%), acute renal failure in two (2%) and colostomy prolapse in two (2%). Intractable hypoglycaemia occurred in three (3.1%) as a result of difficult intravenous access from thrombosed vessels necessitating multiple venous cutdowns. Nine had a repeat surgery because of post-operative complications and seven (78%) of them died within 2 days of the second surgery. Significantly, more deaths occurred in preterm babies (34/41 for preterms vs. 162/419 for term babies $\chi^2 = 8.84$; $P = 0.003$) and those babies delivered outside the hospital (25/95 for inborn vs. 171/365 for out-borns $\chi^2 = 5.22$; $P = 0.02$). Sepsis was the commonest cause of death in 92 (47%) [Table 5].

DISCUSSION

The incidence of neonatal surgical conditions in this study was 6.2%. Although, surgical care is not considered an essential component of most child health programmes in developing countries, this high incidence demonstrates that neonatal surgical conditions are a significant public health problem. It was higher than the 3% reported in Tanzania,[8] however,

Table 4: Types of surgical intervention and associated mortality

Type of surgery	Total No. (%)	Number of deaths No. (%)
Laparotomy with bowel resection and anastomosis	46 (27.7)	32 (40)
Colostomy	23 (13.9)	13 (16.3)
Repair of neural tube defects	19 (11.5)	5 (6.3)
Repair of abdominal wall defects	17 (10.2)	15 (18.8)
Thoracostomy/Oesophagostomy/ gastrostomy	6 (3.6)	6 (7.5)
Incision and drainage/debridement	11 (6.6)	0 (0.0)
§POP casting	16 (9.6)	1 (1.2)
Ventriculoperitoneal shunt	2 (1.2)	1 (1.2)
Cutback anoplasty	3 (1.8)	0 (0.0)
Herniotomy	7 (4.2)	2 (2.5)
‖Excisions	12 (7.2)	3 (3.8)
Repair of sternal cleft	1 (0.6)	0 (0.0)
Tracheostomy	1 (0.6)	0 (0.0)
Perforation of choanal atresia	1 (0.6)	1 (1.2)
Tarsorrhaphy	1 (0.6)	1 (1.2)
Total	166 (100)	80 (100)

(§POP=plaster of paris), ‖This includes excision of cystic hygroma, ranula cyst, haemangioma, polydactyly

Table 5: Major causes of mortality in 196 surgical neonates

Cause of death	No. (%)
¶Septicaemia	92 (47.0%)
Electrolyte/metabolic disturbance	35 (17.9%)
Hypothermia	31 (15.8%)
Severe anaemia from acute blood loss	16 (8.2%)
Multiple abnormalities	9 (4.6%)
Malabsorption secondary to extensive gut resection	4 (2%)
Respiratory failure	4 (2%)
Anaesthetic complications (drug related, cardiac arrest, aspiration)	3 (1.5%)
Renal failure	2 (1%)
Total	196 (100)

¶The microorganisms isolated were *Klebsiella pneumoniae* in 51; *Staphylococcus aureus* in 18; *Escherichia coli* in 7; *Proteus* spp. in 5; *Pseudomonas aeruginosa* in 5; *Enterococcus spp in* 3; *Staphylococcus epidermidis* in 2 and *Streptococcus* spp in 1

the study was over a year period as against the present study that was over an 8-year period.

Congenital abnormalities accounted for over 80% of all neonatal surgical conditions. This was similar to the findings in other studies,[8-10] but in contrast to older children where acquired conditions were the commonest indication of paediatric surgical cases.[7] In a comparison of neonatal surgical admissions between two linked surgical departments in Africa and Europe, acquired surgical condition (NEC) was the commonest surgical condition in the Europe hospital whereas a congenital condition (anorectal malformation) was the commonest surgical condition in the African hospital.[11] The reason for this geographic difference is not readily explainable but it may be linked to better antenatal diagnosis in the Europe hospital.

The most common surgical conditions in the newborn involve the gastrointestinal tract.[12] This was the finding in this study and in other studies.[13-16] The commonest congenital abnormalities requiring surgical repair were anorectal malformation, small intestinal obstruction, neural tube defects and omphalocoele, a finding similar to other studies.[16,17]

The overall mortality in neonates with surgical condition in this study was 42.6%. Other authors had earlier reported lower mortalities ranging from 30.5% to 42.3%.[16-19] The higher mortality in this study further suggests that survival of neonatal surgical cases is yet to improve. A higher mortality of 53.6% reported in another study[20] may be because most of the neonatal surgeries performed in that study were done under emergency condition when the neonate may not have been optimally stabilized. Infection was the commonest postoperative complications and the commonest cause of death as well just like in other studies.[17,18,20]

Significantly, more deaths occurred in preterm babies and those babies delivered outside the hospital. Mortality generally is known to be higher in preterm babies because of the immaturity of all physiologic functions. Babies delivered outside the hospital need to travel several hours to get to a specialist hospital that offers neonatal surgical services during which time the baby's condition may deteriorate, leading to increased operative risk and mortality. The mortality is also often related to the promptness of diagnosis, the complexity of the surgical condition, the type of surgical procedure and presence of complications. Laparotomy for intestinal resection and anastomosis (either for small intestinal obstruction or ruptured NEC), closure of ruptured omphalocoele, colostomy, thoracostomy with oesophageal anastomosis, and multiple abnormalities were associated with high mortality, a finding similar to that in another study.[20]

Factors that probably affected the outcome adversely include lack of antenatal diagnosis such that deliveries of these children were not planned and the children transferred immediately to centres that can offer surgical care. Only 47.3% of the supervised deliveries had ultrasound examination in pregnancy with only 8.8% of the congenital surgical condition diagnosed in the antenatal period. This low level of antenatal ultrasound

scan and diagnosis was also noted in India.[21] Over 75% of the babies were delivered outside the hospital and had to be transported to the unit without resuscitation. The result is that these children presented late when metabolic and medical conditions would have set in to compound the surgical problem. Lack of adequate staff and appropriate facilities like ventilators and total parenteral nutrition also played a role. Delay in presentation, shortage of personnel and inadequate facilities as being the major problems associated with management of neonatal surgical patients were also identified in other studies.[3,9,17,19] Early recognition and immediate treatment of surgical conditions in the newborn infant is, therefore, very important.

CONCLUSIONS

Neonatal surgical cases constituted 6.2% of the total admissions and 11.8% of all deaths in our newborn unit. Congenital abnormalities, especially those involving the digestive and central nervous systems, accounted for the majority of the surgical conditions seen in neonates. Majority of the babies presented late-time enough for other metabolic and medical complications to set in and adversely affect the outcome. Antenatal diagnosis with early referral, improved surgical skills and technologies, adequate staff and post-operative care as well as investments in developing neonatal surgery subspecialty are all required to reduce mortality and ensure a better outcome for surgical neonates in developing countries.

ACKNOWLEDGMENT

The authors wish to thank the nurses and the doctors who assisted in the retrieval of the folders and the required information.

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Cite this article as: Ugwu RO, Okoro PE. Pattern, outcome and challenges of neonatal surgical cases in a tertiary teaching hospital. Afr J Paediatr Surg 2013;10:226-30.

Source of Support: Nil. **Conflict of Interest:** None declared.