



Original Article

The Prevalence, Patterns, and Causes of Deaths of Surgical Neonates at Two African Referral Pediatric Surgical Centers

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Background/ Purpose: *The survival of neonates with surgical pathology has improved considerably in developed countries but is still poor in sub-Saharan Africa due to many factors. The aim of this study is to report the current prevalence, patterns, and factors that influenced deaths of surgical neonates in Africa.*

Materials & Methods: *All the surgical neonates managed between January 2007 and December 2008 at two African referral pediatric surgical centers were included in this prospective study.*

Results: *Of 106 neonates comprising 64 males and 42 females with male: female ratio 1.5: 1 who were aged between 1 and 30 days (mean 8.3 ± 2.7 days) and weighed from 1.4 to 5.9 kg (mean 2.8 ± 1.7 kg), a total of 38 deaths, prevalence rate of 35.8%, were recorded. These deaths occurred mainly among neonates with gastrointestinal anomalies who contributed 30 (78.9%) to total deaths. Nutritional problems in 33 (86.8%) cases, late referrals 25 (65.8%), established overwhelming sepsis on arrival 21 (55.3%), lack of basic facilities 15 (39.5%), anesthetic complications 8 (21.1%) and presence of multiple congenital anomalies 3 (7.9%) were the major determinants of poor outcome. Late referrals and sepsis resulted in early deaths whereas nutritional problems caused deaths after ten days of treatment.*

Conclusion: *The prevalence of death of surgical neonates owing to late referrals and lack of facilities is still very high in this subregion. Early referrals, provision of basic facilities, health awareness program, enactment of favorable government policies and international collaboration are needed to improve present results.*

Index Word: *Prevalence, Patterns, Causes, Surgical neonates, Deaths.*

INTRODUCTION

Surgery on the newborn poses a major challenge worldwide^{1,2}. There has been steady improvement in outcome with low incidence of surgical neonatal deaths in developed countries owing to a lot of factors, including well organized surgical neonatal intensive care units, availability of facilities and highly skilled personnel^{1,3-5}. Also, in recent years, major advances in maternofetal medicine, reproductive genetics and fetal imaging coupled with better understanding of fetal

pathophysiology have facilitated the development of many aspects of fetal and neonatal therapy³⁻⁶. Inter-hospital transfer is often hazardous and may result in the clinical deterioration of critically ill neonates. Subsequently, transport medicine was developed as a subspecialty, principally amongst neonatologists, anesthesiologists and intensivists^{6,7}.

In sub-Saharan Africa, however, intrauterine diagnosis and fetal surgery are not feasible and outcome of

neonatal surgery is still very poor^{2,8}. Unlike the adult patients, neonates with surgical pathology deteriorate rapidly and this necessitates prompt and adequate surgical attention that are not readily available in many of the developing countries. Many studies^{2,8-10} have drawn attention to the high incidence of surgical neonatal death in this subregion, but whether the current prevalence rate has changed, as observed in developed countries in the last decades, is yet to be determined.

In view of this, we undertook a prospective study that collated and analyzed data on the current prevalence rate, pattern of deaths of surgical neonates and factors that contributed to them at two African referral pediatric surgical centers so as to suggest ways of improvement.

PATIENTS AND METHODS

A 2-year prospective study was undertaken at the Pediatric Surgery Unit of the University of Benin Teaching Hospital (UBTH) and Leadeks Medical Centre (LMC), both in Edo state, Nigeria between January 2007 and December 2008. Both centers are referral pediatric surgical centers run by three highly skilled pediatric surgeons. All neonates managed at the two centers during the period were included in the study. Data on them were collected using a structured form and collated at the end of the study. The data collated included age at presentation, sex, surgical pathology, clinical conditions on arrival, morbidity, treatment, mortality, its prevalence and contributory factors. Two children who were discharged against medical advice due to financial constraint were excluded from the study.

Statistical Analysis: The data obtained were analyzed using the SPSS version 11 software package (SPSS, Chicago, IL, USA) and presented as count, frequency, and percentage. Categorical data were analyzed using the Chi-square test and, where necessary, P value <0.05 was regarded as significant

RESULTS

A total of 106 neonates who weighed from 1.4 to 5.9 kg (mean 2.8 ± 1.7 kg), aged between 1 and 30 days (mean 8.3 ± 2.7 days), comprising of 64 males and 42 females with male: female ratio 1.5: 1 were managed during the period. A total of 38 deaths were recorded, giving a prevalence rate of 35.8% among the neonates. The dead

neonates were 35.9% males and 35.7% females with no statistically significant difference observed ($P=1.0$). Gastrointestinal lesions were the major indications for treatment, accounting for 73.6% of the total. These included intestinal atresia 35.9%, with associated 21.4% mortality, gastroschisis 14.1%, with 81.1%, ruptured omphalocele 10.3% , with 62.5% and high anorectal anomaly 10.3%, with 12.5%. Others were necrotizing enterocolitis 9%, that had associated 71.4% mortality, malrotation 9%, with 28.6%, gut perforation 5.1%, with 50% and Hirschsprung's disease 6.4% with none recorded. Consequently, management of neonates with gastrointestinal lesions accounted for the largest proportion, 78.9%, of the surgical neonatal deaths at the two centers (table 1).

The mortality recorded from lesions in other systems were 4 of the 6 neonates (66.7%) with tracheoesophageal fistula, 3 of 13 with genitourinary lesions (23.1%) and 1 of 2 with cranio-spinal lesions (50%), with no death from lesions in head/neck and musculoskeletal systems. The associated morbidities were mainly sepsis/wound infection, burst abdomen, respiratory failure, fluid and electrolytes derangement, hypothermia, hypoglycemia, leakage of anastomosis and inanition. All except neonates with musculoskeletal anomaly had life threatening morbidity that ranged from 44 (56.4%) morbidity recorded among neonates with gastrointestinal lesions to 2 (33.3%) in neonates with head/neck lesions. The majority (65.8%) of the mortality cases, were referred to the unit after compromised clinical conditions as shown in the bar chart (Fig. 1). Consequently, 8 (7.5%) neonates were too ill on arrival and died during resuscitation. Even though many lesions were obvious at birth and many neonates manifested signs and symptoms of the pathology within few days of life, neither the type nor the systemic location of the lesions influenced the mode of presentation as late presentation was common with all the pathologies. Ignorance, superstitious beliefs that a neonate with surgical pathology is evil, financial constraint, lack of adequate means of transportation and inadequate healthcare facilities, particularly in rural areas, influenced late presentation. Therefore, of the total mortality recorded, late referral was implicated in 65.8% cases.

Resistant overwhelming sepsis has had time to establish in 21 (55.3%) neonates who presented late. Many of these neonates had post operative sepsis, wound infections, anastomotic leakage and burst abdomen. Sepsis related deaths were obvious in 55.3% neonates as depicted in table 2. Lack of adequate facilities for

neonatal surgery was a major determinant of poor outcome. Of these, lack of total parenteral nutrition (TPN) posed a big challenge in 33 (86.8%) cases. Such neonates who required TPN were managed with dextrose and multivitamins infusion, fluid and electrolytes management, with little success. Other unavailable facilities were poorly organized surgical neonates intensive care unit, unavailable pediatric ventilator, inadequate incubators, surgical consumables and shortage of skilled personnel which contributed to mortality in 15 (39.5%) cases. Improvised urinary bag was used for closure of gastroschisis and ruptured omphalocele with associated high rate of wound infection, bag detachment and mortality (Fig. 2).

Of the total neonates, the parents of 12 (31.6%) were very poor and could not afford the cost of treatment. Emergency supply of medications covered the first 24 hours of admission during the period. There were

subsequent erratic supplies of medications after this period as many parents could not afford the cost of treatment. Also, many of them resided in rural areas with very poor means of transportation and presented their babies very late. Anesthetic related deaths were common, and contributed to 8 (21.1%) mortality. These deaths were due to lack of facilities required for intra operative monitor, laryngeal trauma during intubation, aspiration, respiratory compromise and drug related complications. Three neonates (7.9%) had multiple anomalies including cardiac anomaly which was diagnosed at post mortem in one neonate. Generally, neonate with sepsis/wound infection, late referrals, anesthetic complications and financial constraint died within few days on admission, while those who had nutritional problems, lack of facilities and multiple anomalies survived much longer before deaths ($P < 0.001$).

Table 1: System affected by surgical pathology, frequency, morbidity and resultant mortality

System	Frequency	%	Morbidity	%	Mortality	%
Gastrointestinal	78	73.6	44	56.4	30	28.3 (38.4%)
Genitourinary	13	12.3	8	61.5	3	2.8 (23.1%)
Tracheoesophageal	6	5.7	6	100	4	3.8 (66.7%)
Head/neck	6	5.7	2	33.3	0	0.0
Cranio-spinal	2	1.8	2	100	1	0.9 (50%)
Musculoskeletal	1	0.9	0	0.0	0	0.0
TOTAL	106	100.00	62	58.5	38	35.8

Table 2: Contributory factors to mortality and mean time lag before deaths of the surgical neonates

Etiologies	Frequency	Percentage	Mean time before death
Nutritional problems	33	86.8	13 ± 3 days
Late referral	25	65.8	2 ± 5 days
Sepsis	21	55.3	2 ± 7 days
Lack of facilities	15	39.5	7 ± 1 days
Financial constraint	12	31.6	2 ± 0.5 days
Anesthetic complications	8	21.1	1 ± 0.2 days
Multiple anomalies	3	7.9	4 ± 0.1 days

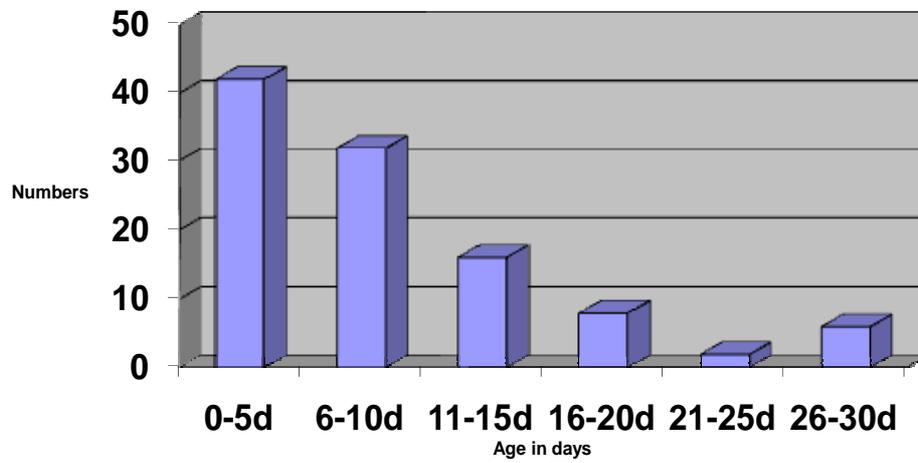


Fig. 1: Age at presentation.



Fig. 2: A two-day-old male neonate with gastroschisis who had improvised silo closure with urinary bag. He died on the second day after surgery due to sepsis.

DISCUSSION

The causes of deaths of surgical neonates are multifactorial and the death of any neonate may be due to a combination of many causes as revealed by this study and other similar studies^{1,2}. The prevalence rate of 35.8% recorded in this study is unacceptably high compared to results from developed countries where close to 100% survival rates are recorded among surgical neonates^{1,3,4}. Similarly, a comparison of the current prevalence rate of 35.8% with previous reports^{2,8-11} in this subregion revealed an increasing rate of surgical neonatal death in developing countries. This may be related to the present economic depression which makes it difficult for many parents to afford the cost of treatment. Affected male and female neonates had similar disease spectrum, experienced similar factors that influenced outcomes with no statistically significant difference observed when mortality was compared between the sexes.

Lesions of the gastrointestinal tract were the major indication for neonatal surgery during the study period as similarly reported by other authors⁸⁻¹¹. The majority of the lesions in other systems were not life threatening and the affected neonates were managed non-operatively until after the neonatal age when they were operated. This is because neonatal surgery and anesthesia is still a big challenge with higher chance of complications and deaths in this subregion^{9,12}. These deaths could result from lack of facilities required for intraoperative monitor, laryngeal trauma during intubation, aspiration, respiratory compromise or drug related complications. Anesthesia related deaths accounted for 21.1% mortality in this study. In view of the unique pharmacokinetics in neonates, earlier authors^{1,13} recommended that lower dosages of drugs which are widely spaced be used especially in the presence of compromised clinical states. Also, regular estimations of serum concentration of drugs were emphasized as a guide for accurate dosing for each neonate. These are, however, not feasible in many developing countries.

In the developed countries, intrauterine diagnosis, fetal intervention, planned delivery and prompt surgical management of relatively clinically stable neonates are possible^{1,4-6}. Late presentation of severely compromised neonates were common in this study with 8 (21.1%) of the neonates died during resuscitation within the first 24 hours on admission. Established resistant sepsis, fluid and electrolytes derangement, hypothermia, hypoglycemia, gross abdominal distension, diaphragmatic splinting, aspiration and respiratory

complications were common on presentation^{8,14,15}. Correcting the compromised clinical conditions were difficult in many neonates, instead, many of them continued to deteriorate. Operating on such clinically compromised neonates resulted in high mortality as reported by other authors^{9,12}. Already established sepsis continued post operatively and responded poorly to antibiotics. The neonates subsequently developed post operative sepsis, wound infections, anastomotic leakage and burst abdomen which culminated in many deaths.

The importance of nutritional support in surgical neonates cannot be overemphasized. This is because glucuronyl transferase enzyme that is required for gluconeogenesis is poorly developed in neonates and the hepatic glycogen store can only sustain the neonate for about four postnatal hours^{1,16}. Extrinsic supply of glucose, fat, protein, minerals and multivitamins must be commenced within the first six hours of birth preferably through enteral route, to prevent nutritional problems. Neonates who cannot be fed enterally as is the case in many surgical neonates must be given balanced diet parenterally^{1,16,18}. TPN is not available in many centers in this subregion and this influenced the outcome considerably during this study^{8,17}. As a result, neonates with ruptured omphalocele, gastroschisis, intestinal atresia and tracheoesophageal lesions who required TPN were kept for almost two weeks on fluid/electrolytes maintenance, glucose and multivitamins infusions with minimal success as also reported in other studies¹⁹⁻²¹.

Surgery on the newborn requires sophisticated facilities that are in general short supply in this center. Silo closure of ruptured omphalocele and gastroschisis give good results in developed centers^{1,6} but the required silastic materials were either not readily available or exorbitantly expensive. This resulted in the use of urine bag as improvised silo, but the outcome was not encouraging due to wound infection resulting in too early detachment of the bags⁸. Other challenges such as poorly organized surgical neonatal intensive care units, poor means of transportation of critically ill neonates, lack of incubators and pediatric ventilators as well as neonates with multiple anomalies that were not diagnosed preoperatively influenced outcome, as also reported by other authors^{2,8-10,13}

CONCLUSION

It is concluded from this study that the prevalence rate of death of surgical neonates is still very high in Africa

and, in fact, appeared to have increased in this study. Late referrals which allowed resistant overwhelming sepsis to be established on arrival, nutritional problems, and lack of basic facilities required for the management of surgical neonates contributed to the high number of deaths. Late referrals and sepsis resulted in many deaths during resuscitation and within the first few days of arrival in the unit whereas neonates with nutritional problems survived for more than ten days on admission. There is a need to encourage early presentation of surgical neonates to hospital and a need for provision of basic facilities required for management. Health awareness campaigns that will lead to early presentation and government policies that will allow neonates have access to free medical treatment need to be encouraged. There is also a need for international collaboration and adequate researches to improve outcome of treatment of surgical neonates in this subregion.

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Osifo, O.D. and Ovueni, M.E. (2009) The prevalence, patterns, and causes of deaths of surgical neonates at two African referral pediatric surgical centers. *Annals of Pediatric Surgery*, 5, 194-199. has been cited by the following article: TITLE: Factors associated with mortality in neonatal surgical emergencies in a developing tertiary hospital in Nigeria.Â The immediate causes of death among these neonates were peritonitis from gangrenous gut, hypovolaemia and repeat surgery. Contributing factors to mortality were delivery in unorthodox health facilities, delay in presentation as well as surgical intervention and inefficient postoperative monitoring. Conclusion: Emergency neonatal surgeries at the UUTH are associated with unacceptable high mortality. The Prevalence, Patterns, and Causes of Deaths of Surgical Neonates at Two African Referral Pediatric Surgical Centers. Article. David Osarumwese. Mike Efe Osifo. Ovueni. Background/ Purpose: The survival of neonates with surgical pathology has improved considerably in developed countries but is still poor in sub-Saharan Africa due to many factors. The aim of this study is to report the current prevalence, patterns, and factors that influenced deaths of surgical neonates in Africa. Materials & Methods: All the surgical neonates managed between January 2007 and December 2008 at two African referral