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Patterns and outcome of neonatal surgery in Sudan

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Abstract:
Background: *Sudan is one of the largest countries with a high birth rate (33.1/1000); with 40% of the population being children. Like many low income countries (LIC) neonatal surgery is overlooked, and for surgically affected neonates the situation is well below optimal. This study was conducted to determine the burden of neonatal surgery in Sudan and to find our own figures regarding patterns of disease and outcome.*
Patient and methodology: *This is a prospective descriptive cross sectional hospital based study conducted over a six months period from July-December 2017 from five pediatric surgery units.*
Results*: A total of 202 patients were studied. Males were predominant (54.5%) with a male to female ratio of 1.2:1. Most patients were term babies (78.2%) with normal body weight (2500-3000 g). One hundred thirty patients (64.4%) presented within the first week of life (mean 7.8±7.2). Ninety two percent of the diagnoses were congenital in origin. The most affected system was gastrointestinal (47.7%), but the most striking result is the high incidence of neural tube defects (26.2%). The most common acquired condition is NEC (3.5%). One hundred twenty two patients underwent surgical intervention, 12 of them needed a second intervention during neonatal period. Fifty nine patients (29.2%) needed surgical intervention but surgery was delayed (neural tube defects, HSD, and omphalocele). Fourteen percent of the population needed ICU admission , 6.5 % needed mechanical ventilation, and 12.2% needed TPN, the percentage of patients who actually received these services were (11%), (5%) and (2.5%) respectively. One fifth of the patients (20.8%) died during the study period with sepsis as a major cause of death. Bowel atresia is the most common diagnosis associated with mortality.*
Keywords: *Neonatal surgery, Sudan,*

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I. Introduction

Sudan is the third largest country in Africa and the fifteenth worldwide. The population of Sudan is 40,235,000 [1,] 40% of them being children (16,000,000) with a birth rate of 33.1/1000 live births (1,324,000/year).[2]Rural populations in Sudan were reported at 66.19% in 2015, with the poverty gap up to 21.30% .[3] Literacy reaches 46% (male: 58%,female: 35%) [4.]

With this large number of children, pediatric medicine has evolved in a steady manner, with 222 pediatric physicians in all specialties distributed all over the Sudan to serve those children. On the other hand if those children suffer surgical conditions this becomes a challenging subject and this will be even worse if a neonate affected. [5]

Pediatric surgery in Sudan is a central health service, and the remote areas are served by general surgeons who have little or no experience in managing pediatric surgical emergencies especially in neonates. There are seven pediatric surgery centers in Sudan, six of them located in Khartoum and one in Wad Madani (213 Km from

Khartoum). Nineteen pediatric surgeons are working in these centers.[5] That's mean for every 842,105.[3] child there is one pediatric surgeon (PS), this means we need extra 61 PS to reach the optimal number of PS (optimal number of pediatric surgeons estimated as 1 PS to 200,000 children). [6]

Neonatal surgery in Sudan like other areas in Africa is faced by challenging problems at multiple levels making neonatal surgery resulting in an unacceptable high mortality and morbidity rate. These problems are related to population, health facilities, and governmental. Living in rural areas, poverty, lack of awareness and absence of primary health care facilities (PHC) lead to delays in presentation of surgically affected neonates, add to this the difficulty of transportation resulting from far away distances. [7]

Globally the major causes of neonatal deaths are birth asphyxia, prematurity and sever infection. [8-10] congenital anomalies are among the top ten leading causes of pediatric morbidity and mortality affecting approximately 7% of all births around the world.[11] About half of the congenital anomalies are amenable to

surgical intervention.[12] Nine percent of the global surgical burden of disease is attributable to congenital anomalies.[13] Early surgical intervention for many congenital anomalies is the method to reduce the burden of childhood disease and to prevent or reduce morbidity and mortality .[12, 14]

The outcome of neonatal surgery has improved steadily in the developed countries, this improvement is attributed to the availability of diagnostic tools during antenatal and postnatal periods, improvement in surgical and anesthetic skills, availability of well trained personnel, sophisticated neonatal intensive care units (NICU) and availability of total parenteral nutrition (TPN). All these are supported by better understanding of neonatal physiology.

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In developing countries however, neonatal surgery is underfunded and viewed as a luxurious specialty due to the burden of other childhood diseases. This defect leads to major gaps in surgical care of the neonates. [16]

This study was conducted to determine the burden of neonatal surgery in Sudan and to find our own figures regarding the patterns of disease and outcome.

II. Patients And Methodology

This is a prospective descriptive cross sectional hospital based study conducted within a six months period from July-December 2017.

All pediatric surgery centers in Sudan that fulfill the criteria of having regular services for neonatal surgery were include.(Soba Teaching Hospital, Alribat Teaching Hospital, Madani National Center of Pediatric Surgery, and Khartoum Teaching Hospital).

All children aged 0-28 days (term neonates) , and all preterm neonates till the age of 40 weeks who presented with surgical conditions to the mentioned pediatric surgery centers above were included in the study.

Data was collected using a designed questionnaire that was filled by the acting pediatric surgical registrar in the mentioned centres.

We also used hospital records to complete the missing information in the questionnaires.

III. Results

Two hundred and two neonates were admitted to the chosen pediatric surgery departments during the study period. One hundred and ten (54.5%) were males, 90 (44.5%) females and 2 (1%) intersex with a male to female ratio of 1.2:1.

One hundred thirty two (65.7%) were delivered at hospitals, 87 (43.1%) of them delivered by C/S and 69 (34.2%) were home deliveries**.** Most of the neonates were term babies (78.2%) with a birth weight ranging from (2500-3000 g)**.**

Most of the patients presented within the first week of life, 130/202 (64.4%) with a mean age at presentation 7.8 ±7.2 days. The mean weight was 2.8 ± 0.72 (2051-3000) Kg.

The disease in 92 % of the study population was congenital in nature. Fifty five (27.4%) of cases presented with upper gastrointestinal (UGI) conditions, 41 (20.3%) with lower (LGI) conditions ,

53(26.2%) were neural tube defects,

20(9.9%) were abdominal wall defects, 16(7.5%) were urogenital, and 17(8.4 %) other conditions.

Table 1: Upper GI conditions

Diagnosis	*No. of cases*	*Percentage*
Bowel atresia	30	14.9
Esophageal atresia	10	5
Malrotation	7	3.5
Meconium ileus	3	1.5
Pyloric stenosis	2	1
Vitellointestinal duct remnants	1	0.5
Omental cyst	1	0.5
Total	***52***	***26.9***

Table 2: Lower GI conditions

Diagnosis	*No. of cases*	*Percentage*
HSD	22	10.9
ARM	17	8.4
Anal stenosis	1	0.5
Rectal diaphragm	1	0.5
Total	***41***	***30.3***

Table 3: Urogenital conditions

Diagnosis	*No. of cases*	*Percentage*
Persistent Cloaca	6	3
Cloacal exstrophy	2	1
PUV	2	1
Testicular torsion	2	1
Bladder exstrophy	1	0.5
Inguinal hernia	1	0.5
Vaginal atresia	1	0.5
Urosepsis	1	0.5
Total	***16***	***8***

The acquired conditions were NEC (3.5%), infantile hypertrophic pyloric hyperplasia (IHPH) (1%), neonatal testicular torsion (1%), gluteal abscess, umbilical sepsis, and upper limb ischemia (0.5% for each).

Table 4: Miscellaneous conditions

Diagnosis	*No. of cases*	*Percentage*
NEC	7	3.5
CDH	2	1
Cystic hygroma	2	1
Sacrococcygeal teratoma	2	1
Upper limb ischemia	1	0.5
Gluteal abscess	1	0.5
Umbilical sepsis	1	0.5
Bowel perforation	1	0.5
Total	17	8.5

Associated congenital anomalies were encountered in 40(19.8%) cases, with cardiac in 12(5.9%) , skeletal 11(5.4%), CNS 7(3.5%) , urogenital 6(3%) , GIT 5(2.5%), Down syndrome 2(1%) , cleft lip 2(1%) , and 4(2%) others.

Most operations were done within the first week of life 51(25%) with the mean age at surgery 11 ± 7.6 days . Neonates who underwent surgical interventions were 125 (61.9%). Forty eight

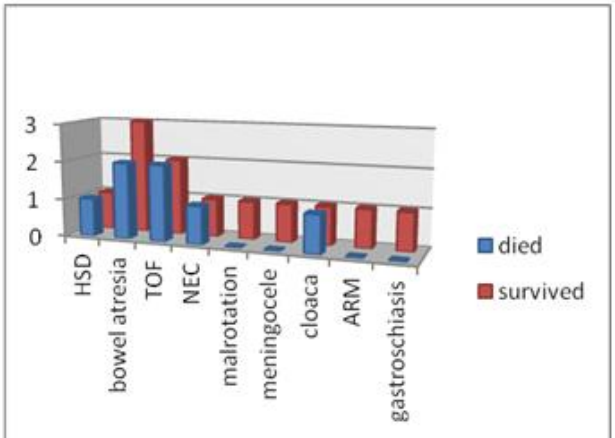


Figure 1: second operative intervention

Fifty nine (29.2 %) of the study population needed surgery but no intervention during study period. These were are mainly neural tube defects (n=27), HSD (n=12) omphalocele (n=1), bladder exstrophy (n=1) and 4 cases died before surgical intervention.

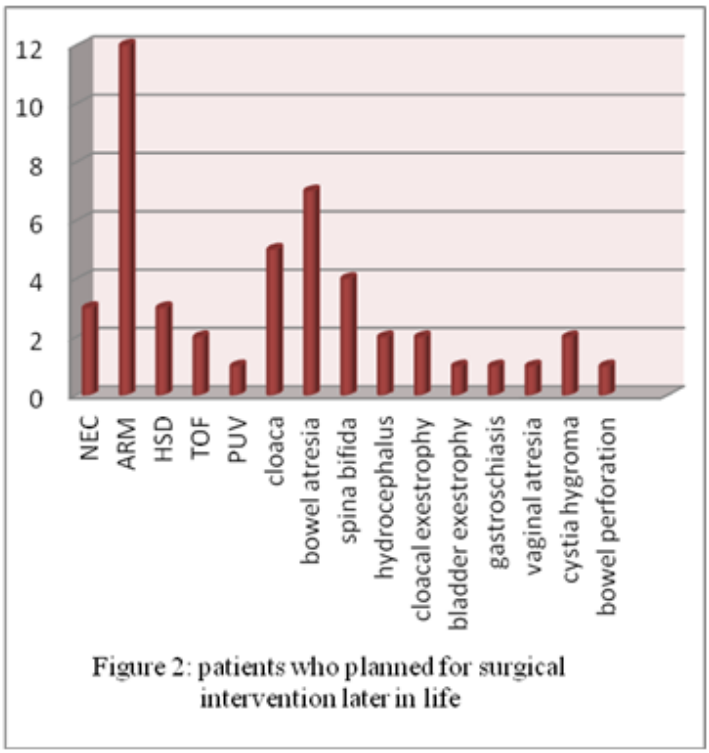
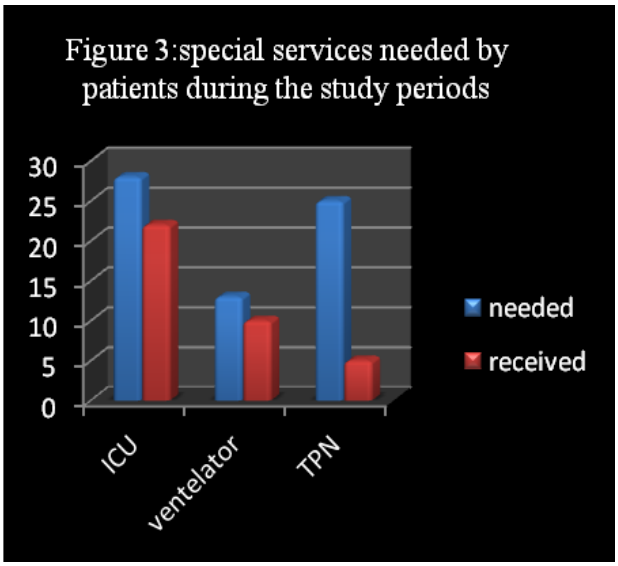
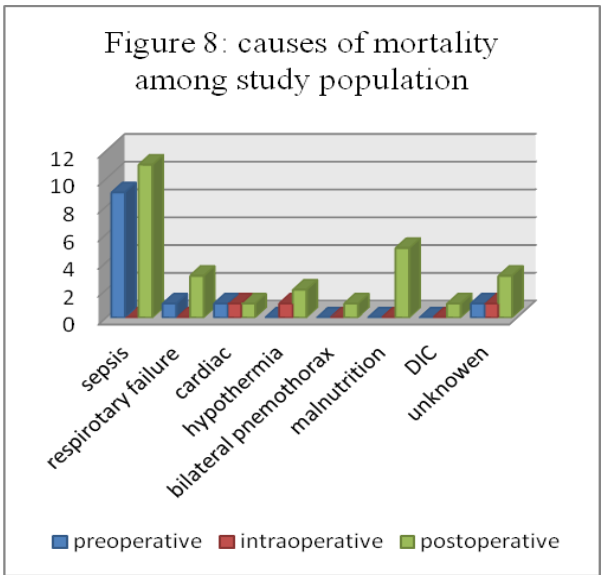


Figure 2: patients who planned for surgical intervention later in life

Forty two (20.8%) of the patients died during the study period, 12(5.9%) preoperatively, 4(2%) intraoperatively, and 26 (12.9%) postoperatively**.** Twenty four deaths are male and 18 females**.** Most deaths were associated with bowel atresia, 11 (26.2%) of cases and esophageal atresia with tracho-oesophageal fistula (EA+TOF) 4 (9.5%) cases. Sepsis was the major cause of death in both the pre- and post-operative periods in 20 (47.6 %) cases.



Eighty six patients were discharged postoperatively with a mean length of stay of 10.3 (1-180) days), and 4 discharged after surviving another operation. Sixty three patients were discharged without surgical intervention with a mean hospital stay of 6.75±3.89 (2-18) days.



IV. Discussion

In this study 202 neonates were admitted to four pediatric surgery centers during a six month period. Most of the patients are males (54.5%) with a male to female ratio of 1.2**:**1; this result is comparable with the results obtained by other authors[19-21]. The mean age at presentation was 7.8 ± 7.2 days, which is slightly younger than the age (11.6 ± 8.81) recorded by Rahmattalla et al in a previous study.[19] The patients in our study were older than studies done in Nigeria reported by Ilori (47.5±44.4 hours)[20], and Ugwu (120.29 ±146.47hours)[8]. Younger age at presentation in those studies may indicate awareness among health personnel in the hospitals where patients initially presented or possibly because there are known tertiary hospitals to refer the patients to where they are diagnosed and managed effectively. The delay in our study may be due to misdiagnosis of patient in peripheral health facilities. Mean weight at presentation was

2.8 ± 0.79 Kg; this result is comparable with the study by Ilori eta al (2.6 ± 0.61 Kg)[20]. Most of our patients were term neonates reflecting the findings of Wella[21] and Ilori[20].

In this study 92% of the cases were congenital in nature, a finding confirmed in all previous studies[19-21]. Consanguinity is a known risk factor for developing congenital anomalies in our cohort (35.5%) which is higher than the results obtained in one study in Egypt(22.4%)[21].

GIT abnormalities are the most common cause of patients admission (47.7%) a result that mirrors studies by Ugwu[8] (43.7%) and Yadav [22] (49.1%). And much higher than Awad study (37.2%)[19].The most common GI abnormality was bowel atresia (14.9%), a finding that was found in Wella study (12.8 %)[21], our incidence is much higher than that in Yadav [22] (8.3 %) and Ilori[20] (only 6 cases in 4 years). ARM are the most common GI condition in Yadav study

≈34%[22], Wella (13.5%)[21] and Ilori (17.8%)[20] these results are much higher than our (8.4%) which is comparable with Nandi [23].

The most striking result in our studywas the high incidence of neural tube defects (26.2%) which is higher than other studies (3.27%)[19] and 14% [22] . These differences in incidences are difficult to explain but may be due to other studies having access to specialized neurosurgery centers.

Associated congenital anomalies were found in 19.8% of cases, which was higher than the results from Wella et al (25%) [21] but lower than those reported by Yadav (7.25%) [22], with skeletal anomalies beingcommonest in all.

The overall mortality in our cohort was 20.8%, similar to Wella (20.5%)[21], but higher than Awad study (12.4 %)[19]. In other studies the mortality ranged from 38.2 % [22] to 62.2% [20]. Mortality occurred most commonly in patients presenting in the first week of life (46%); this may reflect the lack of proper hospital equipment and lack of well-trained personnel. It may also reflect the severity of disease in this age group.. Most mortality is associated with bowel atresia (26.2%) followed by neural tube defects (14%) and abdominal wall defects (9%). Atresias are definitely one of the major contributing conditions to the high mortality in

other studies[20,21]. The unavailability of TPN, plus the associated costs may be a cause. Another contributory factor is the availability of NICU cot spaces. Most hospitals don't have NICU and if they do, the priority is to those delivered in-house.

In this study sepsis was the leading cause of death in (47.6%) of patients; a similar result was obtained by Ugwu (47%)[8]. Repeat surgery lead to death in 66.7% of cases. Age at surgery (P=0.14) and maturity (P=0.81) were not amongst the factors affecting the outcome in our cohort.

V. Conclusion

Neonatal surgery is an important specialty in a country like Sudan where most of the population are children. Surgically affected neonates present a management dilemna and great challenge in our setup.

Neonatal surgical conditions are more common in males. Most of the babies are term with normal body weight. Most of the patients presented late, with most of the cases been congenital in nature, gastrointestinal conditions accounting for ?. An important result in this study is the high incidence of neural tube defects. Many cases needed an ICU, mechanical ventilators and TPN post operatively but only few of them received these requirements specially TPN. One fifth of the patients died, the mortality was mainly among patient with atresia, and esophageal atresia. Sepsis is the most important etiological factor in preoperative and postoperative mortality.

Pediatric surgery centers lack many important facilities that is reflected in the outcome of our practice so improvement of the setups beginning with nursing staff, provision of training to existing staff, provision of proper equipment and intensive care units that accept any neonate even if delivered outside the center is required. Our Ministry of Health needs to address pediatric surgery as one of the health priority in project planning by rehabilitation of the existing centers and construction a new centers in peripheral areas.

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