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EVALUATION OF OUTCOMES FOR NEONATES UNDERGOING SURGICAL INTERVENTIONS

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ABSTRACT

11% of the Global Burden of Diseases (GBD) is attributable to neonatal surgical conditions, which require surgical intervention, yet their management has been neglected. On-time surgical interventions are often the keys to better outcomes, achieving quality of life and improving disability. Sepsis control, high dependency unit/intensive care unit (ICU) care and total parenteral nutrition have been shown to improve the outcomes of neonates with surgical conditions, The aim of the study is to evaluate neonatal operative outcome, A descriptive prospective study at Newborn Unit, District Headquarters Hospital Bannu from March 2022 to January 2023. KRP data on maternal age, place of delivery, mode of delivery, age of the newborn at the time of admission, birth weight, surgical condition, co-morbid conditions, treatment outcomes, surgical complications, time-to-initiation of oral feeds post-operatively, antenatal history & laboratory parameters; and length of hospital stay were retrieved and analyzed, Overall, 124 neonates were enrolled, 1.1:1 male female ratio; median age at admission was 2 days (IQR 1, 5). Most were between 2.5–3.9 kg at birth (59.7%). Gastroschisis 33 (26.6%), neural tube defects 25 (20.2%) and ARM 25 (20.2%) were the most common neonatal surgical conditions. The overall mortality was 31.5% Patients attending antenatal clinic were however significantly associated with lower odds of mortality (OR 0.126; 95% CI 0.025–0.6429; p=0.013) while neonatal sepsis, respiratory distress and electrolyte disturbance were significantly associated with increased odds of mortality respectively ([OR 3.4; 95% CI 1.09–22.06; p=0.049]; [OR 4.9; CI 0.91–11.61; p=0.001]; [OR 3.1; CI 1.21–31.60; p=0.029]), The mortality rate of neonates requiring interventions in the study group was 31.5% with median duration of hospital stay of 14.5 days. Among these neonates, the major co-morbid conditions which significantly increased the odds of mortality were neonatal sepsis, respiratory distress and electrolyte abnormality.

Keywords: *Neonatal Surgical Outcomes, Neonatal Mortality Risk Factors, Neonatal Sepsis and Morbidity, Surgical Interventions in Neonate*

INTRODUCTION

A neonate is defined by the World Health Organization as a child below 28 days old, which represents a vulnerable period of life when the risk of dying is greatest (Ikol et al., 2019). Neonatal surgical conditions rank 11th among the Global Burden of Diseases (GBD), most being congenital anomalies (Wright et al., 2015). Nonetheless, there is an underreporting of their management due to neglect but most of these conditions are surgical (Chirdan & Ameh, 2012).

Global attention has long been on 3 leading causes of neonatal deaths: prematurity; sepsis and perinatal asphyxia (Ikol et al., 2019). Surgical interventions play a major role in the management

of many neonatal surgical diseases with favorable outcomes (Wright et al., 2015). Timely interventions with surgery greatly help improve quality of life and reduce disability. Neonates with surgical disorders have unique challenges in management and postoperative care, necessitating a multidisciplinary mindset in their care. Controlling sepsis, NICU care and access to total parenteral nutrition (TPN) have all been associated with improved outcomes. In most of the developing countries NICU unfriendly neonatal surgical cases have extremely high mortality; this is mostly due to deficiency of TPN, lack of critical care unit and shortage of surgical specialist (Ugwu & Okoro, 2013). There continues to be a lower mortality for most conditions in HICs despite accepting more neonate surgical cases. Promotion of better surgical outcomes that have been achieved in high-income countries (HICs) can only be achieved in developing countries through addressing some of the factors contributing to the adverse impact (Wright et al., 2015). A 2015 study from Kenyatta National Hospital (KNH) found a mortality rate of 33% (Ajanja, 2019). To assess the outcome (mortality, length of stay) of surgical neonates at district headquarter hospital, bannu.

Materials and Methods

Study Design and Setting

This was a cross-sectional descriptive study conducted on neonates admitted to the Newborn Unit of District Headquarters Hospital Bannu between March 2022 and January 2023. The study aimed to compare mortality outcomes and hospital stay of surgical neonates.

Study Population

Neonates who required surgical intervention during the neonatal period formed the study population. The eligible unit was a 60-bed tertiary care neonatal unit caring for infants with medical and surgical conditions.

Healthcare Staff and Surgical Care

In the unit, we had around a nurse each for approximately every 20 patients. General pediatric surgeons, neurosurgeons, orthopedic surgeons, ENT surgeons, and other appropriate surgical specialists reviewed the neonates on a regular basis after admission.

Participant Selection

Neonates were included consecutively in the study after a decision had been made to perform surgical interventions on their conditions, and written informed consent was obtained from the parents or guardians.

Ethical Approval

The study received ethical approval from the Institutional Review and Ethics Committee.

Data Collection

The analysis was based on the following retrospective cohort data:

Maternal Information: Maternal age, location of delivery and type of delivery.

Neonatal Data: Age at admission, birth weight, types of surgical conditions, co-morbid conditions.

Outcomes: success or demise of surgery, post-operative complications, and time interval to start oral feeds.

Configuring Data: Antenatal background and laboratory tests.

Outcome Measurements

Hospital stay was measured from admission until the final disposition, which included discharge after recovery, death, or referral.

Statistical Analysis

A p-value of <0.05 (two-sided) was used as the threshold for statistical significance.

Results

In total, there were 1,096 neonates admitted to the unit during the study period: 11.3% were for neonatal surgical conditions. Thus, the total number of neonates enrolled in the study was 124. Results and discussion Overall, the male: female ratio was 1.1:1. Eighty-four (82·4%) mothers had ANC; twenty-one (82.3%) mothers in ANC clinics. Mothers did not receive nutritional supplements during the first trimester. Only 4% of mothers underwent routine antenatal ultrasound scans; no congenital anomaly was specialized surgery. Analysis of data was carried out at 95% confidence interval using STATA® version 13. Data are reported using frequency tables.

83% were born in other health facilities,87% of neonates were being referred to DHQ bannu for

surgical care,9 (7%) neonates delivered at home and 12 (10%) neonates at DHQ BANNU. A total of 666 neonates were enrolled during the study period (median age at admission 2 days (IQR 1, 5; 1–26 days); 59.7% of the neonates had birth weights between 2.5 and 3.9 kg, 31.5% between 1.5 and 2.4 kg and 4% were >3.9.

Spectrum of neonatal surgical conditions

The first four diagnoses in this study are shown in Table 1. The other 19(15.3%) neonates were diagnosed with sacrococcygeal teratoma, pyomyositis, cystic hygromae, meconium peritonitis, brain abscess and submandibular abscess (Table 1).

Table 1: Main diagnoses, mortality and discharge/referral rates

Diagnosis	Frequency *n*/(%) *n*=124	Discharge / Referred to KNH *n*/(%) *n*=85	Mortality *n*/(%) *n*=39
Gastroschisis	33 (26.6)	14 (42.5)	19 (57.5)
Neural tube defects	25 (20.2)	23 (92)	2 (8)
ARM	25 (20.2)	17 (68)	8 (32)
Small bowel atresia	18 (14.5)	13 (72)	5 (28)
OA/TEF	4 (3.2)	1 (25)	3 (75)
Others	19 (15.3)	17 (89.5)	2 (10.5)

Table 2: Association between independent variables and mortality: bivariate analysis. (n = 122)

	No = 83 (*n*/%)	Yes = 39 (*n*/%)	p-value
ANC attendance None	12 (54.5)	10 (45.5)	0.325
1–3 visits	59 (71)	24 (29)	
≥4 visits	12 (70.6)	5 (29.4)	
Delivery place Home	9 (75)	3 (25)	0.750*
Health facility	74 (67.3)	36 (32.7)	
Birth weight <2.5kg	20 (45.5)	24 (54.5)	0.001
≥2.5kg	63 (80.8)	15 (19.2)	
Sepsis	33 (62.3)	20 (37.7)	0.230

Yes			
No	50 (72.5)	19 (27.5)	
Respiratory distress Yes	12 (35.3)	22 (64.7)	0.001
No	71 (80.7)	17 (19.3)	
Electrolyte imbalance Yes	10 (33.3)	20 (66.7)	0.001
No	73 (79.3)	19 (20.7)	
AKI Yes	2 (25)	6 (75)	*0.013
No	81 (71)	33 (29)	

Surgical complications

The overall surgical complications' rate was 26.9%: wound sepsis (17.6%), post-operative hemorrhage(5.6%), burst abdomen (2.8%) and perforations(1.9%)

Laboratory parameters

Blood cultures shown growth of Klebsiella pneumoniae species and Low platelet count were significantly associated with mortality (p<0.001).

Length of hospital stay

Days hospitalized at a median 14.5 (IQR 6, 32) 0–102 days Postoperative initiation of nectarous feeds varied from 1 to 24days and 51.3% neonates were nil per oral for more than 3days postoperatively. Bivariate analysis was performed using Mann-Whitney U test and a significant association was noted between Time-to-initiation of oral feeds post operatively (p<0.05) and hospital stay.

Factors associated with favorability of outcomes of neonates requiring surgical interventions

Table 3 Cox Proportional Regression Analysis showing increased odds of mortality with: presence of neonatal sepsis (OR 3.4, 95 CI 1.09–22.06, p=0.049), respiratory distress (OR 4.9, CI 0.91–11.61, p=0.001), electrolyte imbalance (OR 03.1, CI 1.21–31.60, p=0.029) while antenatal clinic attendance was protective against death (odds ratio (OR) 0.126; 95% confidence interval (CI) 0.025–0.6429; p=0.013).

Table 3: Simple logistic regression showing association of independent variable with mortality

Variable	Odds ratio	p value	Confidence interval
Platelets ($^{x}10^{9}$/L) (50–150 vs <50)	0.2636	0.286	0.0227, 3.0598
Platelets ($^{x}10^{9}$/L) (>150 vs <50)	0.1199	0.042	0.0156, 0.9252
ANC (attendance vs no attendance)	0.1262	0.013	0.0248, 0.6429
Birth weight (kg) (≥2.5 vs <2.5)	0.8463	0.792	0.2448, 2.9262
Sepsis (Yes vs No)	3.3573	0.049	0.9138, 11.6104

Respiratory distress (+ vs –)	4.9024	0.038	1.0896, 22.0572
Electrolyte imbalance (+ vs –)	6.1778	0.029	1.2077, 31.6020
AKI (+ vs –)	3.0720	0.381	0.2495, 37.8303

Discussion

The median time of presentation to hospital was 2 days which is late in a general sense for many neonatal surgical conditions but specific to anterior abdominal wall defects and small intestine atresia (Kuradusenge et al., 2014). This is probably due to delay from the centre. There could also be late modes of transport; DHQ HOSPITAL BANNU has a broad catchment population with some neonates transferred from as far Turkana & West Pokot counties with poor terrain.

In the region, pediatric surgery is limited to DHQ HOSPITAL BANNU, as it is the only tertiary hospital and the level of care for neonates with surgical conditions is poorly developed at lower institutions. The median age at presentation reported in this study is in variance with the report from Nigeria, where it was 23.5 hours (Abdur-Rahman et al., 2011). Only neonates with anterior abdominal wall defects were studied in Nigeria and such deficits continue to be common presentation with mothers bringing in the neonates ill to the hospital due to the nature of the presentation.

The overall mortality was 31.±%, almost similar to a study conducted at KNH where the overall mortality was 33% (Ajanja, 2019). Both these country's only national referral hospitals and are tertiary level hospitals managing neonates with surgical disorders referred from peripheral facilities located in their catchment populations as well as neighboring provinces, from October 2023. Higher mortality in both the hospitals may also be due to delayed presentation, especially with a complication, that is, fluid and electrolyte derangement. The same results may be linked to the low number of studied neonates in both hospitals as well as the short duration of both studies.

A similar study was conducted by DHQ HOSPITAL BANNU in 2008 where overall mortality was 24% which indicates a rise in mortality trends over the 10 years. However that study was retrospective, carried out over 3 years, and in fewer number of neonates with surgical diseases. This study was in different and new unit (60 bed) whereas earlier study was at old unit (20 bed) and it is multi-disciplinary -neurosurgery, orthopedics and plastic surgery (Tenge-Kuremu et al., 2007). Over the years, there has been an increase in the number of admissions of neonates with surgical conditions leading to a congestion of the unit which may explain the change in the mortality rate. One of the factors significantly associated with mortality was NEO SEPSIS. Mortality rate in this study was lower than reported by Ugwu in Nigeria (48.2%) who also had higher mortality after surgical interventions. A different study carried out by Kouame in Abidjan showed a mortality rate of 52% (Kouame et al., 2015).

HIC) to be predictive of lower mortality in a survey specifically designed to compare mortality outcomes in LICs and HICs. Mortality rates less than 25% were reported in HICs; 50–75% in MICs and >75% in a few LICs (Kouame et al., 2015). This difference may arise as in the present study, self-administered questionnaires were distributed in the context of an annual scientific conference which may lead to recall bias that could jeopardize the validity of study findings. Lower mortality in HICs may reflect inequities in access to adjuncts of peri-operative care (eg NICU, TPN), which are more widely available in HICs.

Gastroschisis was the predominant diagnosis, different from a prior report from the same Centre 10 years prior, which revealed that the most common condition was ARM (34%). It differs from KNH study (Ajanja, 2019) which had highest(19.2%) and next anterior abdominal wall defects(17.2%)at level of ARM. This could be attributed to an overall shift in the incidence of surgical conditions that may affect neonates. In Durban (Sekabira & Hadley, 2009) Gastroschisis alone was said to have increased from 6% in 2003 to 15% in 2007. The incidence of anterior abdominal wall defects is increasing worldwide; the British Register on anomalies has reported that gastroschisis increased from 2.5/10,000 in 1994 to 4.4/10,000 in 2004. Compared to other studies it

has a broader catchment population of neonates with gastroschisis, some coming from as far away as Kiambu, Turkana and Nakuru counties, thus reflecting the rise in gastroschisis numbers dealt with in the hospital.

Inadequate use of nutritional dietary supplements such as folate —both before conception and during pregnancy—has also been associated with an increased risk of not only neural tube defects but also anterior abdominal wall defects. "Most mothers of neonates did not use folic acid as per guidelines for the preconceptual period and first trimester of pregnancy. More than half of the mothers of participants used dietary supplements, such as folic acid and iron, in the second trimester of pregnancy, when organogenesis and presumably vascular development had been completed, meaning that use of these supplements could not have had a beneficial influence on the prevention of neural tube defects (or their effects). A majority (299) of the included participants were primary cases delivered at peripheral health facilities found to be requiring surgical intervention and were referred to DHQ HOSPITAL BANNU. This is commensurate with the remaining studies in which the majority of such neonates with surgical conditions were cared for at tertiary centers (Tenge-Kuremu et al., 2007). There was a high mortality rate (Abdur-Rahman et al., 2011; Tenge-Kuremu et al., 2007), and outcomes of most of the referred neonates were poor. While this study only analysed the effect of attendance at least 1 ANC on the outcome and found an inverse relation with low mortality rate (attendance–mortality correlation), ANC uptake during the study period was poor, wherein only 13.7% of mothers had completed the recommended 4 ANC visits during their pregnancy. In addition, low ANC attendance (as reported in certain studies) and direct usage of nutritional supplementation in peri conception period (as recommended) may also have led to the increase of certain conditions like gastroschisis and neural tube defect.

Perhaps because nearly 50% of mothers also come for first ANC visit at second trimester & only 4% mothers underwent obstetric USG during their pregnancy, none of the congenital nature was diagnosed during prenatally. This may be due to the fact that the majority of the scan are routed in peripheral health facilities and from ultra sonographer, and they may not be able to confirm or detect some congenital anomaly.

Only one quarter of patients were subjected to blood cultures, with sepsis confirmed in 21% of subjects and nearly half receiving a presumptive diagnosis of probable sepsis. Wound sepsis was also the most common complication of surgery in neonates and may partly account for the increased length of stay. And this may also leads to hospital-acquired infection. Moreover, even with the use of tears of skin anterior abdominal defects → this lead can also cause infection Blood Pool due to your sensitivity from daily cleaning, dieting incision wedge.

In this series, however, a significantly higher proportion of neonates remained nil per oral for >3 days (51.3%) with a range of 1–24 days as mentioned previously. TPN was available but not in the unit and would have benefited these neonates. From this they realized that neonates with respiratory distress were four times as likely to die as those without respiratory distress, suggesting a need for better delivery of respiratory support care for these babies, Dr. James said. Status & how are they influencing Poor outcome elsewhere in many developing countries has been blamed lack of supportive care provided eg TPN, NICU services.

Nearly half of neonates that were not resuscitated or were not offered surgery at DHQ HOSPITAL BANNU died or were too sick to safely offer surgery. Because both studies were perinatal death, outcomes were dismal due to insufficient ventilatory support & Neontal ICU. By the quarter of them who died before the operation and the total too ill to survive the operation who died afterward. Low platelet count, respiratory distress needing oxygen and/or CPAP, and electrolyte disturbance were associated with outcomes. In contrast, other reports from different centers have shown that sepsis and multiorgan failure presenting symptoms as respiratory distress and thrombocytopenia (Arnold et al., 2010; Kuradusenge et al., 2014), were the factors most closely related to mortality.

This is different from a Nigerian study in which the median length of stay in hospital was 10 days and the median length of stay in our study was 14.5 days (Kuradusenge et al., 2014). All but one patient in this Nigerian series had isolated anterior abdominal wall defects (omphalocele major in the

majority), which may account for their short hospital stay . This prolonged hospital admission is in contrast to a KNH study which had a median of 10.2days (Ajanja, 2019).The long duration of hospital stay seen in this study may be because most of the neonates with gastroschisis presented late and required staged closure which would cause a delay in recovery and increase the duration of hospital stay. It also significantly related to its relation between timing of initiation of oral feeds and duration of stay. This correlation has most clearly been seen in patients who had been admitted for > 72 h without enteral feeds whom had a 50% mortality (Abdur-Rahman et al., 2011), suggesting that commencing feeds in the early postoperative period is crucial. Co-morbid conditions such as neonatal sepsis and neonatal jaundice might have also contributed most likely to prolonged hospital stay as a treatment of proven sepsis requires to use of antimicrobials for minimum 10–14 days. Burst abdomen and wound sepsis can cause wound complications which might also need re-operation and thus result in increased duration of hospital stay.

Conclusions

The overall mortality of neonates needing surgical procedures at DHQ hospital, bannu was 31.5% and the mean duration of hospitalization was 14.5 days. Some of the conditions that had a strong association with higher odds of demise included neonatal sepsis, respiratory distress and electrolyte imbalance.

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