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Pediatric Surgery

Burden of Neonatal Surgical Conditions and Their Outcomes in a Resource-Limited Tertiary Hospital in Bangladesh

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Abstract **Original Research Article**

Background: In resource-constrained healthcare settings, neonatal surgical challenges contribute significantly to elevated morbidity and mortality rates, particularly in low- and middle-income countries. This study aimed to comprehensively investigate the demographic distribution, prevalence of surgical conditions, procedural trends, temporal patterns, and postoperative complications in neonates admitted to a government hospital in Bangladesh ***Methods:*** A retrospective observational study was conducted, analyzing data from neonates admitted to the pediatric surgery unit at Rajshahi Medical College Hospital, from January to December 2022. Data were collected using structured forms and analyzed using SPSS version 22. ***Results:*** Of the neonates studied, 58.3% were male, and 41.7% were female. Gastrointestinal system disorders were the most prevalent (50.76%) which was followed by abdominal wall defects (18.94%), central nervous system anomalies 9.1%, head, neck, face, and soft tissue diseases 13.5% and urogenital system issues were only 6.0%. Total mortality was 22.35% with notable death in Gastroschisis (54.16%), Oesophageal atresia (50%) and Intestinal atresia (47.37%). Pelvic Colostomy was the predominant surgical procedure (11.2%), with 62.1% performed within the first three days of life. Postoperative complications affected 16.8% of cases. ***Conclusion:*** This study highlights the critical challenges faced by neonates with surgical conditions in resource-limited settings, emphasizing prevalent conditions, temporal distribution patterns, and high mortality rates. Addressing these challenges is essential for improving outcomes and enhancing neonatal surgical care in similar contexts worldwide.

Keywords: Neonatal Surgical Outcomes, Resource-Limited Setting, Binary Logistic Regression.

INTRODUCTION

Healthcare systems, particularly in resource-constrained regions, grapple with significant challenges related to neonatal surgical problems, hindering access to advanced medical care. Globally, neonatal surgical issues present formidable challenges, particularly in areas with limited resources, resulting in elevated morbidity and mortality rates. Progress in neonatal surgery outcomes seen in developed countries is not universally realized in resource-constrained areas [1]. A study carried out in a government hospital in Bangladesh's tertiary level provides important insights into the difficulties encountered in a setting with low resources by illuminating the mortality rate from surgical conditions in children [2]. Regretfully, low- and middle-income countries account for almost 90% of the neonatal surgical patient burden (LMICs) [3]. Studies on the prevalence of surgical problems in neonates go beyond geographical boundaries.

A study conducted in Northern Ghana emphasizes the value of thorough studies, particularly on outcome prediction to address neonatal surgical mortality and morbidity. This study adds to a better understanding of the global landscape by offering insightful information about the difficulties experienced by neonates in a variety of socioeconomic circumstances [4]. Newborn mortality has been demonstrated to significantly contribute to the global under-five mortality rate, with surgical disorders accounting for 10% of newborn deaths in low- and middle-income countries [5,6]. A tertiary hospital experience spanning ten years offers important insights into the range and prevalence of surgical illnesses in neonates. Examining the survival rates of newborns experiencing surgical emergencies—

whether congenital or acquired—is one aspect of this. These kinds of studies are crucial in creating healthcare plans that enhance newborn results [7]. Furthermore, studies carried out in a corporate hospital in Bangladesh emphasize the prompt delivery of advanced perioperative care. This highlights the possibility of achieving better results with improved perioperative care and intervention techniques [8]. Neonate surgery is a very delicate, technical, and sensitive type of surgery, particularly when done in an environment without a neonatal intensive care unit (NICU), complete specialist nursing personnel, a skilled neonatal anesthetic team, and parenteral nutrition (TPN) [9]. For both the pediatric surgeon and the neonate, managing a newborn with surgical problems presents an additional difficulty, particularly in emerging nations where the aforementioned amenities are still deficient [10].

The outcome may be worsened by a lengthy surgical procedure, blood loss during the procedure, and hypothermia during or after the procedure. Neonatal mortality remains high in developing nations compared to industrialized nations due to limited access to prenatal diagnosis and a shortage of skilled workers [11,12]. The majority of surgical reasons in newborns relate to congenital abnormalities. Five congenital defects can be corrected surgically; but, if they are not identified and treated in a timely manner, they will result in death. Shortly after birth of the afflicted infant. Anorectal malformations, Hirschsprung's disease, atresia of the small and large intestine, esophageal atresia, necrotizing enterocolitis (NEC), abdominal wall defects (omphalocele and gastroschisis), strangulated inguinal hernias, neural tube defects, infantile hypertrophic pyloric stenosis, bladder and cloacal exstrophy, posterior urethral valves, teratoma, and skin and soft tissue infections are among the various surgical conditions that manifest in the neonatal period [13,14]. "The pediatric surgery department at Rajshahi Medical College is a tertiary care facility for pediatric and newborn surgery. However, the NICU, TPN, and certified nursing personnel are not available. Despite our limited resources, we successfully manage neonates with surgical problems and achieve satisfactory results. The current research was undertaken to examine neonates with various surgical conditions and assess the outcomes of their management. Additionally, the study aims to compare the gathered data with existing literature on pediatric surgical cases.

METHODOLOGY

This was a retrospective observational study that involved the collection and analysis of data from all patients admitted to the pediatric surgery unit at Rajshahi Medical College Hospital from January to December 2022. Data were gathered by extracting information from hospital records using a structured data collection form, capturing details related to neonatal surgical conditions, demographic and clinical variables, and available treatment facilities. Subsequently, the collected data were analyzed using SPSS version 22, with categorical data presented as frequencies and numerical data expressed as mean ± standard deviation.

RESULT

The study collected data from approximately 264 neonatal surgical patients admitted to the pediatric surgery unit at Rajshahi Medical College Hospital between January to December 2022.

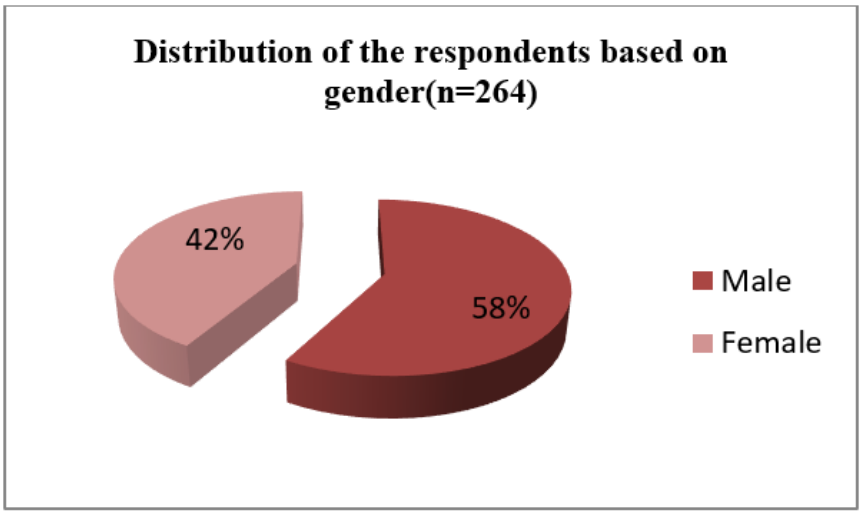

Figure 1: Distribution of the respondents based on Gender (n=264)

The figure presented a gender distribution of 58.3% for males and 41.7% for females.

Table 1: Distribution of respondents based on age in days (n=264)

Age of the Respondents	Frequency	Percentage (%)
1 hour to 7 days	183	69.3
8 to 14 days	22	8.3
15 to 21 days	28	10.6
22 to 28 days	31	11.7

Table 1 presented the distribution of respondents based on their age in days (n=264). The categories included 1 hour to 7 days (69.3%), 8 to 14 days (8.3%), 15 to 21 days (10.6%), and 22 to 28 days (11.7%).

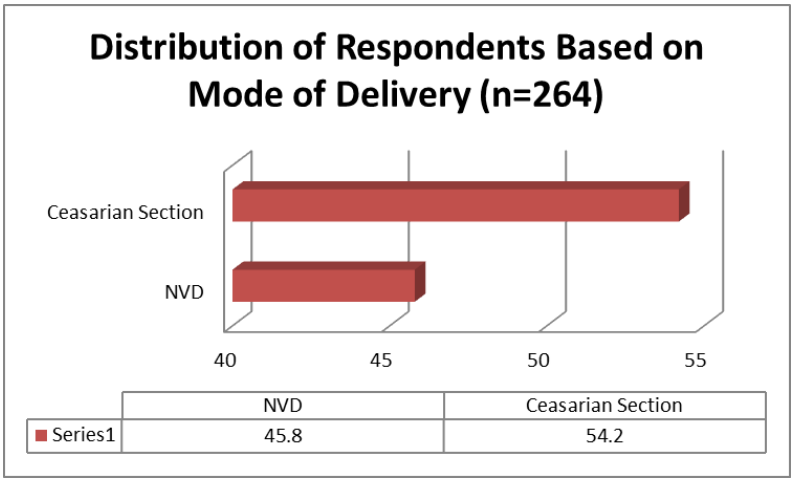

Figure 2: Distribution of Participants Based on Mode of Delivery (n=264)

The figure illustrated the distribution of modes of delivery among the respondents, with 45.8% undergoing normal vaginal delivery (NVD) and 54.2% having a cesarean section.

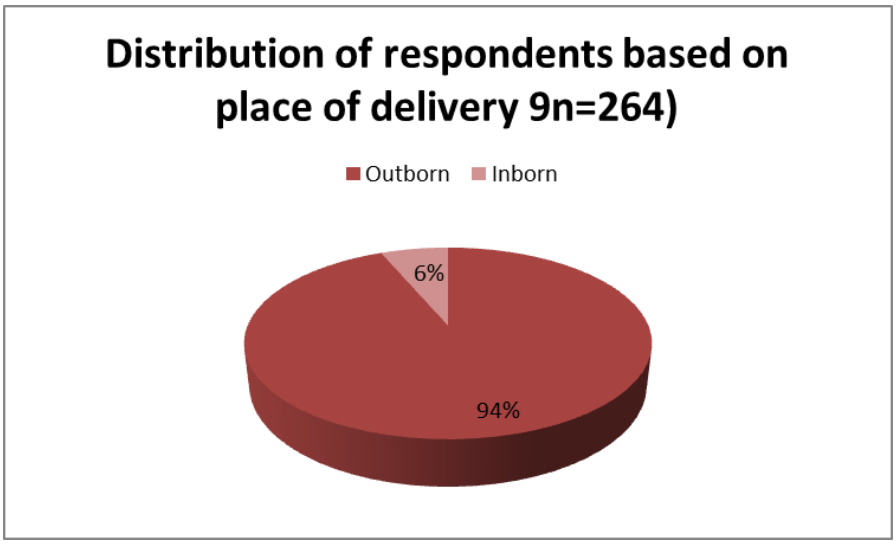

Figure 3: Distribution of respondents based on place of delivery (n=264)

The figure depicted the distribution of infants based on their location of birth. Specifically, 93.6% were classified as out born, while 6.4% were categorized as inborn.

Table 2: Distribution of the participants based on place of delivery (n=264)

Place of Delivery	Frequency	Percentage (%)
Term	210	79.5
Pre Term	54	20.5

Table 2 illustrated the distribution of participants based on the place of delivery (n=264). The categories included Term and Pre-Term. In the past, 210 participants (79.5%) were classified as Term, while 54 participants (20.5%) were categorized as Pre-Term.

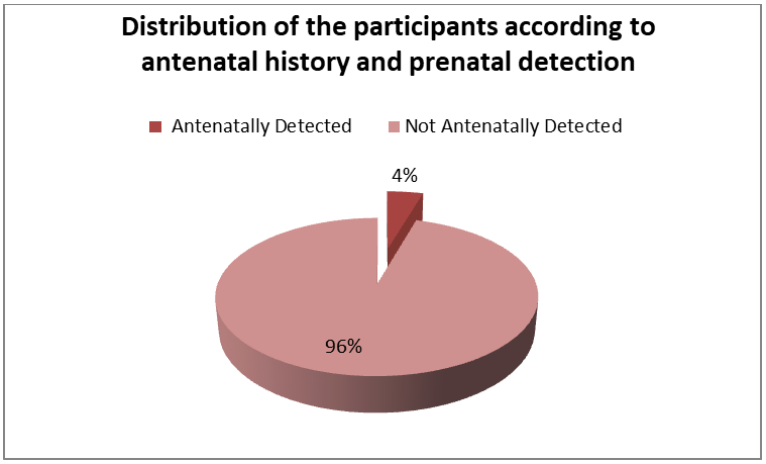

Figure 4: Distribution of respondents according to antenatal history and prenatal detection (n=264)

The figure illustrated the distribution of cases based on antenatal detection, with 4.5% being antenatally detected and 95.5% not antenatally detected.

Table 3: Distribution of Respondents Based on Birth weight (n=264)

Birth weight	Frequency	Percentage (%)
Normal birth weight (>2.5 kg)	178	67.4
LBW(<2.5 kg)	86	32.6

Mean ±SD=2.60 ±0.544

Table 3 showed the distribution of respondents by birth weight (n=264). In the past, 67.4% had a normal birth weight (>2.5 kg), and 32.6% had a low birth weight (<2.5 kg).

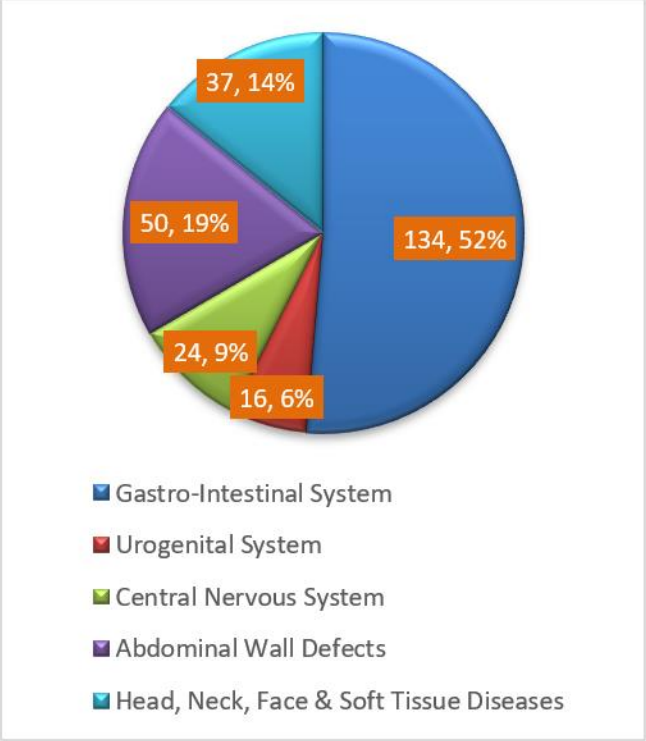

Figure 5: Distribution of Respondents by Various Systems with percentage

The distribution of respondents based on various surgical conditions from a sample size of 264. Gastrointestinal system disorders were the most prevalent (50.76%) which was followed by abdominal wall defects (18.94%). Conditions related to the central nervous system represented 9.1% of cases. Head, neck, face, and soft tissue diseases comprised 13.5% of the respondents. Urogenital system issues were the least frequent condition which comprises of only 6.0%. These findings suggest the diverse range of surgical conditions encountered.

Table 4: Distribution of Respondents Based on Surgical Conditions (n=264)

Diagnosis	Frequency	Percent	No. of mortality	Disease specific mortality rate (%)
Gastro-Intestinal System				
A. Oesophageal Conditions				
Oesophageal Atresia with Tracheo-oesophageal Fistula	2	.8	1	50
B. Gastric Disease				
Antral Web	1	.4	0	0
Pyloric Atresia	3	1.1	0	0
IHPS	4	1.5	0	0
C. Small Intestinal Conditions				
Jejunal Atresia	8	3.0	6	75
Ileal Atresia	10	3.8	2	20
Multiple intestinal Atresia	1	.4	1	100
Malrotation of gut	10	3.8	1	10
NEC	11	4.2	6	54.5
Meconium Ileus	7	2.7	0	0
Meconium plug syndrome	3	1.1	0	0
Intestinal obstruction due to Mackel's band	3	1.1	3	100
Subacute intestinal obstruction	6	2.3	0	0
D. Large Intestinal Conditions				
Hirschsprung's Disease	19	7.2	0	0
Hirschsprung's Disease with sigmoid perforation	3	1.1	3	100
Hirschsprung's Disease with Transverse colon perforation	2	.8	1	50
ARM (High Variety)	16	6.1	8	50
ARM (Low variety)	15	5.7	2	13.33
ARM with Colostomy in situ Septicemia	3	1.2	3	100
ARM with Vestibular fistula	6	2.3	0	0
Persistent Cloaca	1	.4	1	100
Urogenital System				
Pelvi-ureteric Junction Obstruction	1	.4	0	0
Posterior Urethral Valve	3	1.1	0	0
Meatal Cyst	1	.4	0	0
Hydrocele	1	.4	0	0
Undescended Testis	3	1.1	0	0
Withdrawal P/V Bleeding	4	1.5	0	0
Hydrometrocolpos	3	1.1	0	0
Central Nervous System				
Encephalocele	3	1.1	0	0
Hydrocephalus	1	.4	0	0
Meningocele	4	1.5	0	0
Myelomeningocele	16	6.1	1	6.25
Abdominal Wall Defects				
Gastroschisis	24	9.1	13	54.16
Omphalocele	17	6.4	2	11.7
Ruptured Omphalocele	5	1.9	4	80
Congenital Diaphragmatic Hernia	2	.8	0	0
Umbilical Hernia	2	.8	0	0
Head, Neck, Face & Soft Tissue Diseases				
Cleft lip	5	1.9	0	0

Diagnosis	Frequency	Percent	No. of mortality	Disease specific mortality rate (%)
Cleft lip & Cleft palate	2	.8	0	0
Abscess	11	4.2	0	0
Haemangioma	2	.8	0	0
Cystic Hygroma	9	3.4	0	0
Lipoma	2	.8	0	0
Umbilical Granuloma	2	.8	0	0
Cut injury over Scalp	1	.4	1	100
Minor head injury due to fall	2	.8	0	0
Surgical site infection	1	.4	0	0
Others				
Multiple congenital anomalies	3	1.1	0	0

The distribution table of surgical conditions among 264 respondents with 59 (22.35%) mortality reveals a spectrum of issues with low frequency but high disease specific mortality rate like Oesophageal atresia with Tracheo-oesophageal fistula, 2 respondents with 50% mortality, Gastroschisis, 24 with 54.16% mortality and intestinal atresia, 19 with 47.37% mortality, underscoring their critical nature. On the other hand, diseases like Hirschsprung's disease (n=24) and Anorectal malformations (n=41) were high in number but low mortality, only 16.67% and 34.15% respectively. These findings emphasize the complexity and severity of these surgical conditions, highlighting the imperative for specialized care and interventions.

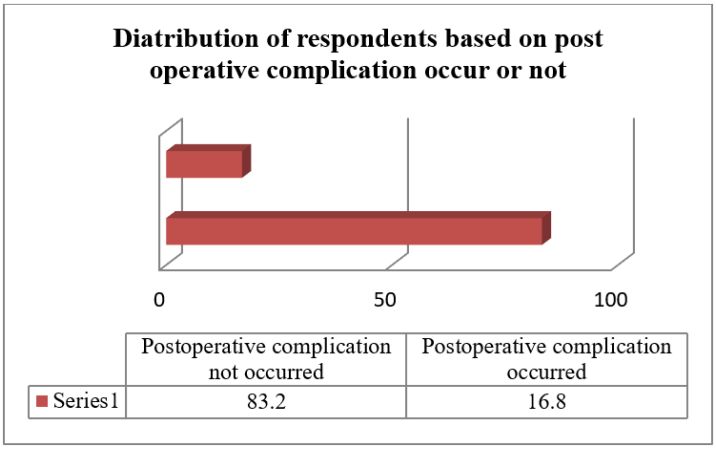

Figure 6: Distribution of respondents according to post operative complication occur or not

This figure revealed that 16.8% of cases encountered postoperative complications, while 83.2% did not. This highlights a substantial prevalence of adverse outcomes following surgery. Addressing and understanding the factors contributing to these complications are crucial for enhancing patient outcomes.

Table 5: Various operative procedures performed on study participants (n=264)

Name of operation	Frequency	Percent
Anderson Hynes Pyeloplasty	1	0.8
Anoplasty	14	11.2
Bishop-koop Ileostomy	1	0.8
Excision of lipoma	2	1.6
Gastro-duodenostomy	1	0.8
Hysterotomy and evacuation	3	2.4
Incision & Drainage	10	8.0
Ladd's procedure	5	4.0
Laparotomy with colostomy	1	0.8
Laparotomy with ileostomy	6	4.8
Laparotomy with jejuno-jejunostomy	6	4.8
Laparotomy with repair of diaphragmatic hernia	1	0.8
Laparotomy with Resection and end to end anastomosis	1	0.8

Name of operation	Frequency	Percent
Laparotomy with Santulli procedure	13	10.4
Multilayered repair of myelomeningocele	6	4.8
Pelvic Colostomy	14	11.2
Primary Repair of cut injury	1	0.8
Primary repair of Gastroschisis	9	7.2
Primary repair of omphalocele	10	8.0
Pyloromyotomy	4	3.2
Resection & Anastomosis	6	4.8
Roux-en-Y Gastro-jejunostomy	3	2.4
Silo Closure followed by staged repair	4	3.2
Staged Closure along with resection-anastomosis	1	1.6
V-P Shunt with Repair of Myelomeningocele	2	0.8
Total	125	100.0

The table summarized the frequency and percentage distribution of surgical procedures. Pelvic Colostomy was the most common operation, representing 11.2% of cases, followed by Anoplasty (11.2%) and Laparotomy with Santulli procedure (10.4%). The data provided insights into the diverse array of surgical interventions, with Pelvic Colostomy emerging as the most frequently performed operation among the study participants.

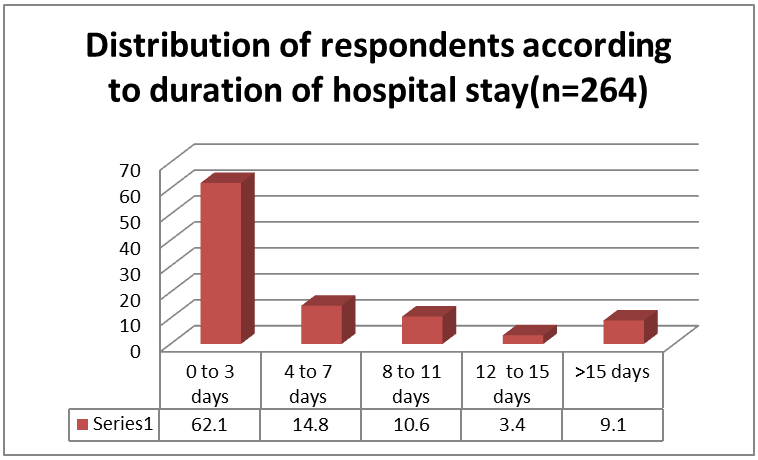

Figure 7: Distribution of respondents according to duration of hospital stay

The figure depicted the distribution of a variable over time intervals. The majority of cases occurred within the first three days (62.1%), followed by 4 to 7 days (14.8%), 8 to 11 days (10.6%), and 12 to 15 days (3.4%). A smaller percentage of cases extended beyond 15 days (9.1%). This information provided a snapshot of the temporal patterns observed in the dataset.

Table 6: Factors Influencing Survival Among Patients with Varied Surgical

Variables of interest/Predictors	Binary Logistic regression		
	Odds Ratio	95% interval of OR	p-value
Term baby	4.373	(1.307, 14.637)	0.017
Operative Treatment	0.192	(0.088, 0.416)	0.000
hospitals stay (8 to 11 days)	2.438	(0.594, 10.002)	0.216

Table 6 summarized the findings from a past binary logistic regression analysis investigating survival factors among patients with varied surgical conditions. Three key predictors were explored: Term Baby, Operative Treatment, and Hospital Stay Duration (8 to 11 days). Term Baby exhibited a statistically significant association with increased odds of survival (Odds Ratio = 4.373, 95% CI: 1.307 to 14.637, p = 0.017). Operative Treatment showed a significant impact, reducing odds of survival (Odds Ratio = 0.192, 95% CI: 0.088 to 0.416, p = 0.000). Hospital Stay Duration (8 to 11 days) suggested increased odds (Odds Ratio = 2.438), but the association was not statistically significant (p = 0.216). Overall, the results highlighted the significance of being a term baby and the influence of operative Treatment on survival outcomes.

DISCUSSION

It is commonly known that over 4 million babies perish within the first few months of life each year, with developing nations accounting for around 98% of these deaths. Due to these newborn fatalities, birth anoxia and Infections are the main causes. But there are other unspoken factors as well. The United Nations Sustainable Development Goal (SDG-3) target of resource-limited neonatal deaths by 2030 cannot be met without enhancing surgical care for newborns in resource-constrained settings. Surgical conditions are typically not highly achieved [15,16]. In this study, we observed a gender distribution of 58.3% for males and 41.7% for females.

This pattern was also noted in an observational study on neonatal surgical outcomes at a tertiary academic hospital, where the gender distribution was 58.3% males and 41.7% females [17]. Age distribution revealed that the majority fell within the 1 hour to 7 days category (69.3%). Similar findings indicate varying levels of detail regarding age distribution in neonatal surgical outcomes. Jackson *et al.* (2013) did not explicitly mention age distribution in their study [18]. In contrast, Siddharth *et al.* (2019) provided detailed information, reporting that all deaths occurred in the early neonatal period, with a majority (69.3%) within 1 to <7 days [19]. Modes of delivery exhibited a split between normal vaginal delivery (45.8%) and cesarean section (54.2%). Chugh *et al.* (2023) found a combination of normal vaginal delivery (45.8%) and cesarean section (54.2%) in cases of primary caesarean section, echoing the observed split in modes of delivery and highlighting their relevance to neonatal outcomes [20].

Additionally, most infants were classified as out born (93.6%). Prevalence of term and preterm deliveries was 79.5% and 20.5%, respectively. Das's (2022) study examined the outcomes of newborns undergoing surgery, and it found a high overall mortality rate of 73.91%. The study focused on how maternal age, prenatal care, congenital malformation history, and socioeconomic position affect the results of newborn surgery [21]. Term, suitably grown male newborns in primiparous pregnancies performed more poorly in the intrapartum and neonatal periods, according to a study by Dunn (2015) that examined gender-specific intrapartum and neonatal outcomes [22]. Antenatal detection was low at 4.5%, and birth weight distribution showed 67.4% with normal birth weight (>2.5 kg). The study's low fetal detection rate of 4.5% suggests that it can be difficult to detect some diseases during pregnancy [23]. Furthermore, the distribution of birth weight analysis showed that a significant percentage, precisely 67.4%, had a normal birth weight, which is defined as being more than 2.5 kg [24]. This data emphasizes the significance of recognizing the majority of infants with a healthy birth weight while simultaneously resolving prenatal detection constraints. Furthermore, our findings highlighted significant occurrences of various surgical conditions, such as Gastroschisis (9.1%), High-variety Anorectal Malformation (ARM) (6.1%), Hirschsprung's Disease (7.2%), and Necrotizing Enterocolitis (NEC) (4.2%), each associated with distinct mortality rates. Moreover, our results are consistent with a study that was carried out in Northern Ghana to evaluate the postoperative conditions of newborns.

Congenital anomalies accounted for more than 82% of all neonatal surgical diseases, according to the study, highlighting the frequency of these conditions in newborns [25]. These consistent results highlight the importance and stability of the occurrence of surgical problems in newborns, with regional variations noted. Anorectal anomalies are among the common congenital abnormalities that require surgical intervention that Woldemicael *et al.* reported in a related investigation, indicating the prevalence of these diseases in various populations [26]. Nevertheless, a study by Radhakrishnan *et al.* did not particularly address high-variety anorectal malformation; instead, it concentrated on problems affecting the newborn digestive tract. This difference highlights how research on neonatal surgical problems varies in both breadth and focus [27]. The most common surgical procedure reported in the study was Pelvic Colostomy, accounting for 11.2% of cases, as highlighted by Fonseca *et al.* (2017) [28]. Temporal distribution of cases showed a majority within the first three days (62.1%). Odhiambo *et al.* (2022) presented findings indicating that the temporal distribution analysis unveiled a predominant occurrence of cases within the initial three days, comprising 62.1% of the total cases [29].

Regarding postoperative complications, 16.8% of cases experienced them, emphasizing the substantial prevalence of adverse outcomes. Dharap *et al.* (2022) noted that when it comes to postoperative complications, a significant majority of cases, totaling 83.2%, encountered adverse outcomes [30]. The mortality issue by drawing parallels with a recent study conducted by Abdul-Mumin *et al.* (2020). Their study focused on identifying determinants of treatment success for preterm babies through binary logistic regression analysis. This approach allowed them to highlight various variables and their impact on overall outcomes, indirectly touching upon the mortality issue. Moreover, the findings of Abdul-Mumin *et al.* align with our study's results, as both underscore the significance of certain factors, such as being a term baby and the influence of operative treatment, in predicting survival outcomes [31,32].

CONCLUSION

This study unveiled significant challenges in managing neonatal surgical conditions in a resource-limited tertiary hospital in Bangladesh. The findings emphasized the prevalence of diverse surgical illnesses,

urging the need for targeted interventions. Demographic patterns aligned with existing literature, while the high occurrence of postoperative complications underscored the urgency for enhanced care strategies. In conclusion, tailored healthcare plans were crucial to address specific challenges and improve neonatal outcomes in resource-constrained settings.

Recommendations

- Improve perioperative protocols to enhance outcomes and decrease complications.
- Strengthen prenatal screening to detect surgical conditions early for timely intervention.
- Invest in NICU facilities, trained staff, and equipment for better neonatal surgical care.

Acknowledgement

I extend my heartfelt appreciation to all who contributed to this study, including the medical staff, research assistant, and administrators in the Department of Pediatric Surgery at Rajshahi Medical College Hospital, Rajshahi, Bangladesh. Dedication and expertise were invaluable in advancing our understanding of neonatal surgical care and improving outcomes for our patients.

Author Contributions

This study, conducted at Rajshahi Medical College Hospital, was spearheaded by Md. Zamil Hossain, Resident Surgeon, who led in study design, data collection, and manuscript drafting. Professor, Md. Nowshad Ali, provided oversight, and contributed to manuscript revisions. Associate Professor Shah Md. Ahsan Shahid refined methodologies, conducted investigations, and aided in manuscript editing. Assistant Professors Shantona Rani Paul and Abdullah Al Mamun played key roles in data curation, investigation, visualization, and manuscript review. Their collaborative effort illuminates neonatal surgical challenges in resource-limited contexts, offering valuable medical insights.

Abbreviations

NICU - Neonatal Intensive Care Unit
NVD - Normal Vaginal Delivery
LBW - Low Birth Weight
NEC - Necrotizing Enterocolitis
ARM - Anorectal Malformation
IHPS - Infantile Hypertrophic Pyloric Stenosis
V-P Shunt - Ventriculoperitoneal Shunt

Article at a glance

Study purpose: The study examined the impact and outcomes of neonatal surgical conditions in a resource-limited hospital in Bangladesh, providing insights for improved healthcare strategies.

Key findings: In a resource-limited tertiary hospital in Bangladesh, this study uncovered prevalent neonatal surgical conditions such as Gastroschisis and High-variety Anorectal Malformation. Demographic patterns, temporal distribution, and a substantial rate of postoperative complications emphasized the need for targeted interventions to enhance neonatal outcomes in constrained healthcare settings.

Newer findings added to what is known: This study contributes novel insights to our understanding of neonatal surgical conditions in a resource-limited setting, expanding knowledge on demographics, conditions, and temporal patterns.

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Conflict of interest: None declared

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