

Spectrum of Neonatal Surgical Emergencies at a Government Tertiary Care Centre in Madhya Pradesh: An Observational Study

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ABSTRACT

Introduction: This impoverished region of India, where the majority of the population suffers from poverty and malnourishment, lacks data regarding the epidemiological pattern for surgical congenital abnormalities to date. Hence, there is a dire need to gather epidemiological data on newborn surgical emergencies, which has been lacking.

Aim: To study the epidemiological data of neonatal patients requiring emergency surgery and to evaluate the variables affecting morbidity and mortality in emergency newborn surgery cases.

Materials and Methods: This retrospective observational study was carried out at Gajra Raja Medical College, Gwalior, Madhya Pradesh, India from October 2018 to August 2022. Case records of emergency surgical interventions in neonates presenting to the Emergency Department under the age of 30 days of life were reviewed. The outcomes, postoperative morbidity, and mortality were noted. The data was presented descriptively using frequency and percentages.

Results: In the present study, the male-to-female ratio was 1:1.2, the mean age was 4.9 days \pm 4.1 days, and the mean birth weight was 2025 \pm 635 grams. Anorectal Malformations (ARM), 178 (37.71%) and Oesophageal Atresia (EA), 133 (27.8%) were the most prevalent congenital abnormalities in the current investigation, followed by other congenital gastrointestinal anomalies. Nonetheless, the remarkably elevated prevalence of pouch colon among patients with ARM deserves particular attention. In compared to a well-prepared Neonatal Intensive Care Unit (NICU), an inadequately equipped Sick Newborn Care Unit (SNCU) with a small nursing staff represents inadequate infrastructure for the management of a surgical neonatal emergency.

Conclusion: The majority of patients died from postoperative septicaemias, accounting for 35.5% of the mortality rate among these neonates who underwent emergency surgery. A large percentage of infant mortality in underdeveloped nations like India might be avoided with proper perioperative care, especially for surgical infants.

Keywords: Anorectal malformation, Neonates, Oesophageal atresia, Pouch colon, Surgical interventions

INTRODUCTION

Congenital malformations, which are estimated to account for 15% of perinatal mortality in India, are structural anomalies of prenatal origin arising from faulty embryogenesis. Congenital malformations affect about 3% of newborns [1,2]. The most crucial life-saving treatments are performed in neonatal surgery, which is the most specialised sub-specialty of Paediatric surgery. Many factors like early diagnosis, birth weight, maturity, preoperative optimisation, and postoperative care, can impact the outcome of a neonatal surgical procedure [2,3]. To save a life, the highest caliber of preoperative, intraoperative, and postoperative infrastructure and expertise are needed.

Reductions in surgical morbidity and deaths in advanced economies have been largely attributed to developments in neonatal intensive care. Higher positive postoperative outcomes for NICUs are attributed to enhanced technology, trained healthcare providers, and better monitoring [2]. Even though more than 90% of patients benefit from surgery in low-to-middle-income nations, the expense of infrastructure for a well-equipped NICU treating surgical neonates is very high, and there are very few assigned neonatologists. This leads to dismal outcomes for emergency neonatal procedures in underdeveloped countries [3,4].

Due to a shortage of paediatric surgical centres in this region of India, epidemiological data on congenital abnormalities in children necessitating emergency surgery is severely underrepresented

[5,6]. For a sizable rural and impoverished population in central Indian states like Madhya Pradesh (particularly the Bundelkhand region), home to about 2% of India's population [5], this paediatric surgery department is the only facility that handles paediatric surgical emergencies. Paediatric surgeons and neonatologists face a significant challenge when dealing with surgical emergencies in newborns, as these cases typically involve congenital abnormalities.

Thus, in comparison to other Low or Middle-income Countries (LMIC) [7-9], the present study was conducted to evaluate the results of neonatal surgical emergencies and investigate the difficulties and constraints associated with neonatal emergency surgery in this region of India, which serves one of the most impoverished populations. There is currently no data on neonatal surgical emergencies from any paediatric surgical centres in central India. Hence, the present study was conducted to study the epidemiological data of neonatal patients requiring emergency surgery and also to evaluate the variables affecting morbidity and mortality in emergency newborn surgery cases.

MATERIALS AND METHODS

The retrospective observational study was carried out over four years, from October 2018 to August 2022, at Gajra Raja Medical College in Gwalior, Madhya Pradesh, India. The data collection took place from September 2022 to November 2023. The study received approved by the Institutional Ethical Committee (ICE approval number 1194/ICE-GRMC/2023 dated 01.06.2023). Written informed

consent was taken from the parents of the neonates for their inclusion in the study.

Inclusion criteria: The study included a total of 472 cases requiring emergency surgical intervention within 30 days of birth during the study period.

Exclusion criteria: Neonates with multiple congenital anomalies, neurosurgical anomalies, and musculoskeletal anomalies were excluded from the study.

Study Procedure

The Department of Paediatric Surgery, with 42 beds in a super-specialty hospital and two dedicated operating rooms, collaborated with the Department of Paediatrics in treating newborns. All newborns were admitted to the SNCU as there was no dedicated NICU, and no neonatologist was available. The SNCU, being the only referral centre in the region, had a high patient volume, with approximately 2-4 neonates per crib and a nurse-to-neonate ratio of approximately 15:1. There was no transport incubator available for transferring surgical neonates to the operating theater, located in a separate building. Bedside examination facilities such as ultrasound were not accessible. Paediatric residents performed duties on the floor, while the team of paediatric surgeons remained on call for surgical newborns.

All neonates were hospitalised, treated prophylactically with vitamin K and broad-spectrum antibiotics, and had dehydration corrected. Routine bedside examinations and radiological studies were performed in all cases to exclude renal and other congenital anomalies. Emergency surgery was performed based on the diagnosis. The outcomes, hospital course, postoperative morbidity, and mortality were noted from the medical records of all neonates. The Saxena-Mathur classification of pouch colon identifies type I as the absence of a normal colon, with the ileum opening into a pouch-like colon, type II as only the caecum, appendix, and some ascending colon being well-formed, with the rest as a pouch, type III as the normal ascending but transverse colon opening into the pouch colon, and type IV as the normal colon up to the level of the rectosigmoid pouch [10,11].

STATISTICAL ANALYSIS

Patient data were recorded manually in patient record files and analysed using Statistical Packages for the Social Sciences (SPSS) version 22.0. Categorical data were presented as frequency and percentages.

Diagnosis (n=472)	Number of cases n (%)	Associated anomaly	Management	Postoperative complications	
Anorectal Malformation (ARMs)-178 (37.71%) (58 females, males 120)	Low ARM male	27 (5.7%)	None	Anoplasty	None
	Intermediate ARM male	12 (2.1%)	Oesophageal atresia (1 case)	Colostomy	Wound dehiscence in 1 case
	High ARM male	31 (6.5%)	Vertebral anomalies (2 cases)	Colostomy	Anal incontinence in 3 cases
	Type I pouch colon*	13 (2.7%)	Oesophageal atresia (2 cases)	Colostomy pouchorrhaphy	Wound dehiscence in 1 case
	Type II pouch colon*	21 (4.4%)	Vertebral anomalies (3 cases)	Colostomy pouchorrhaphy	Anal incontinence in 1 case
	Type III pouch colon*	10 (2.1%)	Vertebral anomalies (1 cases)	Colostomy pouch excision	Anal incontinence in 1 case
	Type IV pouch colon*	6 (1.2%)	None	Colostomy pouch excision	None
	Female ARM	33 (6.9%)	None	Colostomy or primary ASARP	Wound infection in 1 case
	Cloaca (female)	13 (2.7%)	None	Colostomy	Anal incontinence in 1 cases
	Cloaca with Pouch (female)	12 (2.5%)	Hydrometrocolpos (3 cases)	Colostomy pouchorrhaphy	Wound dehiscence in 1 case

RESULTS

A total of 15,871 newborns were admitted to the SNCU in the last four years. Almost 2.97% of total neonatal admissions were diagnosed with either congenital or acquired surgical conditions. A total of 472 newborns were diagnosed with an emergency surgical indication. The number of admissions per year ranged from 106 to 126 over the past four years [Table/Fig-1]. The male-to-female ratio was 1:1.2 (215 males, 257 females). The age range was 1-19 days (mean of 4.9±4.1 days), and the birth weight ranged between 900 and 3100 grams (mean 2025±635 grams) of infants presenting to the surgical emergency department.

Annual statistics	Total no. of SNCU/NICU admissions (N=15871)	Surgical cases operated in newborn period (n=472)	Percentage (2.97%)
October 2018 to September 2019	3698	106	2.86%
October 2019 to September 2020	3938	126	3.19%
October 2020 to September 2021	4475	122	2.72%
October 2021 to September 2022	3760	118	3.13%

[Table/Fig-1]: Annual statistics of paediatric, neonatal and surgical neonatal admissions.

During the study period, a total of 472 neonates were managed by the paediatric surgical team. The most common neonatal surgical diagnosis detected during the study period was congenital gastrointestinal conditions such as ARMs (178 cases), followed by EA with or without tracheoesophageal fistula (148 cases), and congenital intestinal obstruction (64 cases) [Table/Fig-2].

The ARMs accounted for 178 (37.7%) of total admissions. In 33 (6.9%) cases, female infants were diagnosed with either anovestibular or rectovaginal fistula. A very high incidence of Congenital Pouch Colon (CPC) was also noticed among males with ARM: 10.8% of male ARM cases were Type-I pouch, 17.5% were Type-II, 8.3% were Type-III, and 5% were Type-IV pouch. EA was detected in 133 (27.8%) cases. Congenital intestinal obstruction was diagnosed in 64 (13.5%) cases, such as duodenal atresia 12 (2.5%), jejunal atresia 15 (3.1%), ileal atresia 26 (5.5%), colonic atresia 4 (0.8%), combined/multiple atretic segments 3 (0.6%), infantile hypertrophic pyloric stenosis 2 (0.4%), and meconium ileus 2 (0.4%) were noted [Table/Fig-2].

Oesophageal atresia with/without tracheo oesophageal fistula-133 (27.8%)	Pure oesophageal atresia	19 (4.02%)	None	Oesophagostomy gastrostomy	Surgical site infection in 9 cases
	Type C	112 (23.7%)	ARM (3 cases)	Fistula ligation and anastomosis	Anastomosis leak in 14 cases
	H type	2 (0.4%)	None	Fistula ligation and anastomosis	Surgical site infection in 1 cases
Congenital intestinal obstruction-64 (13.5%)	Duodenal atresia	12 (2.5%)	Annular pancreas (1 case)	Anastomosis	Surgical site infection in 2 cases
	Jejunal atresia	15 (3.1%)	None	Anastomosis	Anastomosis leak in 3 cases
	Ileal atresia	26 (5.5%)	None	Anastomosis	Anastomosis leak in 4 cases
	Colonic atresia	4 (0.8%)	None	Colostomy	Surgical site infection in 1 cases
	Combined/multiple atretic segments	3 (0.6%)	None	Anastomosis	Anastomosis leak in 2 cases
	Meconium ileus	2 (0.42%)	None	Stoma	Surgical site infection in 1 cases
	Infertile hypertrophic pyloric stenosis (Not a congenital anomaly but surgical entity diagnosed in infants)	2 (0.42%)	None	Pyelomyotomy	None
Necrotising enterocolitis stage IIIB (Bell's)		12 (2.5%)	None	Stoma	
Anterior abdominal wall defects-30 (6.3%)	Gastroschisis	20 (4.2%)	Atrial septal defect (3 Cases)	Primary repair	Surgical site infection in 9 cases
	Omphalocele	10 (2.1%)	None	Conservative	None
Congenital diaphragmatic hernia		8 (1.6%)	Malrotation of gut (1 case)	Congenital diaphragmatic hernia repair	None
Malrotation with/without volvulus		4 (0.8%)	None	Ladd's procedure	None
Hirschsprung's disease		8 (1.6%)	None	Colostomy	Surgical site infection in 2 cases
Renal disorders	Posterior urethral valve	3 (0.6%)	None	Posterior urethral valve fulguration	None
	Pelviureteric junction obstruction	10 (2.1%)	None	Pyeloplasty	None
	Hydronephrosis-vesicoureteric reflux	5 (1.02%)	None	Conservative	None
Cloacal exstrophy		2 (0.42%)	Multiple	Stoma and defect closure	Surgical site infection in 1 cases

[Table/Fig-2]: Spectrum of neonatal surgical cases admitted and treated. *Saxena-Mathur classification of pouch colon [10,11]; ASARP: Anterior sagittal anorectoplasty

The highest mortality rate was noticed in cases of local exstrophy and Neonatal Necrotising Enterocolitis (NNEC), reaching upto 91%. Also, a higher mortality rate was noted in cases of EA and congenital diaphragmatic hernia. The cases of gastroschiasis were the fifth highest cases among mortality [Table/Fig-3]. The majority

of surgical neonates with congenital anomalies (>50%) who died in the postoperative period were either preterm or low birth weight babies. Clinically or microbiologically proven septicaemia in the postoperative period was observed in most cases (78.5%) who died in the postoperative period [Table/Fig-4].

Diagnosis	Number of cases died in postoperative period	Percentage mortality among particular diagnosis
ARMs (n=178)	17	9.5% among ARM
Oesophageal atresia with/without tracheo oesophageal fistula (n=133)	97	72.9% among oesophageal atresia
Congenital intestinal obstruction (n=64)	24	37.5% among intestinal atresias
Necrotising enterocolitis stage IIIB (Bell's) (n=12)	11	91% among NNEC cases
Gastroschisis (n=20)	11	45.8% among gastroschiasis cases
Cloacal exstrophy (n=2)	2	100%
Congenital Diaphragmatic Hernia (CDH) (n=8)	6	75% among CDH cases

[Table/Fig-3]: Diagnosis-wise mortality operated in emergency.

Cause of death	Number of cases (n=168)	Percentage (35.5%)
Septicaemia	132	78.5%
Prematurity (POG <30 weeks) or low birth weight (weight <2 kg)	98	58.3%
Cardiac failure	56	33.3%
Pulmonary failure	86	51.1%

[Table/Fig-4]: Isolated or combined causes of mortality in neonates operated in emergency. POG: Period of gestation

DISCUSSION

Congenital defects, surgical infections, and acquired surgical disorders during the hospital stay are the main reasons for neonatal surgery admissions. Anorectal Malformations (ARMs) (37.71%) and EA (27.8%) were the most prevalent congenital anomalies identified in present investigation, with other congenital gastrointestinal anomalies following closely behind. A small number of studies did demonstrate a similar pattern, with intestinal atresia and ARMs being the most often occurring congenital abnormalities admitted to and treated in neonatal critical care units in various regions of India, as well as other developing and African nations [7,8,10,11]. Nonetheless, the remarkably elevated prevalence of pouch colon among patients with ARM deserves particular attention. Currently, it is known that 90% of cases are recorded in India, particularly in northern India. However, since awareness of this unusual occurrence has grown recently, some cases are now being reported from other regions of the world [10-12]. In the present study, this incidence is exceptionally high and more inclined towards severe varies associated with cloaca [Table/Fig-2] [10,11]. Congenital Pouch Colon (CPC) is an extremely uncommon anomaly in which an anorectal deformity is linked to variable degrees of dysplastic colon pouch-like dilatation. The genitourinary tract and the pouch typically communicate via a fistulous route. A well-designed research study is warranted to evaluate the link between the greater frequency of severe types of pouch colon or cloaca and the mother's low nutritional condition in this region of India.

The states of Madhya Pradesh and Uttar Pradesh are among the regions with the highest neonatal mortality rates in India and worldwide, according to the National Family Health Survey, 2019-2021 [8]. Although the contribution of neonatal surgery to lower infant mortality rates is unknown, the number of newborn surgical emergencies is rapidly increasing due to improved connectivity to remote areas and increased reporting of caesarean sections in prenatal exams [7, 11, 12]. An increasing number of surgical entities, such as congenital Gastrointestinal (GI) anomalies (Hirschsprung's disease, choledochal cyst, malrotation) and congenital urologic anomalies, which were previously reported in older age groups. Even with the increase in caseload, healthcare decision-makers continue to neglect specialised paediatric surgery facilities. As a

result, there is only one paediatric surgery center in this densely populated region of India, which is still in its infancy and does not have enough support from a NICU. Policymakers in low- and middle-income nations like India may have been reckless in their consideration of neonatal surgical mortality because of the expensive perioperative infrastructure and the paucity of facts supporting its necessity. Since, numerous avoidable factors contribute to this dire situation, where neonatal surgical neonates end up as the victims, the high mortality rate may be caused by inadequate infrastructure.

Limited awareness and misconceptions are also signs of a low socioeconomic class. Most of the time, there is no prenatal diagnostic or foetal health monitoring. As a tertiary referral center, the present department is unable to admit most surgical emergencies until the second day of life or later. In some cases, this delay in admission can reach upto 14 days, which impedes appropriate delivery planning and early postnatal surgical care, linked to better outcomes. About 10% of infants who exhibited signs of a surgical emergency were not able to be revived in time for surgery as a result of the delayed diagnosis and referral process. Due to a lack of equipment and skilled labour, the majority of developing nations are still lagging behind in providing adequate antenatal care [13,14]. The present study revealed a similar situation, with over 80% of mothers not even having an ultrasound examination during their pregnancy. In present study, 35.5% of neonates died after emergency surgery. Poor maternal nutritional conditions appear to be a contributing factor to a high number of low birthweight babies in one of the poorest regions of India. Additionally, increased rates of infant mortality could be the result of congenital surgical abnormalities needing emergency surgery. Low birth weight and preterm delivery raise the risk of surgical newborn mortality by 3.41 and 3.38 times, respectively, as demonstrated by Puri A et al. This was not the case in high-income nations [15]. The death rate in the present study is similar to that of previous research from low- and middle-income nations, confirming the similarities in infrastructure for newborn surgery [Table/Fig-5] [7,12,14,16-18]. A massive load of 50-100 sick neonates in a small area of two rooms and about 600 square feet in the SNCU, with a limited number of nursing staff, demonstrates poor infrastructure for the management of a surgical neonate,

Name of the author	Place/year of study	Sample size	Mortality rate	Major causes of mortality
Gangopadhyay AN et al., [7]	India/2007	1873	15%	Postsurgical septicaemia in cases of low birth weight tracheoesophageal fistula, Gastroschisis
Virupakshappa PM et al., [12]	India/2011	601	40% (oesophageal atresia cases), 4.5% (ARM cases), 80% (emergency laparotomy cases)	Gastroschisis was major cause of mortality
Hasan MS et al., [16]	Bangladesh/2020	3447	14.6%	Gastroschisis (>90%) and oesophageal atresia (>85%) were major contributor to mortality
Sharif MU et al., [17]	Kingdom of Saudi Arabia (KSA)/2013	57	12.28%	Sepsis 5.26%
Ekwunife HO et al., [18]	Nigeria/2019	304	26.6%	Gastroschisis (58.3%) and oesophageal atresia (56.5%) were major cases of mortality
Global PaedSurg Research Collaboration [14]	9 low income countries/2019	93	39.8%	Gastroschisis 90%
Global PaedSurg Research Collaboration [14]	89 high income countries/2019	896	5.6%	Gastroschisis 1.4%

[Table/Fig-5]: Mortality rate comparison to previous studies [7,12,14,16-18].

which requires a neonatologically monitored, sophisticated, and well-equipped NICU. The long duration of surgery, blood loss during the procedure, and hypothermia after surgery negatively affect the outcome. Even in the SNCU, not a single baby received Total Parenteral Nutrition (TPN), although it would have been necessary for most of them. TPN is not available here. In addition, central venous access is time-consuming, expensive, and difficult to manage in a ward where 4-5 nurses care for more than 50 infants. This affected the outcome of gastrointestinal surgery, especially in infants with gastroschisis.

All these constraints reflect very high mortality in cases like gastroschisis, tracheoesophageal fistula, bowel atresia, and necrotising enterocolitis cases in present study. In the present study, sepsis was the most frequent cause of mortality. It is the ultimate outcome of difficulties in properly detecting and caring for surgical infants in the absence of a NICU. For the surgeons who work in these areas, it is frequently discouraging and exhausting when their efforts are in vain. The results may be applied to the entire state of Madhya Pradesh because the study was carried out at one of the newborn surgery referral Institutions with the highest volume, which handles the majority of the state's neonatal surgery cases. Planning and carrying out a development program in this center would undoubtedly increase mortality overall.

Generally speaking, the scarcity of human resources and the poor infrastructure appear to be the primary issues linked to the dismal state of neonatal surgical outcomes; yet, further research is necessary to determine the statistical significance of this relationship. Authors have also proposed a potential remedy that calls for multisectoral cooperation between the government, Non Governmental Organisations (NGOs), and hospital administration. In order to detect problems early and keep these vulnerable individuals from lingering, all maternity clinics must be connected to or linked with a newborn care unit. Additionally, there should be trained staff ready to assist these infants when transferring them to a higher facility. Without assistance from international organisations like the World Health Organisation (WHO), United Nations International Child's Emergency Fund (UNICEF), and other relief agencies, it is genuinely difficult for an LMIC to overcome these obstacles on their own.

A multisectoral partnership with hospital management, the government, and NGOs supporting the infrastructure for this impoverished population could be one proposed approach. A significant change in science can be brought about by low-cost, locally customised technology and equipment operated by highly skilled personnel. Sepsis and related mortality could be reduced if surgical neonates could be housed in a separate ward or NICU managed by a neonatologist with capabilities for infection control and temperature regulation. The presence of patient monitoring systems in this area would enable the early identification and treatment of critically ill newborns. The ratio of medical professionals to patients (including paediatricians, surgeons, anaesthetists, and nurses) is much lower than the minimal criteria. Government agencies and hospital administration need to give this some serious thought. Maintaining this ratio at a suitable level would allow for the consultants to be rostered during emergency hours and for the unwell babies to receive proper monitoring and care.

Limitation(s)

Data analysed with patient records in retrospect has limitations such as lack of uniformity and no comparison groups.

CONCLUSION(S)

The mortality rate in emergency-operated newborns was 35.5%, with the majority of cases succumbed due to postoperative septicemia. With appropriate perioperative care, a significant portion of the infant mortality rate in developing countries like India may be prevented, particularly for surgical newborns. Unfortunately, none of these discussed neonatal surgery, even though it is essential to achieving the goal. However, neonatal surgery is not given the emphasis, it deserves in the national health policy. The construction of enabling infrastructure requires both regional and international cooperation.

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