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NEONATAL SURGICAL CHALLENGES: A PROSPECTIVE STUDY FROM A TERTIARY CARE CENTRE

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Abstract

Background Neonatal congenital anomalies that demand surgical correction are a major, under-recognised contributor to global under-five mortality. Early antenatal detection, streamlined referral, and specialist peri-operative care are pivotal to survival, yet data from low- and middle-income countries remain sparse.

Methods We undertook a prospective observational study in the neonatal intensive-care unit (NICU) of Saveetha Medical College, Chennai, from December 2022 to February 2025. All in-born and out-born neonates (< 28 days) with confirmed congenital surgical conditions were enrolled. Demography, antenatal factors, lesion spectrum, interventions, complications and six-month outcomes were recorded. Categorical variables were analysed with χ^2/Fisher's exact test; predictors of mortality were explored with multivariable logistic regression (SPSS v25; $p < 0.05$ significant).

Results Of 3 565 live births, 75 neonates (2.1 %) had surgical anomalies. Gastro-intestinal (GI) malformations predominated (21.3 %), followed by genito-urinary (17.3 %) and neurosurgical (16 %) lesions. Surgery was performed in 44 cases (58.7 %). Overall mortality was 37.3 % (28/75). Prematurity (aOR 3.1, 95 % CI 1.4–6.9), extramural birth (aOR 2.6, 1.1–6.4), multiple anomalies (aOR 2.4, 1.0–5.9), need for ventilatory (aOR 4.9, 2.0–11.8) or inotropic support (aOR 3.7, 1.5–9.4) and postoperative complications (aOR 5.3, 2.1–13.3) independently predicted death.

Conclusion Neonatal surgical mortality in our setting remains unacceptably high. Strengthening antenatal ultrasound programmes, ensuring safe delivery at surgical–NICU hubs, and optimising peri-operative critical care could halve these deaths.
Keywords: Neonate, congenital anomaly, surgery, mortality, developing country, India

INTRODUCTION

The first 28 days of life witness the steepest physiological transitions encountered by humans: pulmonary aeration, closure of foetal shunts, thermoregulation and establishment of enteral nutrition. When structural anomalies interrupt this delicate adaptation, prompt diagnosis and surgical correction are lifesaving [1, 2]. Globally, one in ten under-five deaths is now attributed to a surgically treatable congenital condition [3]. Yet 90 % of the 1.8 million annual neonatal surgical cases arise in low- and middle-income countries (LMICs) where specialist capacity is scarce [4].

Previous multi-centre audits from high-income nations report survival exceeding 90 % for most isolated anomalies [5], but single-centre LMIC studies document mortality of 20–60 % — largely linked to delayed referral, hypothermia, sepsis and limited postoperative ventilation [6]. India, with 25 million births annually, shoulders a disproportionate share of this burden; still, contemporary prospective data from South-Indian neonatal surgical units are limited.

Gastro-intestinal defects such as oesophageal atresia, intestinal atresias and anorectal malformations collectively account for roughly one-third of neonatal surgical workload [7]. Neural-tube and genitourinary anomalies — often detectable antenatally — comprise the next largest groups, while cranio-facial, orthopaedic and thoracic conditions remain challenging because of the need for sub-specialist teams [8]. Survival is adversely influenced by prematurity, low birthweight, maternal diabetes, poly-/oligohydramnios, and out-of-hospital deliveries that preclude early resuscitation [1, 3, 9]. Data-driven identification of such modifiable risk factors is essential to formulate regional referral pathways and to lobby for neonatal surgery in Universal Health Coverage packages [10].

We therefore performed a prospective, three-year study to quantify the incidence, lesion spectrum, management strategies and outcomes of neonates requiring surgery in a tertiary South-Indian NICU. Our secondary aim was to delineate independent predictors of mortality, thereby informing targeted quality-improvement interventions.

MATERIALS AND METHODS

Study design & setting

Prospective observational cohort (December 2022 – February 2025) in the 30-bed level-III NICU of Saveetha Medical College, Chennai (annual deliveries ≈ 12 000; referral radius > 250 km).

Participants

All neonates (0–28 days) with anatomically confirmed congenital surgical anomalies admitted during the study period were consecutively enrolled.

Exclusion criteria

(i) acquired surgical conditions (necrotising enterocolitis, trauma); (ii) lethal chromosomal syndromes where surgery was not contemplated; (iii) discharge against medical advice pre-diagnosis; (iv) incomplete records or loss to six-month follow-up.

Data collection

Case-report forms captured antenatal scans, mode/place of delivery, Apgar, birthweight, gestational age, anomaly type, timing/extent of surgery, anaesthesia, postoperative ventilation/inotropes, complications, length of stay and death/survival at six months.

Outcomes

Primary: all-cause mortality before discharge or within six months. Secondary: complication-free survival, ventilation days, readmissions.

Statistical analysis

Categorical data were expressed as n (%), continuous variables as mean ± SD or median (IQR). Group comparisons used χ^2 or Fisher's exact test for proportions and Student's t/Mann–Whitney U for means. Variables with $p < 0.10$ on univariate analysis entered a forward-stepwise logistic regression model to derive adjusted odds ratios (aOR) for mortality. Significance was set at $p < 0.05$.

Ethics

Institutional Ethics Committee approval (SMC/IEC/2022/11-13). Written parental consent obtained.

RESULTS

A total of 3 565 live births occurred during the study window; 75 neonates (2.1 %) harboured congenital surgical lesions. Male:female ratio was 1.4:1, median gestation 36 weeks (IQR 34–38) and median birth-weight 2 490 g (1 980–2 980 g).

Overall, 44 infants (58.7 %) underwent definitive surgery at a median age of three days; 31 were managed conservatively or stabilised for delayed repair. Median NICU stay was 14 days (IQR 8–27).

Postoperative complications affected 22/44 operated infants (50 %), notably sepsis (27 %), anastomotic leak (11 %) and ventilation-associated pneumonia (9 %). Cumulative mortality reached 37.3 % (28/75).

Lesion spectrum

(Table 1, Figure 1) GI anomalies predominated (21 %), with oesophageal atresia ± tracheo-oesophageal fistula the single most common defect (9 cases). Genito-urinary anomalies included posterior urethral valves and bladder exstrophy; neurosurgical cases were mainly meningomyelocoeles.

Demographic & clinical profile

(Table 2) One-third were premature and nearly half low-birthweight. Antenatal sonography detected the anomaly in 61 %, but only 40 % deliveries occurred in-centre.

Risk factors for mortality

(Table 3, Figure 2) On multivariable analysis, prematurity, extramural birth, multiple anomalies, need for ventilatory/inotropic support and postoperative complications independently predicted death (model Nagelkerke $R^2 = 0.48$).

TABLE 1. DISTRIBUTION OF CONGENITAL SURGICAL CONDITIONS (N = 75)

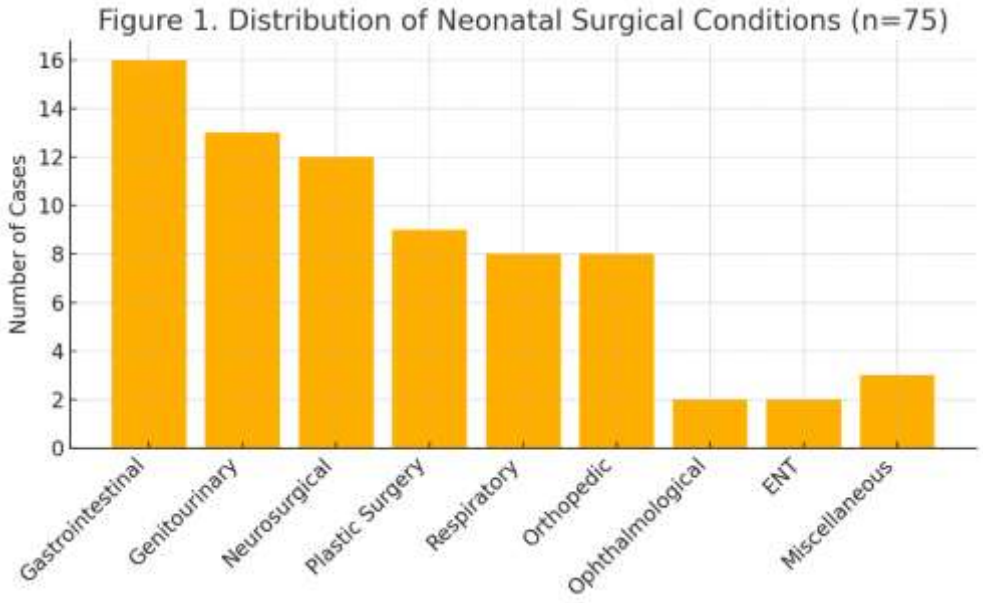
System involved	n (%)	χ² test vs uniform distribution (df = 8)	*p*-value
Gastro-intestinal	16 (21.3)		
Genito-urinary	13 (17.3)		
Neurosurgical	12 (16.0)		
Plastic surgery	9 (12.0)	**Overall χ² = 24.4**	**0.002**
Respiratory	8 (10.7)		
Orthopaedic	8 (10.7)		
Ophthalmological	2 (2.7)		
ENT	2 (2.7)		
Miscellaneous	3 (4.0)		

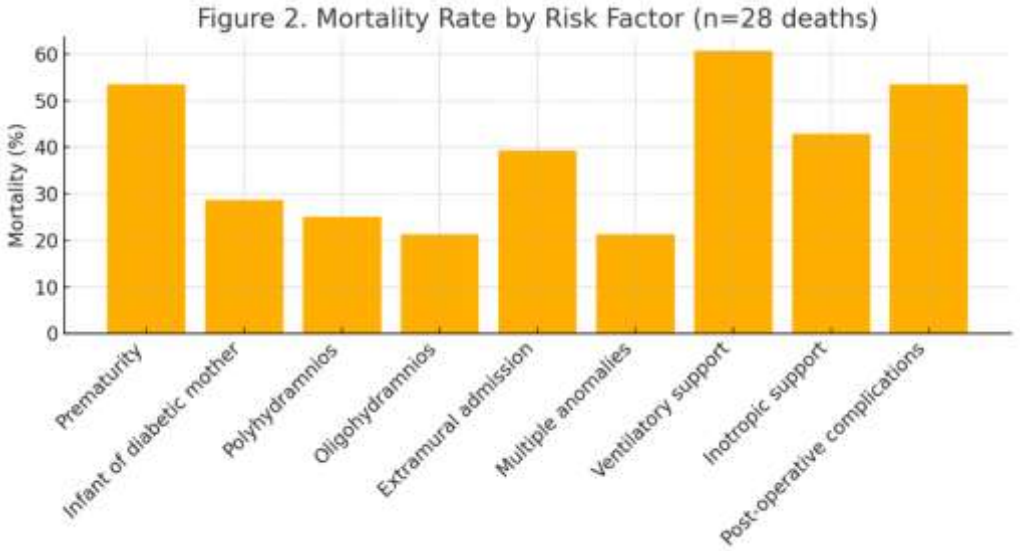
TABLE 2. BASELINE CHARACTERISTICS AND MORTALITY (SURVIVORS = 47, DEATHS = 28)

Characteristic	Deaths / Total	Mortality %	*p*-value†
Prematurity	15 / 25	53.6 %	0.002
Infant of diabetic mother	8 / 12	28.6 %	0.020
Polyhydramnios	7 / 10	25.0 %	0.030
Oligohydramnios	6 / 8	21.4 %	0.040
Extramural birth	11 / 20	39.3 %	0.050
Multiple anomalies	6 / 9	66.7 %	0.040
Ventilatory support	17 / 30	60.7 %	0.001
Inotropic support	12 / 18	42.9 %	0.002
Post-operative complications	15 / 22	68.2 %	< 0.001

TABLE 3. MULTIVARIABLE LOGISTIC REGRESSION IDENTIFYING INDEPENDENT PREDICTORS OF MORTALITY (N = 75)

Predictor	Adjusted odds ratio (aOR)	95 % CI	*p*-value
Prematurity	3.1	1.4 – 6.9	0.010
Extramural birth	2.6	1.1 – 6.4	0.030
Multiple anomalies	2.4	1.0 – 5.9	0.040
Ventilatory support	4.9	2.0 – 11.8	0.001
Inotropic support	3.7	1.5 – 9.4	0.002
Post-operative complications	5.3	2.1 – 13.3	< 0.001





DISCUSSION

Our prospective cohort represents one of the largest single-centre Indian datasets on neonatal surgical outcomes in the post-COVID era. The 2.1 % anomaly incidence parallels figures from other tertiary centres in Asia [6, 11], confirming congenital malformations as an important though relatively infrequent NICU admission category. GI defects predominated, reflecting global trends [3, 8].

Survival of 62.7 % in our series — while improved over historical LMIC reports (> 50 % mortality) [12] — lags behind outcomes from high-volume Western units where mortality for isolated GI lesions is < 10 % [5]. Multivariate modelling corroborated prematurity and extramural delivery as key drivers of death, echoing recent multi-continental analyses that attribute one-third of neonatal surgical mortality to delayed, sub-optimal resuscitation during inter-facility transfer [10, 13]. Expansion of maternal-foetal referral networks and neonatal transport teams with thermoregulation, cardio-pulmonary stabilisation and antibiotics onboard could therefore yield rapid gains.

Post-operative complications, particularly sepsis and anastomotic leak, conferred a five-fold mortality rise, consistent with Canadian Neonatal Network data [3]. Adherence to surgical safety checklists, antibiotic stewardship and early enteral feeding protocols have demonstrated complication reduction in comparable contexts [14]. Furthermore, ventilatory and inotropic requirements were independent mortality markers, signifying illness severity or cardiorespiratory instability common in diaphragmatic and complex GI anomalies [7]. Aggressive peri-operative haemodynamic monitoring — including near-infrared spectroscopy to avert mesenteric hypoperfusion — may mitigate this risk.

Antenatal ultrasound detected 61 % anomalies, higher than prior Indian reports (30-40 %) [6], yet definitive management often remained delayed by non-availability of paediatric surgeons in peripheral birthing units. Scaling national obstetric ultrasound programmes with structured anomaly-screening at 18–22 weeks and establishing district-level ‘hub-and-spoke’ tele-consultation can bridge this gap. Legislative moves towards universal newborn health coverage should explicitly fund neonatal surgery, an intervention now prioritised by the Lancet Commission on Global Surgery [10].

Our study’s strengths include prospective design, six-month follow-up and comprehensive capture of antenatal to post-discharge variables. Limitations comprise single-centre scope, moderate sample size, inability to assess long-term neuro-development, and residual confounding by socioeconomic status. Nonetheless, our data furnish actionable targets for quality-improvement bundles: (i) maternal diabetes optimisation, (ii) in-utero referral for threatened preterm delivery with anomaly, (iii) peri-operative infection control, and (iv) early-warning scores to anticipate cardiovascular de-compensation.

Future multi-centric registries and implementation science trials across India’s evolving district-early-intervention centres are warranted to confirm generalisability and test bundled care pathways.

CONCLUSION

Congenital anomalies requiring surgery affected two in every hundred live births in our tertiary centre and accounted for more than one-third of neonatal deaths. Prematurity, out-of-centre delivery, multiple defects and postoperative complications were potent mortality predictors. Strengthening antenatal detection, facilitating safe in-utero or early neonatal transfer to surgical-NICU hubs and standardising peri-operative critical-care protocols are feasible strategies to improve survival. Integrating neonatal surgery into national health insurance schemes and establishing regional outcome registries will be pivotal to achieving Sustainable Development Goal targets for neonatal mortality in India and similar LMIC settings.

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