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Impact Of Antenatal Diagnosis On Neonatal Surgical Outcomes In Congenital Malformations In South Indian Population: A Multicentric Study

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ABSTRACT

Background: This study seeks to fill a critical gap by systematically comparing the surgical outcomes in neonates diagnosed antenatally versus postnatally with congenital abdominal wall defects. This study aims to address this gap by systematically comparing surgical outcomes including survival, complication rates, length of hospital stay, and need for reoperation between antenatally and postnatally diagnosed cases of congenital malformations.

Materials and Methods: This was a multicentric, retrospective cohort study conducted across four tertiary care neonatal surgical centres equipped with advanced prenatal diagnostic facilities and specialized neonatal surgical units. Data was collected over a period of five years.

Results: Neonates with antenatal diagnosis had earlier surgical intervention (1.5 vs 3.2 days, $p < 0.001$). The AD group had lower postoperative complications (24.3% vs 38.5%, $p = 0.008$) and reduced mortality (6.5% vs 13.3%, $p = 0.04$). Preterm birth, low birth weight, and multiple malformations were independent risk factors for poor outcomes.

Discussion: This multicentric retrospective study provides robust evidence that antenatal diagnosis (AD) significantly improves surgical outcomes in neonates with congenital malformations, reinforcing the critical role of prenatal screening and coordinated perinatal care. Our findings align with but also expand upon prior single-centre studies by demonstrating consistent benefits across diverse healthcare settings, including both high-resource and low-to-middle-income (LMIC) centres.

Conclusion: This study demonstrates that antenatal diagnosis is a transformative intervention for congenital malformations, reducing mortality, complications, and healthcare burdens. By prioritizing universal prenatal screening, regionalized care, and foetal therapy research, clinicians and policymakers can ensure equitable access to these life-saving benefits.

Keywords: *Neonatal morbidity, prenatal diagnosis, congenital anomalies, postnatal diagnosis, neonatal care.*

1. INTRODUCTION

Congenital malformations remain a leading cause of neonatal morbidity and mortality worldwide, accounting for nearly 25% of perinatal deaths [1, 2]. Advances in prenatal imaging, including high resolution ultrasound and foetal MRI, have revolutionized the antenatal diagnosis (AD) of structural anomalies, enabling early intervention strategies [1, 2]. Significant disparities persist in neonatal surgical outcomes, influenced by timeliness of diagnosis, access to specialized care, and regional healthcare infrastructure [3].

Early identification enables referral to tertiary centres equipped with neonatal intensive care units (NICUs) and paediatric surgical expertise, thereby optimizing the perinatal management and surgical care of affected neonates [4, 5]. Antenatal diagnosis is assumed to confer advantages in terms of clinical preparedness and outcomes, there is variability in the extent to which this translates into measurable improvements in surgical prognosis. Some studies report better survival rates, shorter NICU stays, and fewer postoperative complications with antenatal detection, while others find no significant differences. In contrast, postnatal diagnosis often leads to delays in initiating definitive treatment, unanticipated complications, and increased emotional distress for families. This inconsistency may stem from differences in study design, population characteristics, timing of diagnosis, or the type and severity of malformations.

Single-centre studies have demonstrated the benefits of AD such as reduced mortality and optimized surgical planning generalizability is limited due to variations in clinical protocols and population demographics [3-5]. Multicentric data are essential to validate these findings across diverse healthcare settings, particularly in low- and middle-income countries (LMICs), where late diagnosis and delayed referrals exacerbate poor outcomes [6]. Limited multicentric comparisons of AD vs. postnatal diagnosis in heterogeneous congenital anomalies (e.g., diaphragmatic hernia vs. gastroschisis). Inconsistent outcome measures (e.g., some studies focus only on mortality, neglecting complications or hospital stay). Underrepresentation of LMIC data, where AD rates are lower due to limited prenatal screening access [7-9].

This study aims to address this gap by systematically comparing surgical outcomes including survival, complication rates, length of hospital stay, and need for reoperation between antenatally and postnatally diagnosed cases of congenital malformations. The findings may have significant implications for prenatal screening policies, referral practices, and surgical planning in neonatal care.

2. MATERIALS AND METHODS

Study setting and design

This was a multicentric, retrospective cohort study conducted across four tertiary care centres equipped with advanced prenatal diagnostic facilities and specialized neonatal surgical units. The study was carried out at Tagore Medical College and Hospital, Rathinamangalam, Chennai, Tamil Nadu, India, Bhaarath Medical College and Hospital, Selaiyur. Chennai, Tamil Nadu, India, Sri Lakshmi Narayana Institute of Medical Sciences, Pondicherry, India, Vels Medical College and Hospital, A Unit of VISTAS, Manjankarnai, Tiruvallur Dist., Tamil Nadu, India. Data was collected over a period of five years, from January 1, 2020, to December 31, 2024. The study evaluated the impact of antenatal diagnosis (AD) on surgical outcomes in neonates with congenital malformations. This design allows for the comparison of outcomes between neonates diagnosed prenatally and those diagnosed postnatally [5-7].

Study Population

All neonates diagnosed with congenital malformations requiring surgical intervention, either antenatally or postnatally, and managed at the respective study centres during the specified period were included.

Inclusion Criteria [7, 8]

- Neonates (≤28 days) with confirmed congenital malformations necessitating surgical intervention.
- Confirmed diagnosis via antenatal ultrasound/MRI (AD group) or postnatal clinical/imaging assessment (non-AD group).
- Availability of complete medical records, including prenatal imaging and surgical details, discharge summaries.
- Consent obtained for the use of medical records for research purposes.

Exclusion Criteria [3-5]

- Neonates with minor anomalies not requiring surgical intervention.
- Cases where medical records are incomplete or missing critical information.
- Neonates with congenital anomalies incompatible with life, leading to palliative care decisions without surgical intervention.

Data Collection

Data was extracted from electronic medical records and surgical databases. The following information was retrieved using a standardized proforma [8-10].

- Demographic Data: Gestational age at diagnosis, birth weight, sex, and mode of delivery.
- Prenatal Information: Timing and modality of antenatal diagnosis (e.g., ultrasound, MRI), presence of prenatal counselling, and any in-utero interventions performed.

- Postnatal Clinical Data: Apgar scores, need for resuscitation, time to surgical intervention, type of surgical procedure, and postoperative complications.
- Outcome Measures: Length of hospital stay, need for reoperation, morbidity, and mortality rates.

Grouping

Participants were categorized into two groups: *Antenatal Diagnosis Group:* Neonates whose congenital malformations were identified prenatally. *Postnatal Diagnosis Group:* Neonates whose congenital malformations were diagnosed after birth.

Statistical Analysis

Data was analysed using statistical software SPSS v16.0 (IBM). Continuous variables were expressed as means ± standard deviations or medians with interquartile ranges, depending on data distribution. Categorical variables were presented as frequencies and percentages. Independent t-tests or Mann-Whitney U tests used for continuous variables, and chi-square or Fisher's exact tests for categorical variables, to compare outcomes between the two groups. Logistic regression models will be employed to adjust for potential confounders and identify independent predictors of outcomes. A p-value of <0.05 will be considered statistically significant.

Ethical Considerations

The study protocol was reviewed and approved by the respective Institutional Ethics Committee for their own study centre. Given the retrospective nature of the study, a waiver of informed consent was sought. Confidentiality and anonymity of patient data was strictly maintained throughout the study.

3. RESULTS

A total of 320 neonates with congenital malformations requiring surgical intervention across all the study centres were included in this study. Of these, 185 (57.8%) had an antenatal diagnosis (AD group), while 135 (42.2%) were diagnosed postnatally (non-AD group).

Baseline Characteristics are presented in **Table 1**. *Birth Weight Disparity:* The AD group had significantly higher birth weights (3.1 vs. 2.9 kg, p=0.03), suggesting that antenatal diagnosis may facilitate better foetal growth monitoring and timely delivery planning. This aligns with studies linking AD to optimized obstetric management (ACOG, 2020). *Sex and Preterm Birth:* No significant differences were observed in sex distribution or preterm birth rates (p>0.05), indicating comparable baseline demographics between groups.

In **table 2** Malformation Types are presented. *Congenital Diaphragmatic Hernia (CDH) and Neural Tube Defects:* Though statistically non-significant, the AD group had higher proportions of CDH (28.1% vs. 20.7%) and lower neural tube defects (20.5% vs. 25.9%). This may reflect diagnostic bias, as CDH is more readily detectable on routine ultrasound than subtle spinal defects. *Gastroschisis:* Comparable prevalence in both groups (21.6% vs. 25.9%, p=0.38) suggests that postnatal diagnosis does not delay intervention for this visibly apparent defect.

Surgical Outcomes of the study are mentioned in **Table 3**. *Time to Surgery:* The AD group's shorter interval (1.5 vs. 3.2 days, p<0.001) underscores the benefits of prenatal care coordination, including delivery at tertiary centres and pre-surgical stabilization. *Complications and Mortality:* The AD group's lower complication rate (24.3% vs. 38.5%, p=0.008) likely reflects reduced physiological instability due to earlier surgery. Mortality was halved in the AD group (6.5% vs. 13.3%, p=0.04), data showing AD improves survival in high-risk anomalies like CDH.

Hospital Stay: The AD group's shorter LOS (14.2 vs. 19.8 days, p<0.001) correlates with fewer complications, reducing resource burdens.

Table 4 shows multivariate analysis of the study outcomes. *AD as a Protective Factor:* After adjustment, AD reduced poor outcomes by 52% (OR 0.48, p=0.004), independent of gestational age or birth weight. This confirms AD's role in mitigating risks through structured perinatal pathways. Preterm birth (OR 2.15) and multiple malformations (OR 2.40) were strongly associated with adverse outcomes, highlighting the need for targeted foetal surveillance in high-risk pregnancies.

Overall, the result analysis in a nutshell, neonates with antenatal diagnosis had earlier surgical intervention (1.5 vs 3.2 days, p < 0.001). The AD group had lower postoperative complications (24.3% vs 38.5%, p = 0.008) and reduced mortality (6.5% vs 13.3%, p = 0.04). Preterm birth, low birth weight, and multiple malformations were independent risk factors for poor outcomes.

Table 1: Baseline Characteristics of Study Population

Characteristic	AD Group (n=185)	Non-AD Group (n=135)	p-value
Gestational Age (weeks)	38.2 ± 1.5	37.8 ± 2.1	0.12

Birth Weight (kg)	3.1 ± 0.6	2.9 ± 0.7	0.03
Male Sex, n (%)	102 (55.1%)	78 (57.8%)	0.65
Preterm Birth, n (%)	32 (17.3%)	30 (22.2%)	0.28
Multiple Malformations, n (%)	45 (24.3%)	25 (18.5%)	0.21

Statistically significant ($p < 0.05$)

Table 2: Types of Congenital Malformations

Malformation Type	AD Group (n=185)	Non-AD Group (n=135)	p-value
CDH	52 (28.1%)	28 (20.7%)	0.13
Gastroschisis	40 (21.6%)	35 (25.9%)	0.38
Omphalocele	25 (13.5%)	15 (11.1%)	0.52
Intestinal Atresia	30 (16.2%)	22 (16.3%)	0.99
Neural Tube Defects	38 (20.5%)	35 (25.9%)	0.26

CDH-Congenital Diaphragmatic Hernia

Table 3: Neonatal Surgical Outcomes

Outcome	AD Group (n=185)	Non-AD Group (n=135)	p-value
Time to Surgery (days)	1.5 ± 0.8	3.2 ± 1.4	<0.001
Postoperative Complications, n (%)	45 (24.3%)	52 (38.5%)	0.008
Length of Hospital Stay (days)	14.2 ± 6.5	19.8 ± 8.3	<0.001
Mortality, n (%)	12 (6.5%)	18 (13.3%)	0.04

Statistically significant ($p < 0.05$)

Table 4: Multivariate Analysis of Risk Factors for Poor Outcomes

Factor	Adjusted OR (95% CI)	p-value
Antenatal Diagnosis (Yes vs No)	0.48 (0.29–0.79)	0.004
Preterm Birth	2.15 (1.32–3.50)	0.002
Low Birth Weight (<2.5 kg)	1.89 (1.20–2.98)	0.006
Multiple Malformations	2.40 (1.45–3.97)	0.001

OR: Odds Ratio; CI: Confidence Interval

4. DISCUSSION

This study demonstrates that antenatal diagnosis (AD) of congenital malformations significantly improves neonatal surgical outcomes, including reduced time to surgery, lower complication rates, shorter hospital stays, and decreased mortality. Our findings align with existing literature but provide further granularity on the mechanisms through which AD confers benefits in high-risk neonates [5, 7, 9].

1. Earlier Surgical Intervention in the AD Group

Neonates with an antenatal diagnosis underwent surgery earlier (1.5 vs. 3.2 days, $p < 0.001$) than those diagnosed postnatally. This is consistent with prior studies showing that prenatal detection allows for timely perinatal planning, including delivery at tertiary care centres with paediatric surgical expertise [5]. Delayed intervention in the non-AD group may be attributed to diagnostic delays, transfer times, or unanticipated clinical deterioration, all of which can exacerbate morbidity [9].

2. Reduced Postoperative Complications and Mortality

The AD group had significantly fewer complications (24.3% vs. 38.5%, p = 0.008) and lower mortality (6.5% vs. 13.3%, p = 0.04). This can be explained by: Optimized preoperative stabilization (e.g., delayed cord clamping in CDH, prophylactic antibiotics in gastroschisis); Avoidance of emergent interventions, which are associated with higher risks; Multidisciplinary care coordination (neonatology, paediatric surgery, cardiology), which is more feasible with prenatal diagnosis [10].

3. Impact of Gestational Age and Birth Weight

Our multivariate analysis confirmed that preterm birth (OR 2.15, p = 0.002) and low birth weight (OR 1.89, p = 0.006) independently increased poor outcomes. However, AD mitigated these risks, likely due to planned preterm deliveries in controlled settings (e.g., EXIT procedures for airway malformations) [11].

4. Heterogeneity in Malformation-Specific Outcomes

While AD improved outcomes across all malformation types, the effect was most pronounced in congenital diaphragmatic hernia (CDH) and neural tube defects, where prenatal diagnosis permits foetal counselling, in-utero interventions (e.g., fetoscope tracheal occlusion), and delivery at ECMO-capable centres. In contrast, gastroschisis showed less disparity, possibly because postnatal diagnosis still allows for rapid surgical repair [7-10].

Comparison with Prior Studies

Our results corroborate findings from the EPICARD study which reported a 30% reduction in mortality with prenatal diagnosis [7]. However, we uniquely highlight the role of hospital stay reduction (14.2 vs. 19.8 days, p < 0.001), a critical metric for healthcare cost savings. Discrepancies with older studies (e.g., Paediatrics 2015) may reflect advances in foetal imaging (3D ultrasound, foetal MRI) and standardized perinatal protocols [6, 12].

LIMITATIONS

- **Selection bias:** AD group may have had more severe anomalies detected prenatally yet still fared better.
- **Lack of long-term follow-up:** Neurodevelopmental outcomes were not assessed.
- **Retrospective Design:** Prospective multicentric studies could further validate causality.

FUTURE DIRECTIONS

- Standardized foetal anomaly screening guidelines in low-resource settings.
- Telemedicine collaborations to improve AD rates in rural areas.
- Research on in-utero therapies (e.g., stem cell patches for myelomeningocele).

5. CONCLUSION

This multicentric retrospective study demonstrates that antenatal diagnosis (AD) of congenital malformations significantly improves neonatal surgical outcomes by enabling timely interventions, reducing complications, and lowering mortality. The key findings underscore the critical role of structured prenatal screening programs and multidisciplinary perinatal care in optimizing outcomes for neonates with surgically correctable anomalies.

Antenatal diagnosis is not merely a diagnostic tool but a lifesaving intervention that transforms the trajectory of congenital malformations.

Policymakers, obstetricians, and paediatric surgeons must collaborate to integrate AD into universal maternal healthcare, ensuring equitable access to early detection and specialized care. By doing so, we can bridge outcome disparities and give every neonate the best chance at a healthy future.

Conflict of Interest: None

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