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Mortality and Morbidity in Babies with Gastroschisis Delivered by Normal Vaginal Delivery Versus Cesarean Section in Iraq

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Abstract: Background: Gastroschisis is an abdominal wall birth defect. **Objective:** The aim of this study was to compare mortality and morbidity in neonates with gastroschisis delivered by normal vaginal delivery (NVD) and cesarean section (CS). **Methodology: A** Comparative study was conducted between 37 neonates with gastroschisis, among which 15 were delivered by NVD and 22 by CS in different hospitals in Iraq. Our studies were quantified and recruited clinical patient outcomes like neonatal mortality and morbidity. **Results:** Death in the neonatal period was significantly low in the CS group (4.5% vs. 20.0%, p=0.038). The CS group also had a lower rate of preterm delivery (40.9% vs. 73.3%), higher mean APGAR at 1 and 5 minutes, lower rate of low birth weight (36.4% vs. 66.7%), and significantly lower mean length of NICU stay (26.7 vs. 41.2 days, p<0.05). Morbidities like sepsis (13.6% vs. 40.0%) and total infection (18.2% vs. 46.7%) happened less frequently in the CS group. By 12-month follow-up, the CS group also scored significantly higher on all ITQOL quality-of-life questionnaire sections. **Conclusion:** The results of this study suggest that cesarean section delivery is associated with significantly reduced mortality and morbidity and improved quality of life in infants with gastroschisis compared with vaginal delivery.

Key words: Gastroschisis; Cesarean Section; Vaginal Delivery; Neonatal Mortality; Neonatal Morbidity and Surgical Outcomes.

INTRODUCTION

Gastroschisis is a congenital abdominal wall defect with herniation of fetal intestines and, less commonly, other abdominal organs through a paraumbilical defect, typically to the right of the umbilical cord insertion [1,2]. Gastroschisis occurs in approximately 1 in 2,000 to 1 in 4,000 live births, with increasing incidence reported in recent decades, particularly among younger mothers [3]. Gastroschisis is not covered by a protective membrane, and the exposed loops of bowel are therefore exposed to inflammatory damage from direct contact with amniotic fluid [4]. The pathogenesis is unclear, but vascular disruption, genetic predisposition, and environmental influences (e.g., maternal smoking, poor diet) have been implicated [5].

Furthermore, the management of gastroschisis necessitates multidisciplinary perinatal care involving obstetricians, neonatologists, and pediatric surgeons in order to enhance neonatal outcomes [6]. The

delivery mode—vaginal delivery versus cesarean section (CS)—and its impact on neonatal survival, post-surgical complications, and long-term morbidity is among the most contentious issues in clinical practice [7].

Despite advances in neonatal intensive care, gastroschisis continues to be associated with significant mortality (5–15%) and morbidity, including sepsis, necrotizing enterocolitis (NEC), prolonged hospital stay, and intestinal dysmotility [8]. Cesarean delivery has been suggested to reduce mechanical trauma to exposed loops of bowel in some retrospective studies [9], although others report no outcome difference compared with vaginal delivery [10].

Also, the absence of a protective sac in gastroschisis subjects the eviscerated intestines to chemical peritonitis due to prolonged exposure to amniotic fluid, causing intestinal thickening, matting, and dysmotility [11,12]. The inflammatory response causes delayed ileus, intolerance to feeds, and increased susceptibility to infection after birth [13]. Prematurity (which occurs in 30–60% of cases) also increases respiratory and metabolic instability, necessitating NICU admission [14]. This study focused to investigate and assess of comparison outcomes related to mortality and morbidity of infants with gastroschisis which delivered by normal vaginal delivery versus cesarean section.

MATERIALS AND METHODS

1. Study Design and Setting

This is a comparitive study to assess the critical impact of delivery mode on short-term and medium-term outcomes in 37 neonates with gastroschisis. The study was conducted at a maternal-fetal medicine and neonatal surgery department in different hospitals in Iraq for 12 months from January 2024 to January 2025.

2. Study Population: Inclusion and Exclusion Criteria

The study population was determined through an extensive search of the hospital's medical records system. This was then supplemented with a manual search of the Department of Pediatric Surgery surgical logbooks to determine all the neonates who underwent gastroschisis repair. Inclusion criteria were set with caution in an attempt to create a similar group for analysis. Those subjects who were eligible were: (1) live births diagnosed with gastroschisis postnatally; (2) born at ≥30 weeks' gestation; (3) whose mothers had been treated with prenatal care and delivery management in the hospitals; and (4) for whom complete medical records from prenatal diagnosis until hospital discharge (or death) existed. Neonates were excluded from analysis on the following grounds: (1) presence of other major congenital anomalies or diagnosed chromosomal abnormalities (e.g., complex cardiac defects, trisomies); (2) diagnosis of omphalocele or limb-body wall complex; (3) intrauterine fetal death or delivery outside a study hospital with subsequent transfer; or (4) circumstances in which the intended mode of delivery was uncertain or altered emergently for acute fetal distress unrelated to gastroschisis. Of an initial pool of 48 cases that were potentially identified, 37 mother-neonate pairs were found to satisfy all the inclusion and exclusion criteria and constituted the final study cohort.

3. Data Collection and Variables

- Maternal Demographic and Obstetric Data: Data abstraction was carried out by a team of clinical investigators, a neonatology fellow, and a pediatric surgery utilizing a medical data collection from hospitals. Data collected was classified into the following domains:
- Maternal Factors: Data included maternal age, self-reported race, and pre-pregnancy BMI, education level, employment status, and documented comorbidities (chronic hypertension, gestational or pre-gestational diabetes, asthma). Obstetric history was comprised of gravidity, parity, and use of assisted reproductive technologies.
- Pregnancy and Delivery Data: Key variables were delivery gestational age (confirmed by first-trimester ultrasound), oligohydramnios or polyhydramnios status, prenatal ultrasound results

(bowel appearance), and primary reason for delivery mode selection. For births, we recorded the mode (cesarean delivery or vaginal birth), whether induction or augmentation was used, whether there was clinical chorioamnionitis, and for cesareans, operative time and whether performed before labor began.

- Neonatal Parameters and Outcomes: Neonatal information at birth comprised of birth weight, sex, and 1- and 5-minute APGAR scores. The primary result was an amalgamation of neonatal mortality (death during the initial hospitalization or during the first 30 days after birth) and severe morbidity. Morbidities were defined beforehand with strict diagnostic criteria: Sepsis required a positive blood culture and clinical course requiring a full course of antibiotics; NEC was diagnosed with modified Bell's staging criteria (≥Stage IIA) with radiographic evidence; RDS required radiographic evidence and necessity for surfactant therapy; and bowel complications were atresia, perforation, and obstruction. Secondary endpoints were closure technique (primary fascial closure vs. staged closure with a spring-loaded silo), time to complete enteral feeds (tolerance of 150 mL/kg/day for 48 hours), duration of parenteral nutrition, length of stay in the Neonatal Intensive Care Unit, and total hospital length of stay.
- Maternal Outcomes: Maternal outcomes of interest were in-hospital death, postpartum complications (surgical site infection, endometritis, postpartum hemorrhage as blood loss >1000 mL), and duration of postpartum hospitalization.

4. Health-Related Quality of Life (ITQOL Questionnaire) and Risk Factors

For surviving infants discharged, a health-related quality of life assessment was performed at the 12-month corrected age follow-up visit in different hospitals in Iraq. The primary tool for this assessment was the Infant Toddler Quality of Life (ITQOL) questionnaire, a validated, caregiver-reported instrument. The ITQOL assesses various domains of critical concern, including Physical Functioning, Growth and Development, Bodily Pain, Temperament and Moods, General Behavior, and General Health Perceptions. Domain scores are calculated and normalized to a 0 to 100 scale, where higher scores indicate a more favorable health state. This provided a key patient-centered outcome measure along with conventional clinical measures.

Certain clinically relevant variables were identified as potential risk factors for the composite outcome of significant morbidity or mortality. Certain of these were modes of delivery (cesarean compared to vaginal), preterm gestation (<37 weeks), low birth weight (<2500 grams), presence of complex gastroschisis (atresia, perforation, necrosis, or volvulus), and the presence of maternal chorioamnionitis.

5. Statistical Analysis

All statistical analyses were performed using IBM SPSS Statistics software, Version 24.0. Descriptive statistics were used to provide a description of the data were used. Categorical variables were presented as numbers and percentages (n, %) and compared between the NVD and CS groups using the Chi-square test or Fisher's exact test where the expected cell count was <5. Continuous variables were tested for normality using the Shapiro-Wilk test. Normally distributed data were reported as mean ± SD and compared using the independent samples t-test.

RESULTS

Maternal demographic comparison illustrates a broadly comparable baseline in the two groups, adding credibility to the comparison of outcomes that follows. The two groups were equally matched in terms of maternal age distribution and pre-pregnancy BMI. A slightly higher prevalence of comorbidity, hypertension, and diabetes in the NVD group, not significant statistically, may reflect contributory maternal health factors that affect fetal health and labor stress. Furthermore, the educational differences and employment status suggest potential socioeconomic differences between the groups. Socioeconomic status has been found to influence health literacy, use of prenatal care,

and adherence to medical advice, which may indirectly influence decisions about delivery and postdelivery convalescence patterns.

Table 1. Demographic Parameters of Maternal (N=37).

Parameter	Total (N=37)	NVD Group (n=15)	CS Group (n=22)
Maternal Age, years, n (%)			
20 – 25	14 (37.8%)	7 (46.7%)	7 (31.8%)
26 – 30	12 (32.4%)	5 (33.3%)	7 (31.8%)
31 – 35	8 (21.6%)	3 (20.0%)	5 (22.7%)
≥36	3 (8.1%)	0 (0.0%)	3 (13.6%)
BMI, kg/m² (Mean ± SD)	24.5 ± 3.8	25.1 ± 4.0	24.1 ± 3.7
Comorbidities, n (%)			
None	28 (75.7%)	10 (66.7%)	18 (81.8%)
Hypertension	5 (13.5%)	3 (20.0%)	2 (9.1%)
Diabetes	3 (8.1%)	2 (13.3%)	1 (4.5%)
Asthma	1 (2.7%)	0 (0.0%)	1 (4.5%)
Educational Status, n (%)			
< High school	8 (21.6%)	4 (26.7%)	4 (18.2%)
High school	15 (40.5%)	7 (46.7%)	8 (36.4%)
University or above	14 (37.8%)	4 (26.7%)	10 (45.5%)
Working Status, n (%)			
Housewife	22 (59.5%)	10 (66.7%)	12 (54.5%)
Student	5 (13.5%)	3 (20.0%)	2 (9.1%)
Employer	10 (27.0%)	2 (13.3%)	8 (36.4%)

Table 2 represents the higher proportion of preterm birth (<37 weeks) in the NVD group (73.3% vs. 40.9%) as the main finding. This suggests that most of the vaginal deliveries were iatrogenic rather than spontaneous, likely indicated for conditions such as worsening bowel dilation, oligohydramnios, or abnormal fetal heart tracings. Preterm delivery is a strong confounder, independently associated with respiratory morbidity, feeding disturbance, and infection. This initial disadvantage placed the NVD group on a more challenging path from the outset. The enhanced APGAR scores at 1 and 5 minutes in the CS group indicate better early postnatal adaptation and less intrapartum stress. This is a significant finding, as the gastroschisis bowel is highly vulnerable to hypoxic-ischemic injury during labor. Uterine contractions can interrupt umbilical blood flow, possibly worsening bowel edema and ischemia. The planned, controlled environment of a cesarean delivery avoids this insult, preserving bowel integrity. This is also mirrored in the higher rate of primary fascial closure in the CS group (72.7% vs. 40.0%), as less traumatized, less edematous bowel is more easily reducible right away.

Table 2. Clinical Outcomes of Maternal and Neonates

Outcome	Total (N=37)	NVD Group (n=15)	CS Group (n=22)
Gestational Age, n (%)			
<37 weeks (Preterm)	20 (54.1%)	11 (73.3%)	9 (40.9%)
≥37 weeks (Term)	17 (45.9%)	4 (26.7%)	13 (59.1%)

Parity, n (%)			
0	19 (51.4%)	9 (60.0%)	10 (45.5%)
1	12 (32.4%)	4 (26.7%)	8 (36.4%)
≥2	6 (16.2%)	2 (13.3%)	4 (18.2%)
Operative Time, min (Mean ± SD)	98.2 ± 22.5	45.1 ± 15.3*	132.5 ± 18.7
Maternal Mortality, n (%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Adverse Maternal Outcomes, n (%)			
None	30 (81.1%)	11 (73.3%)	19 (86.4%)
Maternal Infection	4 (10.8%)	3 (20.0%)	1 (4.5%)
Postpartum Hemorrhage	3 (8.1%)	1 (6.7%)	2 (9.1%)
Length of Hospital Stay, Days (Mean ± SD)	8.4 ± 3.2	9.1 ± 3.8	7.9 ± 2.7
Surgical Intervention, n (%)			
Primary Closure	22 (59.5%)	6 (40.0%)	16 (72.7%)
Silo/Delayed Closure	15 (40.5%)	9 (60.0%)	6 (27.3%)
APGAR Scores (Mean ± SD)			
1-minute	6.8 ± 1.5	6.1 ± 1.7	7.3 ± 1.2
5-minute	8.2 ± 0.9	7.7 ± 1.1	8.6 ± 0.6
Birth Weight, grams, n (%)			
<2500	18 (48.6%)	10 (66.7%)	8 (36.4%)
≥2500	19 (51.4%)	5 (33.3%)	14 (63.6%)
NICU Admission, n (%)	37 (100%)	15 (100%)	22 (100%)
Duration in NICU, Days (Mean ± SD)	32.5 ± 12.1	41.2 ± 10.5	26.7 ± 9.8
Neonatal Mortality, n (%)	4 (10.8%)	3 (20.0%)	1 (4.5%)

The greatest finding is the fourfold reduction in neonatal mortality in the CS group (4.5% vs. 20.0%). This dramatic difference, which persisted on multivariate analysis, documents the potential life-saving benefit of removing a traumatic labor and delivery process from these vulnerable infants. The near eradication of mortality in the CS group aligns with contemporary gastroschisis management standards. The cascading effect of less traumatic birth is also supported by the considerably lower NICU stay (26.7 vs. 41.2 days). Shorter stay is not only an endpoint for analysis but a composite marker of fewer complications, faster achievement of full enteral feeds, and general clinical stability.

Time to fully enteral nutrition is a crucial milestone in the care of gastroschisis, and it is a direct indicator of the recovery of the damaged bowel function. The information in Table 3 is quite distinct: more than half of the CS group (54.5%) was on full feeds by day 15, as compared with just 26.7% in the NVD group. This was a gut delay in the vaginally born group and was the result of the more severe bowel trauma produced by the synergistic stressors of labor, potential infection, and ischemia. Reduced motility and long-lasting feeding intolerance necessitate long-term parenteral nutrition, with

its accompanying risks of liver disease and bacteremia, thus prolonging the duration of the hospitalization.

Table 3. Time to Full Enteral Feeding (Days).

Time to Feeding	Total (N=37)	NVD Group (n=15)	CS Group (n=22)
<15 Days	16 (43.2%)	4 (26.7%)	12 (54.5%)
≥15 Days	21 (56.8%)	11 (73.3%)	10 (45.5%)

The = disparity in patterns of morbidity presented in Table 4 is a pathophysiologic rationale for the findings presented above. The significantly higher rate of sepsis (40.0% v 13.6%) and overall infection (46.7% v 18.2%) in the NVD group is biological inevitability. The passage through the colonized birth canal exposes the eviscerated, unprotected bowel to a massive bacterial inoculum. This "bacterial shower" may result in a deluge of inflammatory reaction and systemic infection. The sterile environment of the cesarean delivery protects the bowel from such early contamination. The higher respiratory distress syndrome rates in the NVD group are most likely multifactorial, secondary to their higher prematurity rate and risk of sepsis-induced respiratory failure.

Table 4. Hospitalization Morbidities in Neonates by Delivery Mode.

Morbidity	Total (N=37) n (%)	NVD Group (n=15) n (%)	CS Group (n=22) n (%)
Sepsis	9 (24.3%)	6 (40.0%)	3 (13.6%)
Bowel Obstruction	5 (13.5%)	3 (20.0%)	2 (9.1%)
Respiratory Distress Syndrome	12 (32.4%)	7 (46.7%)	5 (22.7%)
Necrotizing Enterocolitis	3 (8.1%)	2 (13.3%)	1 (4.5%)
Other Congenital Anomalies	4 (10.8%)	2 (13.3%)	2 (9.1%)
Transient Tachypnea	7 (18.9%)	4 (26.7%)	3 (13.6%)
Intestinal Atresia	4 (10.8%)	2 (13.3%)	2 (9.1%)
Infection	11 (29.7%)	7 (46.7%)	4 (18.2%)
Total Morbidity Events	**55**	**33**	**22**

The ITQOL scores at age one offer a groundbreaking insight into the long-term effects of the mode of delivery. The highly significant elevation in all scales for the CS group—Physical Health, Emotional Functioning, and Developmental Functioning—shows that the benefit of a less adverse neonatal course lasts long after hospital discharge. Infants with a prolonged in-hospital course characterized by infections, surgery, and pain have a higher risk of neurodevelopmental impairment and poor growth. The inverse correlation between stay and QOL scores strongly demonstrates that the neonatal experience lays the foundation for subsequent well-being. A morbidity-reducing strategy translates directly to better child development and family functioning.

The multivariate model (Table 6) statistically verifies the central finding of this study. After other variables had been adjusted for, cesarean delivery in itself was an independent protective factor against mortality and morbidity (aOR: 0.25). Analysis confirms the point that the benefit of CS is not a proxy for other advantages but, in itself, a strong determinant of improved outcomes. It also verifies the established roles of preterm birth and low birth weight as strong risk factors.

Table 5. Health-Related Quality of Life (ITQOL Questionnaire) at 12-month follow-up.

ITQOL Domain (Score 0-100)	Total (N=33) Mean ± SD	NVD Group (n=12) Mean ± SD	CS Group (n=21) Mean ± SD
Physical Health	78.2 ± 12.4	71.5 ± 14.1	82.1 ± 9.8
Emotional Functioning	81.5 ± 10.7	76.2 ± 11.9	84.7 ± 8.9
Social/Family Functioning	85.9 ± 9.3	80.8 ± 10.5	88.9 ± 7.1
Developmental Functioning	79.8 ± 13.5	72.3 ± 14.8	84.1 ± 10.5
Behavioral Functioning	83.1 ± 11.2	77.5 ± 12.0	86.4 ± 9.3

Table 6. Multivariate Analysis of Risk Factors for Mortality and Morbidity.

Risk Factor	Adjusted Odds Ratio (OR)	95% Confidence Interval (CI)	p-value
Cesarean Delivery (Protective)	0.25	0.08 – 0.79	0.018
Preterm Birth (<37 weeks)	4.10	1.30 – 12.94	0.016
Low Birth Weight (<2500g)	3.85	1.22 – 12.14	0.021
Maternal Infection	2.95	0.68 – 12.82	0.149
NICU Admission	37 (100%)	15 (100%)	22 (100%)

Table 7. Chi-Square Test Analysis of Key Associations.

Association	Chi-Square Value (χ^2)	p-value
Delivery Mode & Mortality/Morbidity		
Mortality (NVD vs. CS)	4.29	0.038
Morbidity Incidence (NVD vs. CS)	6.54	0.011
Length of Stay & QOL	-0.672	<0.001
Birth Weight & APGAR Scores	+0.587	<0.001
Time to Full Enteral Feeding & Hospital Stay	+0.721	<0.001

DISCUSSION

This comparative analysis of 37 neonates with gastroschisis on the optimal mode of delivery for this congenital anomaly. Our primary finding—that cesarean delivery was associated with significantly diminished neonatal mortality and morbidity, reduced NICU hospital stays, faster attainment of full enteral feeds, and improved quality of life scores at age one year.

The greatest finding was the stark contrast in neonatal mortality, 20.0% in the vaginal delivery compared with 4.5% in the group undergoing cesarean section. This difference, significant on multivariate analysis (aOR: 0.25, 95% CI: 0.08–0.79), is a highly important clinical finding. This finding is contrary to some of the population-based studies and meta-analyses conducted to date that have identified no mortality difference by route of delivery [15,16]. In spite of this, our results concur with other single-institution reports of trends toward improved survival with cesarean delivery, particularly in those conditions where vaginal delivery was precluded by more protracted and traumatic labors and higher rates of emergent conversion of cesarean section [17]. The higher rate of low birth weight (66.7% vs. 36.4%) and preterm birth (73.3% vs. 40.9%) in the vaginal group would have largely explained this discrepancy in mortality since they are known independent risk factors for adverse outcomes. It is logical to think that the process of labor pathophysiologically—characterized

by uterine contractions and potential cord compression—may exacerbate the inflammatory and ischemic insult on the exposed, thickened, and edematous bowel in gastroschisis infants and lead to a more prolonged course in the postnatal period [18]. Other than mortality, the morbidity profile decisively in favors of the cesarean section group. [19]

The incidence of sepsis (40.0% versus 13.6%) and any infection (46.7% versus 18.2%) was more in excess after vaginal delivery. This is a biologically plausible finding. The exposed fetal bowel is highly susceptible to infection, and passing through the bacteria-colonized birth canal may be a cause of microbial contamination. [20] This "bacterial shower" associated with vaginal delivery may directly inoculate the eviscerated bowel loops, causing an infectious cascade more difficult to control in the postnatal course. In contrast, the controlled, sterile environment of an operating room for a cesarean section may avoid this initial bacterial exposure [21]. Besides, the CS group had a much higher incidence of primary surgical closure (72.7% versus 40.0%), that suggests these infants had less bowel edema and inflammation at birth, a condition more conducive to early closure of the abdominal wall. [22] It's a significant surgical outcome because successful primary closure has fewer complications and is of shorter duration on parenteral nutrition. The greater than twofold duration of NICU inpatient stay in the vaginal delivery group (41.2 days vs 26.7 days) is a quantitative measure of the additive burden of these morbidities.

Prolonged NICU hospital stay is not merely a marker of healthcare utilization; it is an indirect measure of a more complicated and longer clinical course of the neonate. Such prolonged stay is often required by the challenges of sepsis management, delayed parenteral nutrition weaning due to compromised intestinal function, and treatment of associated complications like NEC [23]. [24] The faster time to full enteral nutrition in the CS group further validates the concept of preserved bowel integrity. Mechanical injury and potential hypoxic-ischemic insult during delivery may impair intestinal motility and barrier function, leading to a prolonged period of intestinal dysmotility and feeding intolerance [25]. The one-year quality of life data, as measured by the ITQOL questionnaire, provides a novel and patient-centered view to our findings. [26]

The equally increased scores across all domains—Physical Health, Emotional Functioning, and Developmental Functioning—of the CS group suggest that the benefit of this delivery mode might continue to the neonatal phase beyond the immediate. Those infants with less complicated neonatal courses and fewer infections, with earlier resolution of PN dependence, may be positioned for maximal growth and neurodevelopmental development in the first year of life [27]. The opposite of a correlation between length of hospital stay and QOL score also demonstrates the substantial impact that a difficult course of neonatal life can have upon later life well-being of an infant [28].

CONCLUSIONS

In conclusion, our results indicate that in our series, cesarean section was associated with significantly better survival, reduction in morbidity, and quality of life at one year for infants with gastroschisis compared to vaginal delivery.

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