CLINICAL AND PROGNOSTIC SIGNIFICANCE OF INTRA-ABDOMINAL PRESSURE IN CHOOSING A SURGICAL STRATEGY FOR GASTROSCHISIS IN NEWBORNS

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Abstract

Background. Gastroschisis is a congenital defect of the anterior abdominal wall in newborns, characterized by the evisceration of bowel loops without a protective sac. Timely and appropriate abdominal wall closure is essential for favorable outcomes. Objective: To evaluate the clinical and prognostic significance of intra-abdominal pressure monitoring for determining the optimal surgical strategy in newborns with gastroschisis.

Materials and Methods. A retrospective cohort study was conducted on 32 newborns with gastroschisis treated in two tertiary centers in Kazakhstan and Russia from 2015 to 2025. Patients were allocated into two groups based on intraoperative intra-abdominal pressure values: Group 1 (n=21) underwent primary fascial closure using the Elective Delayed Midgut Reduction technique; Group 2 (n=11) received staged silo-assisted closure. intra-abdominal pressure was measured intravesically, and a threshold of 22–24 cm H_2O was used to guide the surgical decision. Clinical outcomes included duration of mechanical ventilation, total parenteral nutrition, ICU stay, hospital stay, complication rate, and mortality. Statistical analysis was performed using the Mann–Whitney U test ($p < 0.05$).

Results. Group 1 had significantly better outcomes, including shorter durations of mechanical ventilation (6 vs. 13 days, $p = 0.01$), ICU stay (12 vs. 20 days, $p = 0.01$), parenteral nutrition (14 vs. 22 days, $p = 0.04$), and lower mortality (4.8% vs. 27.3%, $p = 0.03$). Group 2 showed a higher complication rate, especially adhesive obstruction and sepsis.

Conclusion. Intraoperative intra-abdominal pressure measurement is a valuable tool for guiding surgical strategy in gastroschisis. An individualized approach based on physiological parameters improves safety and outcomes in neonatal surgical care.

Introduction

Gastroschisis is one of the most common congenital anomalies of the anterior abdominal wall in newborns. This defect is characterized by evisceration of the bowel loops through a paraumbilical defect without a covering sac, which distinguishes it from omphalocele. The extra-abdominal location of the intestines and their prolonged exposure to amniot-

ic fluid in utero lead to serosal inflammation, bowel wall edema, and impaired peristalsis.[1-3]

According to contemporary population-based data, the incidence of gastroschisis reaches 4.5–5 per 10,000 live births, particularly among young women of reproductive age, and shows an increasing trend, particularly in low- and middle-income countries.[4,5]

A key challenge in the management of gastroschisis remains the choice of optimal abdominal wall closure technique. The two main surgical approaches are primary fascial closure and staged silo-assisted closure using a temporary silo bag (silo).[6] Primary closure is preferred when the bowel appears viable and there is no significant viscero-abdominal disproportion. However, in the presence of bowel dilation or elevated intra-abdominal pressure (IAP), placement of a silo becomes the safer strategy.[7,8]

The major limiting factor for primary closure is the risk of developing intra-abdominal hypertension and abdominal compartment syndrome, resulting from diaphragmatic compression, decreased pulmonary compliance, impaired venous return, and reduced organ perfusion.[9,10]

To objectively assess the level of IAP, a method of intraoperativeintravesical pressure measurement has been adapted for neonatal practice. This approach allows for timely detection of critical elevations in IAP and supports an evidence-based decision for staged abdominal wall closure.[11]

Therefore, there is a pressing need to develop an objective, physiologically sound algorithm for surgical decision-making in neonates with gastroschisis, based on intraoperative intra-abdominal pressure monitoring.

Materials and Methods

Study design and setting. This was a retrospective, two-center cohort study conducted between 2015 and 2025at the Multidisciplinary Regional Children's Hospital in Aktobe (Republic of Kazakhstan) and the Regional Children's Clinical Hospital in Yekaterinburg (Russian Federation).

Participants. A total of 32 newborns with confirmed antenatal or postnatal diagnosis of gastroschisis were included in the study. All patients were admitted within the first 24 hours of life.

Inclusion criteria:

- Confirmed diagnosis of gastroschisis.
- Admission during the first 24 hours after birth.

Exclusion criteria:

- Severe congenital heart or lung defects.
- Associated gastrointestinal anomalies requiring stoma formation at the initial stage of treatment.

Measurement of intra-abdominal pressure. IAP was measured intraoperatively using the intravesical method. A sterile 0.9% sodium chloride solution (0.5 mL/kg; Kelun-Kazpharm LLP, Republic of Kazakhstan) was instilled into the bladder through a CH 6 urinary catheter (outer diameter 2.0 mm, inner diameter 1.1 mm; JULDYS KENAN Co., Ltd, Republic of Kazakhstan; ISO 13485:2016–certified). The height of the fluid column was measured in the supine position using a sterile transparent medical-grade ruler. An IAP level of 22–24 cm H_2O was considered critical (Figure 6).

Primary outcomes:

- Duration of mechanical ventilation.
- Time to initiation of enteral feeding.
- Duration of total parenteral nutrition.
- Length of intensive care unit stay.
- Total duration of hospitalization.
- Postoperative complications (adhesive intestinal obstruction, sepsis, necrotizing enterocolitis).
- Mortality.

Ethical approval. The study was approved by the local ethics committees of both participating institutions (Protocol No.7-2025-09/HC, approved 03 July 2025). All patient data were anonymized, and no personally identifiable information was included. The study complied with the principles of the Declaration of Helsinki (2013 revision).

Statistical analysis. Statistical analysis was conducted using IBM SPSS Statistics software, version 20.0 (IBM Corp., Armonk, NY, USA). Quantitative variables were compared using the Mann–Whitney

U test. A p-value of < 0.05 was considered statistically significant.

Results

Perinatal characteristics. The two groups were comparable in terms of gestational age and birth weight. However, the median 5-minute Apgar score was significantly higher in Group 2 compared with Group 1 (8 vs7; p = 0.03), which may indicate more stable neonatal condition at birth (Table 1).

Table1. Perinatal characteristics of newborns with gastroschisis

Variable	Group 1 (n = 21)	Group 2 (n = 11)	p-value
Gestationalage, weeks	37 (36–38)	38 (36–39)	0.21
Birthweight, grams	2350 (1990–2425)	2480 (2260–2770)	0.18
5-minute Apgarscore, points	7 (6–7)	8 (7–8)	0.03

Intervention

Preoperative care. In most patients, bowel loops were visibly edematous, inflamed, and covered with fibrin (Figure 1). Immediately after birth, all newborns received cleansing siphon enemas to reduce the visceral component of the viscero-abdominal disproportion. Passage of meconium was considered a positive prognostic sign indicating intestinal patency (Figure 2).

Picture 1. Clinical appearance at birth: subtotal evisceration of edematous, inflamed bowel loops covered with fibrin.


Picture 1


Picture 2

Picture 2. Reduced viscero-abdominal disproportion after siphon enema; passage of meconium observed – a favorable prognostic sign.

Picture 3. Complete primary fascial closure using the Elective Delayed Midgut Reduction (EDMR) method by *A. Bianchi.*


Picture 3

Group 2 (n = 11): Staged silo closure using an improvised sterile polyethylene bag when the IAP threshold was exceeded (Figure 4–6).

Picture 4. Staged silo-assisted reduction using an improvised sterile polyethylene bag in case of severe viscero-abdominal disproportion.

Picture 5. Intermediate stage of silo reduction: bowel loops fully reduced into the abdominal cavity on postoperative day 5, prior to definitive closure.

Picture 6. Intra-abdominal pressure measurement via urinary bladder using a CH6 catheter and sterile ruler prior to surgical decision.

Postoperative course. Group 1 (primary fascial closure) demonstrated significantly better outcomes in the early postoperative period. These included shorter durations of mechanical ventilation (6 vs 13 days; p = 0.01), intensive care unit stay (12 vs 20 days; p = 0.01), and total parenteral nutrition (14 vs 22 days; p = 0.04). The total length of hospitalization was also shorter (30 vs 41 days; p = 0.04). Notably, mortality in Group 1 was significantly lower than in Group 2 (4.8% vs 27.3%; p = 0.03) (Table 2).

Parameter	Group 1 (n = 21)	Group 2 (n = 11)	p-value
Duration of mechanical ventilation, days	6 (3–11)	13 (7–20)	0.01
Length of intensive care unit stay, days	12 (7–18)	20 (16–28)	0.01
Duration of total parenteral nutrition, days	14 (8.5–18)	22 (18–28.5)	0.04
Total hospitalization, days	30 (25–42)	41 (34–47)	0.04
Mortality, number (%)	1 (4.8%)	3 (27.3%)	0.03

Table 2. Early postoperative parameters

Postoperative complications. The overall rate of postoperative complications was significantly higher in Group 2 (64%) compared to Group 1 (24%; p=0.03). Specifically, adhesive intestinal obstruction occurred more frequently in Group 2 (55% vs 19%; p = 0.04), and sepsis was observed only in Group 2 (27% vs 0%; p = 0.02). The incidence of necrotizing enterocolitis was identical in both groups (Table 3).

Table 3.
Frequency of postoperative complications

Complication	Group 1 (n = 21)	Group 2 (n = 11)	p-value
Adhesive intestinal obstruction	4 (19%)	6 (55%)	0.04
Neonatal sepsis	0	3 (27%)	0.02
Necrotizing enterocolitis	1 (4.8%)	1 (9.1%)	1.00
Total complications	5 (24%)	7 (64%)	0.03

Causes of mortality. There was one death in Group 1, which occurred due to delayed diagnosis of adhesive intestinal obstruction. In Group 2, three deaths were recorded-two due to adhesive obstruction and one due to neonatal sepsis. Necrotizing enterocolitis did not result in mortality in either group (Table 4).

Table 4.
Causes of mortality

Cause of death	Group 1 (n = 21)	Group 2 (n = 11)
Adhesive intestinal obstruction	1	2
Neonatal sepsis	0	1
Necrotizing enterocolitis	0	0
Total deaths	1	3

Discussion

The choice of optimal surgical strategy for abdominal wall closure in newborns with gastroschisis remains a subject of ongoing clinical debate. The primary dilemma lies in selecting between immediate fascial closure and staged silo-assisted reduction, with the overarching goal of minimizing the risk of intra-abdominal hypertension and its associated complications.

In recent years, intraoperative measurement of intra-abdominal pressure has gained recognition as an objective and physiologically grounded criterion to guide surgical decision-making. According to published literature, IAP values exceeding 22–24 cm H_2O are strongly associated with thoracoabdominal organ compression, reduced venous return, impaired pulmonary function, and compromised tissue perfusion[12,13]. In this study, adherence to the aforementioned threshold enabled timely identification of patients at risk and guided the appropriate choice of surgical strategy.

The Elective Delayed Midgut Reduction (EDMR) technique, as described by A. Bianchi, yielded superior clinical outcomes. Patients in this group experienced shorter durations of mechanical ventilation, total parenteral nutrition, and intensive care unit stay, along with significantly lower mortality rates. These findings align with international meta-analyses that support primary closure in the absence of elevated IAP.[7]

For patients with pronounced viscero-abdominal disproportion and elevated IAP, staged silo-assisted reduction was implemented using improvised sterile polyethylene bags. While commercial silicone silos with circumferential rings (e.g., Schuster silo) are considered ideal,[14] their high cost and limited availability necessitated the use of resource-appropriate alternatives. The safety and effectiveness of such improvised solutions have also been validated in prior clinical reports.[10,11]

The higher rates of adhesive intestinal obstruction and sepsis observed in the staged treatment group may be attributed to prolonged extra-abdominal exposure of inflamed bowel loops and delayed restoration of intestinal motility. This underscores the importance of achieving early closure whenever physiologically feasible. Moreover, histological data suggest that earlier fascial clo-

sure reduces the extent of inflammatory and degenerative changes in the bowel wall, potentially improving long-term functional outcomes.

In summary, the findings of this study highlight the clinical and prognostic utility of intraoperative IAP monitoring in selecting a safe and effective surgical approach for gastroschisis. An individualized strategy, grounded in objective physiological indicators, contributes to improved perioperative outcomes and reduced complication rates in neonatal surgical practice.

Limitations. This study has several limitations. First, its retrospective design inherently carries the risk of selection and information bias. Second, the sample size was relatively small, particularly in the staged treatment group, which may limit the generalizability of the findings. Third, long-term outcomes, such as bowel function and quality of life, were not assessed. Finally, the use of improvised silos may introduce variability in technique and postoperative care, potentially affecting complication rates. Prospective multicenter studies with larger cohorts are needed to validate these results and further refine surgical decision-making algorithms.

What's known? Primary fascial closure is preferred in gastroschisis when feasible, yet the decision often relies on subjective judgment. Elevated intra-abdominal pressure is linked to adverse outcomes, and its intraoperative measurement is recognized as a valuable tool to guide surgical strategy.

What's new? This study validates a defined intra-abdominal pressure threshold (22–24 cm H_2O) as an objective criterion for selecting between primary closure and staged silo repair, demonstrating improved early postoperative outcomes and reduced mortality in newborns with gastroschisis.

Conclusion

The results of this study confirm the clinical effectiveness of intraoperative intra-abdominal pressure monitoring in determining the optimal surgical strategy for newborns with gastroschisis. Applying a critical threshold value of 22–24 cm H_2O enables objective assessment of the feasibility of safe primary fascial closure and supports timely transition to staged silo-assisted repair when required. The Elective Delayed Midgut Reduction (EDMR) technique demonstrated superior early postoperative outcomes, including shorter duration of mechanical ventilation, parenteral nutrition, and intensive care stay, as well as lower mortality rates. Conversely, staged management was crucial in patients with marked viscero-abdominal disproportion to prevent life-threatening complications associated with elevated IAP. Personalized surgical strategies based on IAP monitoring should be regarded as an essential component of gastroschisis management algorithms in neonatal practice, enhancing safety, reducing complications, and improving overall outcomes.

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