LUMEN ET VIRTUS
ISSN: 2177-2789

MAIN SURGICAL APPROACHES AND COMPLICATIONS OF GASTROSCHISIS: A SYSTEMATIC REVIEW

https://doi.org/10.56238/levv16n47-108

Submitted on: 03/27/2025 **Publication date:** 04/27/2025

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ABSTRACT

Objective: This systematic review article aims to compile and analyze the evidence on complications and strategies for the management of gastroschisis, providing a comprehensive and up-to-date view to guide future research and clinical practice. **Methodology:** The systematic review used the PVO strategy to investigate the main surgical treatments for gastroschisis and its complications. Searches were carried out in the PubMed Central (PMC) and Virtual Health Library (VHL) databases with specific descriptors, resulting in 158 articles. After applying the inclusion and exclusion criteria, 14 articles were selected for analysis. **Discussion:** Immediate postnatal care is crucial to avoid complications such as fluid loss, hypothermia, and infections. Infants with gastroschisis should be treated in neonatal intensive care units. Initial measures include protection of the herniated viscera, regulation of body temperature, and gastric decompression. **Results:** Surgically, timely reduction of herniated viscera is essential to avoid severe abdominal syndromes. The choice between primary or delayed correction depends on the patient's

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conditions. An integrated and vigilant approach is vital to improve neonatal outcomes and reduce the morbidity and mortality associated with gastroschisis.

Keywords: Gastroschisis. Management and complications.

INTRODUCTION

Gastroschisis is a congenital anomaly characterized by a defect in the abdominal wall, usually located to the right of the midline. This defect occurs when the abdominal organs fail to return to the abdominal cavity in an appropriate manner. Among the risk factors, young maternal age, infections, and smoking stand out. The etiology of gastroschisis is not yet fully understood, although there are several theories, such as vascular lesions, failures in the folding of the ventral wall, and alterations in the insertion of the yolk sac, none of which have been confirmed. This ventral defect, less than 4 cm in diameter, is not covered by membranes, exposing the intestines. Gastroschisis can be identified on ultrasound as a visceral hernia floating in the amniotic fluid, unprotected by any membrane. Although its cause remains unknown in most cases, there is a strong correlation with young maternal age. The overall occurrence is estimated at approximately one case for every 1,953 births. (FERREIRA et al., 2022; DIYAOLU et al., 2021)

Usually, the defect is located to the right of the umbilical cord and contains mainly the midgut, as well as the stomach and, occasionally, gonads or distal colon [1,8]. Exposure of the intestines to the uterine environment can result in thickening, edema, entanglement, and a layer of fibrin covering the bowel loops. These changes can worsen after birth, with the intestines exposed to the external environment. Newborns with gastroschisis often present with prematurity, respiratory complications, and low gestational weight. (DIYAOLU et al., 2021)

Risk factors include low preconception body mass index, early age of the mother, and unfavorable socioeconomic conditions. Pathological changes of the intestine, such as thickening and stiffness, result from exposure to amniotic fluid. In addition, the difference between abdominal growth and abdominal cavity volume can complicate the return of intestinal loops to the postnatal cavity. Intestinal dysmotility, common in these cases, has causes that are not fully elucidated. The model known as "two strokes" suggests that mesenteric ischemia may also contribute. Advances in maternal-fetal care, intensive neonatal care, and pediatric surgical procedures have improved prognosis. (DURMAZ et al., 2022)

Gastroschisis is divided into two main types: simple and complex. The simple variant is characterized by the absence of intestinal complications, while the complex includes problems such as intestinal atresia, perforation, necrosis of segments, or volvulus. Fetuses with complex gastroschisis have significantly higher rates of mortality and morbidity compared to simple cases. Even with early ultrasound diagnosis, there is no consensus on

the ideal time of delivery or the best management. (FERREIRA et al., 2022; DIYAOLU et al., 2021; RADUMA et al., 2021)

Cases of complicated gastroschisis often result in a higher risk of morbidity and mortality due to gastrointestinal conditions such as atresia, perforation, stenosis, volvulus, or intestinal necrosis. These situations require prolonged periods of mechanical ventilation, longer hospitalizations, prolonged adynamic ileus, and delays in complete acceptance of enteral feeding. In addition, there is an increase in infectious, respiratory, and gastrointestinal complications. On the other hand, simple gastroschisis is not associated with these specific pathologies. Intestinal dilation, seen on ultrasound, can help predict complicated cases. (DIYAOLU et al., 2021)

Advances in maternal-fetal medicine, pediatric surgery, and neonatal intensive care have considerably improved the prognosis of gastroschisis, although neonates with complex gastroschisis still have significant differences in postoperative complications, length of hospital stay, and clinical behavior compared to those with simple gastroschisis. The origin of complex gastroschisis remains uncertain, but it may be linked to ongoing inflammation caused by exposure to amniotic fluid and the formation of fibrotic layers over exposed intestines. Other mechanisms are still being investigated. (DURMAZ et al., 2022)

Despite the advances, gastroschisis remains a topic of discussion with regard to optimal management, treatment strategies, and timing of delivery. This article seeks to compile and examine the current evidence on complications and therapeutic approaches to provide a comprehensive view that guides future clinical practice and research.

METHODOLOGY:

This paper is a systematic review aimed at understanding the main aspects related to gastroschisis. The objective is to present the most used surgical methods in the treatment of this condition, as well as the associated complications, seeking to provide greater clinical clarity on the subject. To carry out this study, a guiding question was developed based on the PVO strategy (population, variable and objective): **"What are the main surgical procedures to treat gastroschisis, in addition to its possible complications?"**

The searches were carried out on the PubMed Central (PMC) and Virtual Health Library (VHL) data platforms. For this, four descriptors combined with the Boolean operator "AND" were used: *Gastroschisis*, *Digestive System Surgical Procedures*, *Postoperative Period* and *Short Bowel Syndrome*. In the PMC database, the search strategy consisted of the combinations: *Gastroschisis AND Digestive System Surgical Procedures AND*

Gastroschisis AND Postoperative Period. In the VHL, the terms used were: *Short Bowel Syndrome AND Gastroschisis AND Postoperative Period AND Gastroschisis*. From these searches, 134 articles were identified, which were then submitted to selection criteria.

The inclusion criteria considered articles published between 2019 and 2024, written in English, Portuguese, or Spanish, which addressed the proposed topics and were available in full. Review, observational, and experimental studies were included. The exclusion criteria discarded duplicate articles, non-complete abstracts, publications that did not directly address the topic, and those that did not meet the inclusion criteria.

When applying the descriptors and criteria in the databases consulted, a total of 1358 articles were found. After the analysis and exclusion of items that did not meet the specifications, 14 articles from the PubMed database were included, resulting in a total of 14 studies used to compose this review.

DISCUSSION:

The definition of the most appropriate time for delivery in cases of gastroschisis continues to be widely debated. Delayed delivery can prolong the exposure of the intestine to toxic amniotic fluid, increasing the risk of intrauterine complications, such as closure of the abdominal defect. On the other hand, preterm birth presents its own challenges. Limited data indicate that elective late preterm delivery, performed between 35 and 37 weeks of gestation, is related to lower rates of infectious complications and a faster recovery of enteral feeding function, when compared to expected full-term delivery. However, unplanned preterm birth often results in longer delays in recovering bowel function. Better results have been observed in term preterm births, just after 37 weeks, compared to expected full-term delivery. The choice about the exact moment of delivery should consider gestational age, ultrasound findings, and fetal tests. Currently, most units choose to deliver at 37 weeks. (BIELICKI et al., 2021)

The main focus of immediate postnatal care is to prevent excessive fluid loss due to evaporation, reduce the risk of hypothermia, and avoid infections. (BIELICKI et al., 2021) All newborns with gastroschisis should be treated in neonatal intensive care units, being monitored by intensivists, respiratory therapists, and pediatric surgeons. Initial measures include protecting the intestine through a translucent bag, temperature control, homeostatic stabilization and minimizing liquid losses through evaporation. The initial evaluation of the intestine aims to rule out obvious complications, such as volvulus or atresia. For gastric decompression, an orogastric tube is introduced. In addition, intravenous access is

established for fluid replacement, including insertion of a peripheral central line for total parenteral nutrition when necessary. (DIYAOLU et al., 2021)

The exposed viscera are covered with warm gauze soaked in saline solution and the lower part of the newborn is placed in a plastic bag, especially in cases of transport to another hospital. For respiratory support, it is recommended to avoid methods that promote continuous positive airway pressure or use of high flow oxygen, so that there is no risk of intestinal distension. (BIELICKI et al., 2021)

There are divergences in the data on the relevance of the place of birth for congenital surgical anomalies. Limited studies suggest that being born outside specialized surgical centers may be associated with less favorable neonatal outcomes, especially for newborns with congenital diaphragmatic hernia, which has high mortality rates in the first days of life. In the case of gastroschisis, transfer for surgical repair may delay the start of enteral feeding, prolonging the length of hospital stay. (MALDONADO et al., 2023)

Early exposure to breast milk can bring benefits to newborns, being the preferred choice for feeding, especially after gastrointestinal surgeries. Breast milk has anti-inflammatory properties and nutrients adapted to the specific needs of neonates, in addition to being easy to digest. Intestinal dysmotility, caused by exposure to amniotic fluid, can lead to symptoms of food intolerance and delay the advancement of enteral nutrition. Studies show that babies with gastroschisis fed with breast milk achieve complete enteral nutrition in less time and have a shorter hospitalization period compared to those fed with formula. (TUCKER et al., 2020)

Early enteral feeding offers immunological advantages to the intestine, promoting the regeneration of intestinal villi, improvement in enzyme activity and strengthening of intestinal microflora. These benefits may also reduce the risk of complications, such as necrotizing enterocolitis (NEC) and cholestatic injury, while amplifying nutritional gains. Research indicates that the optimal timing and pace of advancement in enteral feeding is related to better clinical outcomes, faster interruption of parenteral nutrition, shorter hospital stay, and reduced treatment costs in children with gastroschisis. (RADUMA et al., 2021)

The main objective of the surgical management of gastroschisis is to reduce the herniated viscera efficiently and at the right time, avoiding damage to the structures involved and preventing the occurrence of abdominal compartment syndrome (BIELICKI et al., 2021). After birth, exposed intestines are vulnerable to dehydration, mechanical trauma, pressure necrosis, and infections. To mitigate these risks, two postnatal approaches have become standard procedures in the treatment of gastroschisis: primary correction and delayed correction (DIYAOLU et al., 2021; DURMAZ et al., 2022).

In the primary correction technique, the aim is to reposition the intestine in the abdominal cavity, covering the defect with the remainder of the umbilical cord and applying an occlusive dressing. This procedure can be performed at the bedside, using a silo bag filled with heated saline solution, or in a surgical environment, where primary reduction is performed followed by suture closure. In the case of suture closure, the fascial edges are approximated with absorbable sutures, and it is essential to monitor and avoid excessive increase in intra-abdominal pressure (IAP) (>20 mmHg). If elevated IAP prevents primary closure, one can choose to close the skin over the defect or use prosthetic materials for temporary closure (DIYAOLU et al., 2021; BIELICKI et al., 2021).

The sutureless technique, on the other hand, can be done at the bedside, without the need for general anesthesia. A waterproof dressing is applied directly to the defect, and the umbilical stump can be used to protect the viscera. When it is not possible to reduce the intestines immediately, late correction is performed, using a silastic silo to contain the intestines. These are gradually reintroduced into the abdominal cavity, and final closure is performed after complete reduction. This method is recommended in cases of intestinal thickening or dilation or in situations of respiratory compromise or abdominal compartment syndrome (DIYAOLU et al., 2021).

Fetal surgery for gastroschisis is a controversial topic. Although morbidity in the neonatal period may be relevant, overall survival rates exceed 90%, with positive long-term prognosis. However, the risk of intrauterine mortality, prematurity, and complications resulting from intrauterine repair should be considered. Patients with complex gastroschisis face higher morbidity and mortality rates compared to those with simple gastroschisis, which suggests that fetal intervention should be focused primarily on complex cases (DURMAZ et al., 2022).

Gastroschisis can be classified into two types: simple, without associated complications, and complicated, characterized by pathologies such as atresia, perforation, stenosis, volvulus or intestinal necrosis. Complicated gastroschisis has higher morbidity and mortality compared to the simple form (DIYAOLU et al., 2021). Newborns with complicated gastroschisis often face long hospital stays, longer mechanical ventilation time, higher incidence of sepsis, and liver complications associated with prolonged parenteral nutrition, which can progress to severe liver failure (DIYAOLU et al., 2021; BIGIO et al., 2021).

Complications in gastroschisis are common, with about 30% of cases involving complex conditions, such as atresia or intestinal stenosis. Other secondary problems include intestinal dysmotility, necrotizing enterocolitis (3.8-8.2%), volvulus (0.5-3.0%), intestinal necrosis (4.5%), and evanescent gastroschisis (

Surgical site infection (SSI) following interventions to correct abdominal birth defects is a significant and common clinical complication, especially in infants under three years of age. This problem still needs detailed studies. Forms of SSI include wound infection, dehiscence, anastomotic leakage, postoperative peritonitis, and fistula formation, all of which are potentially associated with prolonged hospitalization, increased medical costs, negative impacts on quality of life, and increased mortality rates. (LD, GD, et al., 2021)

Birth defects such as gastroschisis, omphalocele, and small bowel atresia are more likely to result in SSI, compared with other types of malformations. This elevated risk is partly attributed to the fact that many babies with these conditions are born prematurely, as occurs in more than half of gastroschisis cases. (LD, GD, et al., 2021)

A comprehensive analysis included 154 studies, totaling 11,786 patients. The data revealed that the pooled rate of SSI after abdominal defect correction surgeries was 6% (95% CI: 0.05–0.07), ranging from 1% (95% CI: 0.00–0.05) for common bile duct cyst surgery to 10% (95% CI: 0.06–0.15) in cases of gastroschisis. The rate of wound dehiscence was 4% (95% CI: 0.03–0.07), being lower in cases of duodenal obstruction (1%) and higher in gastroschisis surgeries (6%). (LD, GD, et al., 2021)

Abdominal compartment syndrome is a feared complication after reduction and closure of the gastroschisis defect. It is defined by IAP (intra-abdominal pressure) greater than 20 mmHg, measured by bladder pressure, accompanied by dysfunction of one or more organs, such as anuria. Although rare and with unknown incidence, it is believed that late closure of the defect may reduce the risk of this condition. (DIYAOLU et al., 2021; BIELICKI et al., 2021)

Between 10 and 15% of patients with gastroschisis have associated intestinal atresia, with a higher incidence in the small intestine (80%) compared to the colon (20%). Management of this complication may include three approaches: resection and primary anastomosis prior to abdominal closure, in cases with little inflammation; creation of a stoma or use of a silo when there is significant inflammation, with definitive intervention after 7 to 10 days; or resection and anastomosis depending on the patient's stability, adequate perfusion, and absence of distal obstruction. (BIELICKI et al., 2021)

Patients with gastroschisis are at high risk of incisional hernia, which occurs in about 10% of cases. Complex gastroschisis and silo closure were identified as risk factors, while cases of simple gastroschisis showed a lower probability of developing incisional hernia, with an odds ratio of 0.18 compared to complex cases. (EEFTINCK SCHATTENKERK et al., 2020)

Ventral hernias after gastroschisis repair are known, although few studies have analyzed the incidence based on the type of closure performed. Patients with immediate closure had a higher frequency of ventral hernias than those who had silos placed for a short period. The increase in the duration of silo use correlated with a higher rate of hernias, especially when the silo remained for more than 10 days, equalizing the rates in the immediate closure group. This may be linked to abdominal wall tension and fascial stress on immediate closure. The use of the silo can help reduce intestinal edema and reduce tension at the time of definitive closure. (HAWKINS et al., 2023)

According to Sosnowska (2021), the neonatal survival rate in cases of gastroschisis was 91.29%, with postnatal mortality of 8.71%. Fourteen deaths were recorded in simple cases and sixteen in complex cases. Although these numbers are promising, further investigations are needed to optimize outcomes and the recovery process after surgical intervention, with the support of multidisciplinary teams. Full recovery depends not only on the severity and management of gastroschisis, but also on other associated congenital conditions and the clinical status of the patient. (SOSNOWSKA-SIENKIEWICZ et al., 2021)

Among the risk factors for mortality in neonates with gastroschisis are low birth weight, prematurity, lack of prenatal diagnosis, complex gastroschisis, sepsis, and inadequate hospital conditions. Identifying these factors is essential to create strategies that improve survival rates by health authorities and hospital managers. (MUNIZ et al., 2023)

CONCLUSION:

Immediate postnatal care of babies with gastroschisis is indispensable to prevent complications such as dehydration, hypothermia, and infections. These patients should be treated in neonatal intensive care units, being monitored by multidisciplinary teams composed of intensivists, respiratory therapists, and pediatric surgeons. Among the first measures taken are the protection of exposed viscera with the use of translucent bags, strict control of body temperature, and the insertion of orogastric tubes to facilitate gastric decompression. It is also essential to perform a detailed assessment of the condition of the intestines to identify potential complications such as volvulus or intestinal atresia.

In the nutritional aspect, the early introduction of breast milk has shown important results, as it offers anti-inflammatory properties and nutrients specially adapted to the condition of newborns. In addition to improving gastrointestinal health, this type of feeding helps prevent complications such as necrotizing enterocolitis and accelerates the transition to full enteral feeding.

In the surgical field, it is essential to reduce the herniated viscera in the appropriate time, minimizing the risk of serious complications, such as abdominal compartment syndrome. The decision between primary or delayed correction methods should be individualized, considering the patient's clinical condition, with a focus on reducing abdominal tension and preventing postoperative complications, such as incisional hernias.

Thus, an integrative and attentive approach, which prioritizes the early identification of risks and the application of effective management strategies, is essential to optimize clinical outcomes, promoting neonatal health and reducing the morbidity and mortality associated with gastroschisis.

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