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REVIEW ARTICLE

Role of Surgery in the Outcome Difference of Gastroschisis between High-income and Low-middle-income Countries: A Review

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Abstract

Gastroschisis is a major congenital abdominal wall defect where the abdominal viscera comes out through a gap right to the umbilicus. The management of gastroschisis requires prompt and aggressive medical and surgical intervention immediately after birth. However, there is a notable disparity in mortality rates between developed countries and LMICs. Despite various surgical technique adjustments, LMICs still suffer from a high mortality rate, with certain centers reporting a 100% mortality rate. This article seeks to examine the literature and evaluate the impact of surgical techniques on the outcome of gastroschisis.

Keywords: *Gastroschisis, primary fascial closure, preformed silo, staged closure.*

Introduction

Gastroschisis is a congenital anterior abdominal wall defect with an incidence rate of 5 cases per 10,000 live births. Unfortunately, the incidence is rising worldwide.[1] In this condition, there is a gap right to the umbilical cord through which the intestine emerges from the abdomen.[2] Rarely, gaps left to the umbilical cord have also been reported.[3,4] It is differentiated from the omphalocele by the absence of the covering membrane and the gap lateral to the umbilicus.[2] Gastroschisis contributes to maximum mortality among neonatal surgical emergencies in LMICs. Even in some centers, all babies with gastroschisis die. Interestingly, mortality from gastroschisis in HICs is rare.[5,6] Even in some reported studies, it is almost nil, where the primary outcome measures are the length of hospital stay (LOS) and the duration of total parental nutrition (TPN). This unusual disparity in outcome depends not on the surgical procedure used but rather the intensive perioperative care. Still, there are endeavors to modify surgical procedures to reduce morbidity in HICs and mortality in LMICs.[1,5,7-10] The uncovered intestine creates two different types of problems. In utero, it is exposed to the amniotic fluid and undergoes chemical changes. These changes alter its normal functions. After birth, the exposed intestine evaporates fluid, loses heat, becomes swollen, and invites infection. In 10-15% of babies, gastroschisis is associated with co-existing intestinal pathologies like atresia, necrosis, and perforation. Therefore, it requires aggressive medical and surgical management immediately after birth.[2,10-12]

The goals of management are- 1. Correction and prevention of hypothermia, hypovolemia, and sepsis 2. Reposition of the intestine and closure of the abdominal wall gap, 3. Establishment of normal enteral feeding.[13,14]

The successful outcome depends on the timely utilization of maximum resources to achieve all three goals. Unfulfillment of any of these goals

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compromises the survival chances of these babies. This article aims to review the role of surgery in the outcome of gastroschisis.

Types of surgical procedures in gastroschisis

The surgical procedures used in gastroschisis can be broadly classified into two groups-

Primary closure: Here, the exteriorized gut is reduced into the abdomen, and the abdominal gap is closed immediately after birth. The first primary fascial closure of gastroschisis was reported in 1913.[15] Since then, it has been the first approach for gastroschisis in most centers. It offers an early reduction of the intestine into the abdomen and closure of the defect. It reduces the fluid and heat loss and chances of contamination of the exposed viscera. However, it increases the intra-abdominal pressure due to the viscero abdominal disproportion in these babies. The reduced intestine produces abdominal compartment syndrome more or less in every patient, the severity of which depends on the degree of the viscero abdominal disproportion. Therefore, these babies develop respiratory and renal compromise after surgery and require a prolonged period of mechanical ventilation. However, the viscero-abdominal disproportion does not allow primary fascial closure in all patients.[8,13-15] Some centers monitor intravesical and/or intra-gastric pressure to determine the possibility of primary fascial closure.[16,17]

Modifications of primary closure technique: Several surgical approaches have been described to reduce postoperative intraabdominal pressure and the need for mechanical ventilation. Several authors with successful outcomes have reported umbilical cord flap coverage of the gap. It maintains lower intra-abdominal pressure and reduces the need for mechanical ventilation. The flap is autogenic, so there is less chance of infection, and no extra cost.[18-20] Resection of various lengths of the gut has been reported to facilitate successful primary closure with lower intra-abdominal pressure. Okoro PE et al. achieved >67% survival rate in African resource-constrained centers with primary closure after extended right hemicolectomy.[21] Negash et al[22] described a successful outcome of primary closure aided by ileocecal resection and ileostomy in two patients.

Staged or delayed closure: Here, the exteriorized gut is gradually reduced into the abdomen over time, and then the abdominal wall is closed. After its introduction in 1969, it has become a routine procedure in many centers. Initially, a silastic sheet was used to cover the exposed viscera, sutured with the skin and fascial margin of the gap. The staged closure became more popular with the invention of a preformed silo. Combined with suture-less closure, this self-retaining device is easy to use and can be placed at the bedside without anesthesia, eliminating the need for anesthesia completely. These bags are transparent and allow inspection of the gut for possible necrosis and perforation.[8,15,23,24]

Modifications of staged closure technique: Unfortunately, the preformed silo is expensive and unavailable in low- and middle-income countries (LMICs). However, several improvised silo techniques are currently in use in these countries. Sterile urobag is commonly used as an alternative to the preformed silo. Successful outcomes have also been reported using surgical gloves, female condoms, and saline bags. Recently, wound protectors are gaining popularity as a preformed silo. It is self-retaining, available, and cost-effective. It can be placed at the bedside without anesthesia.[25-28]

Role of surgery in outcome

A significant advancement in treating gastroschisis occurred in 1970 with the introduction and widespread use of total parental nutrition (TPN).[29] This, combined with advancements in peri-operative intensive care, greatly increased the survival rate of neonates with gastroschisis. Mortality rates have significantly decreased, and gastroschisis is no longer considered fatal in medical centers with access to these resources. [7-9] Mortality is no longer an outcome measure in developed centers. Instead, the length of hospital stays, duration of TPN and mechanical ventilation contributing to the treatment cost is a matter of concern.[1]

Therefore, in developed centers, the modifications and choice of surgical procedures are directed at reducing the duration of mechanical ventilation, hospital stay, and TPN. Allotey et al. compared the benefits of staged closure with preformed silo against the traditional primary closure. The mean duration of mechanical ventilation was similar between the two groups. However, the primary closure group required higher mean airway pressure and inspired oxygen. The duration of TPN and hospital stay were also similar. They had no mortality in any group.

They concluded that staged closure is associated with less barotrauma and reduced intra-abdominal pressure.[8]

Schlatter et al[29] changed their surgical approach to gastroschisis in the past decade. Previously, they preferred emergency primary closure, which transitioned to staged closure in the past decade. In their series, patients in the staged closure group required fewer days on ventilators and had fewer complications. However, there was no difference in mortality. The overall survival was 98%.[29]

Similarly, Kidd et al[30] started staged closure routinely after 1993 in their practice. They reported longer duration of ventilation and hospital stay in staged closure. However, complications related to high intra-abdominal pressure were less. There was no difference in mortality.[30]

Various studies from developed countries, including multicentre cohorts, randomized controlled trials, and meta-analyses, have concluded that the type of surgery does not impact the survival of neonates with gastroschisis. However, it does affect the overall cost of treatment. A longer duration of mechanical ventilation, hospital stay, and TPN (total parenteral nutrition) are associated with higher treatment costs. As a result, gastroschisis is considered the most expensive non-cardiac congenital anomaly. Each patient requires more than 100,000 USD. [9,31-36]

This is where the survival rate varies between developed centers and LMICs. Despite several modifications in surgical technique, Inadequate infrastructure, unavailability of intensive care facilities, mechanical ventilation, and TPN are primarily responsible for the unacceptably higher mortality in LMICs. The type of surgery has no role in this. According to Ford et al[10], gastroschisis can serve as a valuable indicator of the capacity of healthcare institutions to provide neonatal surgical care, as it demands considerable resource allocation.

Conclusion

Gastroschisis is a major birth defect that demands costly intensive care before and after surgery. This care involves mechanical ventilation and total parental nutrition. Surgery is the primary treatment, but without proper pre- and post-operative care, survival rates are low regardless of the surgical approach used.

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