



Contents lists available at ScienceDirect

The American Journal of Surgery

journal homepage: www.americanjournalofsurgery.com

Outcomes of bedside sutureless umbilical closure without endotracheal intubation for gastroschisis repair in surgical infants



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ARTICLE INFO

Article history:

Received 21 December 2016

Received in revised form

24 January 2017

Accepted 16 March 2017

ABSTRACT

Introduction: Newborns with gastroschisis have historically undergone surgical repair under general anesthesia. Our institution recently transitioned to the sutureless umbilical closure for gastroschisis. We sought to evaluate the feasibility of bedside gastroschisis repair without endotracheal intubation.

Methods: A retrospective review was performed of neonates with gastroschisis who underwent sutureless umbilical closure from 2011 to 2015. Clinical characteristics and outcomes between groups were compared.

Results: In total, 53 infants underwent sutureless umbilical closure. Closure without endotracheal intubation was attempted in 23 (43%) babies and was successful in 15 (65%) infants. Two of the 8 patients who required intubation needed a temporary silo. Neonates successfully repaired without intubation were more premature ($p < 0.01$), smaller at birth ($p = 0.01$), and repaired nearly an hour sooner ($p < 0.01$). There were no differences in time to full enteral nutrition, length of stay, bowel ischemia, or sepsis.

Conclusion: Bedside sutureless umbilical closure without intubation is feasible and effective in newborns with gastroschisis. The procedure decreases time to gastroschisis closure. Smaller and more premature neonates were more likely to be successfully closed without intubation.

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1. Introduction

Gastroschisis is a congenital defect of the abdominal wall through which bowel and other abdominal organs protrude. Infants with gastroschisis are often growth-restricted and born prematurely.¹ Gastroschisis is surgically managed by reduction of the bowel and other eviscerated organs inside the abdomen with closure of the fascial defect in a primary or staged operation. After a period of support with intravenous nutrition while waiting for bowel function to commence, infants usually undergo a slow transition to full feeding over a period of several weeks to months. Infants with gastroschisis are at risk for adverse gastrointestinal outcomes including bowel ischemia and dysmotility as well as infection and complications related to long-term central venous access.

The management of gastroschisis has evolved over time. Common closure techniques include primary fascial closure, silo placement followed by delayed primary fascial repair, and sutureless umbilical closure. The latter procedure, which is typically performed on the first day of life, involves the gentle reduction of the exposed viscera and coverage of the abdominal wall defect using the patient's own umbilical cord.² Typically, the procedure has been performed under general anesthesia requiring endotracheal intubation and possibly neuromuscular paralysis, but surgeons have attempted the procedure using minimal sedation without endotracheal intubation.³ Several studies have described equivalent or improved outcomes with sutureless umbilical closure without general anesthesia and endotracheal intubation as long as reasonable selection and conversion criteria are applied.^{4–7} However, adverse outcomes have been reported with this technique, and to date there are no randomized controlled trials comparing non-intubated umbilical closure to other techniques for repair of gastroschisis^{8–10}

At our institution, the primary umbilical closure for gastroschisis closure has become the procedure of choice for most

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newborns with gastroschisis and appropriate anatomy.¹¹ In 2014, the pediatric surgeons at our institution began performing the procedure using only mild sedation without endotracheal intubation prior to the repair. This study evaluates our hospital's experience with this variation on the procedure including a description of our method, evaluation of outcomes, and predictors for success with the procedure.

2. Materials and methods

A retrospective chart review was performed of newborns with gastroschisis who underwent sutureless umbilical closure from 2011 to 2015 at a free-standing children's hospital. The decision to attempt gastroschisis closure without intubation was made by the attending pediatric surgeon. Clinical characteristics and outcomes between groups were compared using parametric and non-parametric tests. In general, student's t-test was used for comparison of means. In cases where the mean was disproportionately affected by outliers or sample size was less than 15 subjects, the Mann-Whitney *U* test was used. Fisher's exact test was used to compare proportions between groups. Statistical analysis was performed using PASW 18.

2.1. Non-intubated sutureless closure technique

Our institution has a pre- and post-arrival clinical pathway in place for all newborns with gastroschisis (<http://www.seattlechildrens.org/healthcare-professionals/gateway/pathways/>).¹² All neonates with gastroschisis were outborn and transferred in immediately after birth for surgical management. Prior to transfer, a bowel bag was placed to cover the exposed viscera, and ampicillin and gentamicin were administered intravenously. Upon arrival, the neonate was assessed by an attending pediatric surgeon, and a decision was made regarding the feasibility of an attempt at gastroschisis closure without intubation.

For all bedside sutureless umbilical closures, pre- and post-procedure gastric pressures were measured using a nasogastric tube. A Hegar dilator was used to dilate the anus and decompress meconium from the left side of the colon. The bowel bag was removed, and the abdomen was prepped with betadine. The neonate was given a small dose of intravenous narcotic and remained on supplemental oxygen via nasal cannula for the duration of the procedure. The most common dosing of narcotic was 0.025–0.05 mg/kg of intravenous morphine, which was repeated as needed (typically only a total of 0.025 mg/kg was needed), with occasional use of an intravenous benzodiazepine. We routinely used a pacifier dipped in sucrose water for the baby's comfort during the procedure. The nasogastric tube was placed to suction during the reduction and the bedside nurse would periodically provide manual suction to the tube as needed. The intestine was returned to the abdominal cavity with gentle pressure starting from the stomach or most proximal small bowel and alternating with distal colon until the entirety of the bowel was completely reduced. Vital signs were monitored continuously during the closure, assessing for apnea and oxygen saturation. The umbilical cord was cut to the length necessary to cover the umbilical defect and suture ligated. The cord was then used to cover the defect as has previously been described² (Fig. 1). A dry sterile adhesive dressing was placed to cover the cord and abdominal wall defect. Post-procedure pain was managed with a standardized comfort protocol (0.025 mg/kg morphine plus infusion if indicated and acetaminophen).

2.2. Intubated sutureless closure technique

If the attending surgeon decided to utilize endotracheal intubation for the closure, the neonate was intubated prior to the procedure by the neonatology team. In our institution, the standard intravenous medications for sedation at the time of intubation are fentanyl (2 mcg/kg) and rocuronium (1 mg/kg). In addition, after intubation, all infants were placed on a comfort protocol (0.05 mg/kg intravenous morphine plus infusion if indicated and acetaminophen). In the setting of a failed attempt at a gastroschisis closure without intubation, the same technique described above for gastroschisis closure was used following endotracheal intubation. Of note, if the bowel could not be reduced for any reason, a spring-loaded silo was placed through the defect at the bedside.

Post operatively, all neonates were monitored according to protocol with judicious fluid management, frequent laboratory analysis, and monitoring of urine output. Patients were started on parenteral nutrition on day of life one or two. Enteral feeds were initiated when the baby had documented bowel function and tolerated removal of the nasogastric tube. Feedings were started at 10 cc/kg/day of breast milk or standard infant formula and advanced by 10 cc/kg/day to goal.

3. Results

We identified 53 newborns during the study period who underwent planned sutureless umbilical closure for gastroschisis. Demographic data for this cohort are summarized in Table 1. Thirty infants (57%) were intubated prior to repair, either for the procedure itself ($n = 24$) or for respiratory distress ($n = 6$). Sutureless umbilical closure without intubation was attempted in 23 (43%) infants. There were no differences in gestational age or birthweight between groups (Table 2). Additionally, no differences were observed in short-term outcome variables including hospital and NICU length of stay, age at initiation of enteral feeds, and duration of TPN.

Complications including bowel ischemia, necrotizing enterocolitis, need for conversion to silo procedure, and infection were similar between groups. There was one death in a newborn who underwent an unsuccessful attempt at sutureless umbilical closure without intubation. This infant was ultimately placed in a spring-loaded silo after the failed attempt at sutureless closure and later intubated for respiratory distress. The infant had numerous complications including a central line infection and venous thrombosis but was discharged home on full enteral feeds at two



Fig. 1. The typical appearance of the infant's abdominal wall immediately following the sutureless umbilical closure technique for gastroschisis.

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