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Original Article

# Bedside reduction of gastroschisis: A feasible option

**J Deepak[1], K L Aravind[2], Vinay Jadhav[1], Gowri Shankar[1], M Narendrababu[1]**

*From [1]Department of Pediatric Surgery, Indira Gandhi Institute of Child Health, Bengaluru, [2]Department of Pediatric Surgery, Mysore Medical College and Research Institute, Mysore, Karnataka, India*

**Correspondence to:** J Deepak, Department of Pediatric Surgery, Indira Gandhi Institute of Child Health, Bengaluru - 560 029, Karnataka, India. Phone: +91-9686844664. E-mail: drjdeepak@yahoo.co.in

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## Abstract

**Background:** Gastroschisis is a common neonatal malformation, with an incidence of 0.4-3 per 10,000 live births worldwide. **Objective:** This study was planned to assess the feasibility of bedside reduction of gastroschisis (BRG) in the neonatal intensive care unit (NICU) at our institution. **Materials and Methods:** Retrospective analysis of newborns with gastroschisis managed at our institution between September 2008 and May 2013. Initial bedside reduction in NICU was attempted in all the neonates procedure was done under local anesthesia. Incision was extended transversely on the lateral aspect when required. Gradual reduction of bowel loops done with monitoring of parameters. Complete abdominal wall closure in multiple layers/skin closure only was done based on intra-abdominal tension. The final outcome was recorded. **Results:** During the study period of 60-month, 10 children were treated for gastroschisis at our institution. The sex ratio among them was 8:2 in favor of males. The average age was 23 h (range: 4-72 h). The average birth weight of the babies was 2290 g (range: 1700-2600 g). Six patients were in the high-risk group and 4 in the low-risk group. The BRG was successful in 7 patients and a silo was placed in 3 patients who did not tolerate BRG. General anesthesia was required in 3 patients only for subsequent repair. The overall survival was 70%. **Conclusion:** BRG is a feasible and safe option. Selective use of silo, gradual staged bowel reduction, and delayed primary closure of the defect can be done on the bedside when attempted BRG is unsuccessful.

**Key words:** *Bedside reduction of gastroschisis, gastroschisis, ward reduction of gastroschisis*

Abdominal wall defects are relatively rare anomalies. The incidence of gastroschisis is 4-5/10,000 live births [1]. Gastroschisis is rarely associated with other anomalies, but the major morbidity and mortality are because of the intestinal damage which occurs during fetal life due to prolonged exposure of the gut to the amniotic fluid resulting in dysfunction of the mucosa and poor motility of the gut. The survival rate of gastroschisis cases has been increased over 90% during the last two decades in many centers due to developments in antenatal care, neonatal intensive care, and total parenteral nutrition (TPN) [2].

The optimal management for neonates with gastroschisis is unclear because there are conflicting opinions in the literature regarding optimal timing, route of delivery, location of post-natal repair, primary versus elective secondary repair, and whether fetal bowel dilatation is a predictor of outcome. Successful reduction and closure of gastroschisis largely depend on the degree of viscero-abdominal disproportion. Ideally, the eviscerated bowel should be returned to the abdominal domain, avoiding intra-abdominal hypertension, and subsequent abdominal compartment syndrome. Until recently, it has been widely accepted that emergency surgery by operative fascial closure (OFC) offers the greatest chance of survival with minimal morbidity and only when OFC is unsafe, staged reduction and closure is used.

To avoid the problems associated with general anesthesia (GA), it has been proposed that the reduction of abdominal contents can be achieved in the neonatal intensive care unit (NICU) without GA. Bianchi and Dickson [3] were the first to report a series of patients to undergo this form of ward reduction in which the infants with gastroschisis had their gut reduced in NICU without GA, sedation, or analgesia. The aim of this study was to determine the feasibility and safety of bedside reduction of gastroschisis (BRG) and factors affecting the morbidity and mortality in these patients.

## MATERIALS AND METHODS

A retrospective review of our experience with BRG at our institution, between September 2008 and August 2013, was done. The patient medical records were examined, and data pertaining to the demographic information, clinical history, hematological investigations, imaging studies, risk group stratification, operative technique, post-operative recovery, and complications and duration of hospitalization were obtained.

BRG was attempted in all the newborns with gastroschisis. The patients were divided into two groups based on the associated risk factors such as low birth weight (<1500 g), associated life threatening congenital malformations, pre-existing sepsis (based on clinical criteria, C-reactive protein and blood culture), severe hypothermia and hypovolemia. In the presence of any of the above-mentioned risk factors, they would be placed into the high-risk group and others were placed in the low-risk group.

BRG procedure was done at NICU under aseptic precautions with a ventilator standby. Exposed bowel was covered with warm saline dressing after cleansing of the bowel loops off the peel. Gastric decompression was done by inserting an orogastric or nasogastric tube. Gentle rectal washes were given using warm saline. An intravenous normal saline bolus of 10 ml/kg was given to correct the fluid deficits and 10% dextrose was administered as maintenance fluid. Gradual reduction of bowel loops into the abdominal cavity was attempted in all the children while monitoring the lower limb pulse rate, pulse volume, and oxygen saturation (Fig. 1a-c). The lateral extension of the defect was made to facilitate bowel reduction as and when required. The abdominal wall was infiltrated with a local anesthetic before extension of the defect. The defect was closed in layers or in a single layer using 4-0 absorbable sutures.

When the patients did not tolerate the BRG, a custom made sterile silo was sutured to the edges of the defect after giving local anesthesia. Gradual reduction of contents was done inside the silo over a period of 2-7 days in the NICU (Fig. 2). The patients were discharged after establishing full oral feeds. The final outcome of all the patients was recorded.

## RESULTS

During the study period of 60-month, 10 children were treated for gastroschisis at our institution. The sex ratio was 8:2 in favor of males. A mean age of the patients was 23 h (range: 4-72 h). Mean birth weight was 2290 g (range: 1700-2600 g). Six children were born as full term and remaining 4 were delivered as pre-term. In this study, antenatal ultrasonogram (USG) was done in 7 patients and was reported as normal and it was not done in 3 patients. Thus, diagnosis of gastroschisis was not made by antenatal USG in any of our patients.

Six patients were in the high-risk group and 4 in the low-risk group when they were stratified by the criteria mentioned above. Among the high-risk patients, 1 had cyanotic congenital heart disease, 4 children were in severe hypothermia and hypovolemia, and 1 child had sepsis with hypothermia. The sepsis, hypothermia, and hypovolemia were related to inadequate precautions taken at an immediate post-natal period in the primary health care center before referring to our institution and also inadequate fluid resuscitation and exposure to hypothermic ambient temperature during transportation of the patient.


**Figure 1: (a-c) Gradual bedside reduction of gastroschisis after cleansing the peel on the bowel wall. The defect was closed in layers using 4-0 polyglactin.**

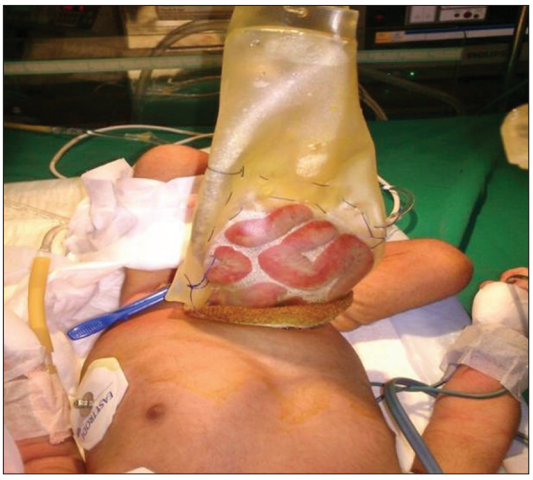

**Figure 2: Silo placement around the defect to cover the exposed bowel loops and gradual bowel reduction over 5 days to achieve complete reduction.**

BRG was successful in 7 patients and a silo was placed in 3 patients who did not tolerate BRG. The mean time duration for BRG procedure was 18 min (range: 15-25 min). Among the 7 patients who underwent successful BRG, 4 patients had uneventful recovery, 1 patient each had burst abdomen and incisional hernia, and 1 patient expired. The child who developed burst abdomen on day 8 after BRG was taken for abdominal wall repair under GA in operation theater and the procedure was uneventful. A child with an incisional hernia underwent repair at 1 year of age under GA, and the patient recovery was uneventful.

Among 3 patients in whom a silo was placed, gradual reduction of contents and bedside closure of defect was done in 1 patient. The closure of the gastroschisis defect was done under GA in OT in another patient. The third patient died secondary to associated risk factor, i.e., cyanotic congenital heart disease while awaiting the staged bowel reduction in the silo.

The outcome was analyzed according to risk groups. Mechanical ventilation at NICU was required in 1 out of 4 patients in the low-risk group and in all 6 patients in the high-risk group. There was a mortality of 30% (3 out of 10 patients) in the present study. The cause of death was irreversible cardiac failure secondary to cyanotic congenital heart disease in 1 patient, severe sepsis leading to irreversible septic shock in 1 and hypothermia with hypovolemic shock in 1 patient. All the three mortalities were in the high-risk group. The mortalities were not related to the procedure in any of these patients. There was no mortality in the low-risk group.

GA for subsequent procedures was needed in 1 patient in high-risk group and 2 patients in low-risk group and it was avoided in 7 (70%) patients. The average time taken to reach full oral feeds was 18.3 days (15.2 days in low-risk group and 22.8 days in high-risk group). The average duration of hospital stay was 23.2 days (19.1 days in low-risk group and 27.9 days in high-risk group). Clinical outcome of all the patients in the study is summarized in Table 1. All the seven surviving patients were followed at outpatient department at 10 days, 1 month and 3 months after discharge. Subsequently, they were followed up at 6 monthly intervals. One patient required incisional hernia repair at 1 year of age. All the other patients were doing well. Average follow-up period was 48 months (range: 24-60 months). Summary of all the patients included in this study is presented in Table 2.

## DISCUSSION

The management of gastroschisis remains an issue for analysis and improvement. The problems in gastroschisis are the small peritoneal cavity and the shortened, noncompliant midgut covered with a friable vascular peel. Techniques for

**Table 1: Summary of clinical outcomes based on risk group stratification**

| Clinical outcome | Low risk group (n: 4) | High risk group (n: 6) | Total (n: 10) |
|---|---|---|---|
| Need for mechanical ventilation | 1 (25%) | 6 (100%) | 7 (70%) |
| Need for general anaesthesia for subsequent procedure | 2 (50%) | 1 (16.6%) | 3 (30%) |
| Time to reach full enteral feeds | 15.2 days | 22.8 days | 18.3 days |
| Duration of hospital stay | 19.1 days | 27.9 days | 23.2 days |
| Mortality | None | 3 (30%) | 3 (30%) |

**Table 2: Summary of demographic details, procedures done and follow up**

| S. No | Sex | Age (hrs) | Weight (in gm) | Antenatal scan findings | Associated conditions | Need for ventilation | Need for anesthesia in OT | BRG outcome | Additional Procedure | Final outcome |
|---|---|---|---|---|---|---|---|---|---|---|
| Case 1 | M | 48 | 2300 | Not done | Cyanotic congenital heart disease | Yes | No | Unsuccessful | Silo placement | Expired on POD1 |
| Case 2 | F | 72 | 2300 | Not done | Sepsis | Yes | No | Successful | None | Expired on POD3 |
| Case 3 | F | 24 | 2500 | Normal | None | No | No | Successful | None | Uneventful |
| Case 4 | M | 18 | 2400 | Normal | None | Yes | Yes | successful | Secondary closure POD8-burst abdomen | Uneventful |
| Case 5 | M | 18 | 2600 | Normal | None | No | No | Successful | None | Uneventful |
| Case 6 | M | 4 | 2400 | Normal | None | No | Yes | Successful | Incisional Hernia repaired at 1 year | Uneventful |
| Case 7 | M | 18 | 2300 | Normal | Hypovolemia/ Hypothermia | Yes | No | Successful | None | Expired on POD1 |
| Case 8 | M | 12 | 2600 | Normal | Hypovolemia/ Hypothermia | Yes | No | Unsuccessful | Silo, delayed primary closure day 5 | Uneventful |
| Case 9 | M | 12 | 1800 | Not done | Hypovolemia/ Hypothermia | Yes | No | Successful | None | Uneventful |
| Case 10 | M | 4 | 1700 | Normal | Hypovolemia/ Hypothermia | Yes | Yes | Unsuccessful | Silo, delayed primary closure day 4 | Uneventful |

**BRG: Bedside reduction of gastroschisis**

reducing intra-abdominal tension have included abdominal wall stretching and pre-reduction bowel evacuation and a more liberal use of a staged silo approach [4]. In 1998, Bianchi and Dickson [3] published their early experience with elective delayed midgut reduction without anesthesia, which uses the reactions of the conscious unsedated child to regulate the rate and extent of reduction and to limit operator enthusiasm.

In our study, reduction of bowel loops was done in the NICU as early as possible after initial stabilization of general condition. About 7 out of 10 patients were already on ventilator support during BRG. All the six patients in the high-risk group required ventilator support for associated comorbidities and only 1 among 4 patients in the low-risk group required ventilator support. The aim of BRG in NICU was to avoid exposure to GA and its associated complications. Silo was placed in 3 out of 10 patients who did not tolerate primary BRG as noticed by signs of respiratory distress and lower limb ischemia.

No single technique is applicable in all circumstances, and management should be tailored to meet the special requirements of the individual child. Intestinal atresia in association with gastroschisis, with an incidence of 5.5-25%, has been considered a poor prognostic feature [5-7]. The complicated gastroschisis not fit for BRG include intestinal atresia and bowel perforation. None of the patients in our study had atresia or perforation; hence, all of them were subjected to BRG.

Hospital mortality ranges from 7% to 10%, often related to septicemia according to Davies et al. [8]. In another study, the survival rate was 80% in patients with primary closure, 54.5% in patients with elective delayed reduction, and 62.5% in patients who had staged reduction with silo [9]. The mortality rate in this study was 30%. The major cause of mortality among patients with gastroschisis in our study was pre-existing hypothermia and hypovolemia, which is completely avoidable. There is a need to standardize the process of referral of these vulnerable patients to tertiary care centers under optimum conditions to avoid these mortalities.

Failure of initial reduction and the need for a silo are common in up to 30% of cases [8]. In our study, the placement of silo due to unsuccessful BRG was done in 3 (30%) patients and is comparable to published literature. Survivors may require more than 1 surgical procedure subsequently. In our study, delayed closure of defect was done on bedside in 1 patient thus avoiding GA. However, 1 patient required GA for delayed defect closure and another patient expired before the defect closure.

The major morbidity is delayed acquisition of intestinal function [10]. This situation is accepted to occur as a result of intestinal loops getting exposed to amniotic fluid and due to compression effect of the abdominal defect on the herniated organs [11,12]. Some papers report that better results were achieved as a result of less contact between amniotic fluid and intestinal structures in pre-term infants with gastroschisis and support pre-term birth for these babies [13]. There are studies suggesting no difference between pre-term and term births of patients with gastroschisis [14]. While other studies report that pre-term and low birth weight infants with gastroschisis need longer time to start oral intake and longer hospitalization [15]. In our study, the effect of gestational age on mortality and morbidity was not determined.

Gut hypomotility and delay in establishing feeds are usual, with a median duration of establishing full enteral feeds of 3-4 weeks and TPN is required for most of this time. There is normally a prolonged hospital admission with a median duration of around 6 weeks in most series [8]. In our study, average time to reach full enteral feeds was 18.3 days and average duration of hospital stay was 23.2 days.

A recent Cochrane systematic review found no evidence from randomized controlled trials to either support or refute the practice of ward reduction [16]. However, we had advocated an initial BRG for all the patients in our study to save the resources including operation theater time, the cost of treatment and to avoid possible complications of GA during neonatal period. The possible complications of reduction of gastroschisis include hemodynamic compromise of lower abdomen, kidneys, and legs with abdominal compartment syndrome; gut perforation; infection (septicemia and/or wound infection); abdominal scars; a cosmetically abnormal umbilicus; late surgery for gut adhesions or scar cosmesis; compromised nutrition; adverse neurologic outcome [17-19].

The limitations of this study are that it is a retrospective study; there is no control group of patients with other modality of the treatment for comparison. Unlike in other tertiary care general hospitals, where the delivery of neonates is done in the same hospital, all the neonates in our hospital are delivered elsewhere and then transported in suboptimal conditions. Hence, the risk stratification may not be universally applicable.

## CONCLUSION

BRG is a feasible and safe option for initial treatment of gastroschisis. Selective use of silo, gradual staged bowel reduction, and delayed primary closure can be done on the bedside when attempted BRG is unsuccessful. Regular antenatal scans to detect the anomaly and planned delivery at tertiary care center helps in early intervention, avoidance of hypothermia, hypovolemia, and sepsis and improves the feasibility of BRG thus decreased need for mechanical ventilation and GA.

## REFERENCES

1. Holland AJ, Walker K, Badawi N. Gastroschisis: An update. Pediatr Surg Int. 2010;26(9):871-8.
2. Abdel-Latif ME, Bolisetty S, Abeywardana S, Lui K; Australian

and New Zealand Neonatal Network. Mode of delivery and neonatal survival of infants with gastroschisis in Australia and New Zealand. J Pediatr Surg. 2008;43(9):1685-90.
3. Bianchi A, Dickson AP. Elective delayed reduction and no anesthesia: 'Minimal intervention management' for gastrochisis. J Pediatr Surg. 1998;33(9):1338-40.
4. Filston HC. Gastroschisis – Primary fascial closure. The goal for optimal management. Ann Surg. 1983;197:260-4.
5. Shah R, Woolley MM. Gastroschisis and intestinal atresia. J Pediatr Surg. 1991;26(7):788-90.
6. Cusick E, Spicer RD, Beck JM. Small-bowel continuity: A crucial factor in determining survival in gastroschisis. Pediatr Surg Int. 1997;12(1):34-7.
7. Hoehner JC, Ein SH, Kim PC. Management of gastroschisis with concomitant jejuno-ileal atresia. J Pediatr Surg. 1998;33(6):885-8.
8. Davies MW, Kimble RM, Cartwright DW. Gastroschisis: Ward reduction compared with traditional reduction under general anesthesia. J Pediatr Surg. 2005;40(3):523-7.
9. Erdogan D, Azili MN, Cavusoglu YH, Tuncer IS, Karaman I, Karaman A, et al. 11-year experience with gastroschisis: Factors affecting mortality and morbidity. Iran J Pediatr. 2012;22(3):339-43.
10. Ergün O, Barksdale E, Ergün FS, Prosen T, Qureshi FG, Reblock KR, et al. The timing of delivery of infants with gastroschisis influences outcome. J Pediatr Surg. 2005;40(2):424-8.
11. Langer JC, Longaker MT, Crombleholme TM, Bond SJ, Finkbeiner WE, Rudolph CA, et al. Etiology of intestinal damage in gastrochisis. I. Effects of amniotic fluid exposure and bowel constriction in a fetal lamb model. J Pediatr Surg. 1989;24(10):992-7.
12. Langer JC, Bell JG, Castillo RO, Crombleholme TM, Longaker MT, Duncan BW, et al. Etiology of intestinal damage in gastroschisis, II. Timing and reversibility of histological changes, mucosal function, and contractility. J Pediatr Surg. 1990;25(11):1122-6.
13. Hadidi A, Subotic U, Goeppl M, Waag KL. Early elective cesarean delivery before 36 weeks vs. late spontaneous delivery in infants with gastroschisis. J Pediatr Surg. 2008;43(7):1342-6.
14. Soares H, Silva A, Rocha G, Pissarra S, Correia-Pinto J, Guimarães H. Gastroschisis: Preterm or term delivery? Clinics (Sao Paulo). 2010;65(2):139-42.
15. Driver CP, Bruce J, Bianchi A, Doig CM, Dickson AP, Bowen J. The contemporary outcome of gastroschisis. J Pediatr Surg. 2000;35(12):1719-23.
16. Davies MW, Kimble RM, Woodgate PG. Ward reduction without general anaesthesia versus reduction and repair under general for gastroschisis in newborn infants. Cochrane Database Syst Rev. 2002;(3):CD003671.
17. Burge DM, Ade-Ajayi N. Adverse outcome after prenatal diagnosis of gastroschisis: The role of fetal monitoring. J Pediatr Surg. 1997;32(3):441-4.
18. Davies BW, Stringer MD. The survivors of gastroschisis. Arch Dis Child. 1997;77(2):158-60.
19. Langer JC. Gastroschisis and omphalocele. Semin Pediatr Surg. 1996;5(2):124-8.

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