Delivery room surgery: an applicable therapeutic strategy for gastroschisis in developing countries

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**Background:** The survival rate of infants with gastroschisis has improved significantly. It is over 90% in developed countries, but 50% in developing countries. This study aimed to investigate the factors improving the survival rate of infants with gastroschisis in developing countries.

**Methods:** Neonates meeting the inclusion criteria, who presented to our center since the establishment of delivery room surgery, were enrolled into this retrospective study. Data were evaluated specifically to determine the role of delivery room surgery in reducing the mortality and morbidity of infants with gastroschisis and to identify factors optimizing the conditions of outborn infants.

**Results:** A total of 64 infants were identified. The overall survival rate of the infants was 60.9%. The survival rate of infants in inborns was 76.5%, and the survival rate of infants in outborns was 43.3%. Infants of the outborn group took more time to reach full enteral feeding, and were more likely to require a prolonged stay in hospital when compared with those of the inborn group. Logistic analysis identified that the surgical technique, the presence of sepsis and intestinal necrosis could be expected to influence the outcome of gastroschisis.

**Conclusions:** The strategy of delivery of patients in a center prepared to perform delivery room closure of gastroschisis appears to improve the survival of patients with gastroschisis. Further reduction in mortality rates will depend on improved conditions of outborn infants.
Methods
Patients and data collection
This study was carried out at a tertiary center of pediatric surgery, where delivery room surgery had been performed routinely since 2000. The study protocol was approved by the Ethics Committee of our institution.

From January 2000 through June 2012, we retrospectively reviewed the medical records of all newborns with gastroschisis who were born at our center (inborn group) and all newborns with gastroschisis who were born elsewhere and transferred to our center (outborn group). We collected data on maternal age, gestational age, mode of delivery, birth weight, gender, presence of associated anomalies, size of defect, condition of eviscerated bowel, delivery-management interval, and surgical management approach (primary or staged closure). Patients in both inborn and outborn groups were investigated in prespecified subgroups by a novel scoring tool, gastroschisis prognostic score (GPS, the Canadian Pediatric Surgery Network). We looked at outcomes in patients of the inborn group, outborn group, simple gastroschisis subgroup (defined as infants with a GPS less than 4), and complicated gastroschisis subgroup (defined as infants with a GPS of 4 or more). The outcomes included the length of ventilation, duration of total parental nutrition (PN), length of stay (LOS), rates of intestinal failure, and intestinal failure associated liver disease (IFALD), episodes of sepsis, occurrence of short bowel syndrome, occurrence of necrotizing enterocolitis, unplanned reoperation, and survival rate. Furthermore, patients’ laboratory data at admission, such as arterial blood gas, liver function, kidney function, blood coagulation function, and complete blood count, were also collected.

Definitions
The GPS is an easy, efficient, reproducible, robust and sensitive method for outcome prediction in neonates with gastroschisis that can be completed at the bedside without the need for monitoring or laboratory data. The score’s component variables included the following: (a) bowel matting (none, 0; mild, 1; or severe, 2); (b) bowel necrosis (absent, 0; focal, 1; or diffuse, 2); (c) bowel atresia (absent, 0; suspected, 1; or present, 2), and (d) bowel perforation (absent, 0; or present, 2). A composite score of 4 or more identifies a high risk of adverse outcome (including mortality). Here, we separated patients and stratified outcome results based on the detailed prognostic scale of the Canadian Pediatric Surgery Network. For the purposes of this study, we defined intestinal failure as a requirement for more than 28 days of parenteral nutrition; sepsis as any positive culture that required antibiotic treatment; intestinal failure associated liver disease as liver dysfunction (cholestasis in association with raised serum alkaline phosphatase and total bilirubin concentrations) in infants receiving parenteral nutrition; and short bowel syndrome as small bowel length less than 75 cm for term neonates or less than 50 cm for premature neonates or dependence on parenteral nutrition for longer than 42 days.

Treatment protocol
The patients of the inborn group were diagnosed with gastroschisis before birth by prenatal ultrasonography and delivered via elective cesarian section at our center. The delivery was attended by a delivery room surgery team, which included an obstetrician and fellow, a pediatric surgeon and fellow, a neonatologist, a pediatric anesthesiologist, and nurses. On delivery, the newborn was placed in an overhead warmer. Intravenous access was established and resuscitation initiated. A nasogastric tube was passed and placed to low intermittent suction. A pediatric surgeon and a neonatologist evaluated the baby together and ascertained whether the herniated organs can be reduced immediately. If complete reduction was not possible, a spring loaded silo was placed without general anesthesia. If complete reduction was deemed safe, the herniated organs were covered with moist warm gauze and the baby was transferred to the operating room directly adjacent to the delivery room. Then the baby was intubated and general anesthesia was provided. Temperature, electrocardiograph, blood pressure, and oxygen saturation were monitored. The operation proceeded with reduction and primary fascial closure. After surgical management, the baby was transferred to the neonatal intensive care unit (NICU).

All the patients of the outborn group were delivered at other hospitals and transferred to our center for treatment. If complete reduction was deemed safe, the patients were moved to the operation room for primary reduction. If complete reduction was not possible, the patients were managed in a standard fashion by placing spring loaded silos at the bedside in the NICU. When these patients were stable and most of the viscera could be replaced into the abdominal cavity, delayed fascial repair was performed. During the study period, other aspects of care were similar in both subgroups.

Statistical analysis
From the database, SPSS 10.0 was used for statistical analysis. Comparisons between unpaired groups with respect to continuous variables were performed with Student’s t test. For the comparison of small numbers of patients, Fisher’s exact test was used. Logistic and linear regression analysis was also performed. P values less than 0.05 were considered statistically significant.

Results
From January 2000 through June 2012, 69 newborns...