Gastroschisis: Delivery and Immediate Repair in the Operating Room

Surachai Saranrittichai MD*

* *Khon Kaen Regional Hospital, Khon Kaen*

Background: *Gastroschisis is a congenital abdominal wall defect with the small and large bowel protruding through. Early closure prevents heat and water loss, infection, and bowel edema. Immediate primary fascial closure should be done when possible.*

Objective: *To compare the outcome of a goup of gastroschisis neonates diagnosed before birth who underwent delivery and immediate surgical repair in the operating room (IOR group) with another group who underwent delivery outside the operating room and urgent surgical repair in the operating room later (OOR group).*

Material and Method: *A retrospective cross sectional study between January 1, 2005 and December 31, 2007 was conducted on 49 neonates with gastroschisis treated at Khon Kaen Regional Hospital by one pediatric surgeon.*

Result: *Thirteen neonates were in the IOR group and 36 in the OOR group. Statistical significance was observed between both groups with regard to delivery-operation interval and operative procedure. The time interval from birth to operative repair of IOR group was shorter (0.8 ± 0.4 vs. 11.4 ± 4.2, $p < 0.001$). The abdominal wall defect of all neonates in IOR group could be corrected by primary fascial closure (100%) compared with only 61.1% in the OOR group ($p < 0.01$). There were no statistical significant difference between the two groups regarding days to extubation (4.7 ± 2.7 vs. 8.3 ± 6.3, $p < 0.058$), days to enteral feedings (10.5 ± 4.5 vs. 13.7 ± 5.9, $p < 0.092$), and length of stay (21.7 ± 9.9 vs. 28.7 ± 19.6, $p < 0.235$), but there was a trend in the IOR group toward earlier extubation, toleration of enteral feeding, and discharge. Overall mortality rate was 14%. All of the IOR group survived. There were 19% deaths in the OOR group.*

Conclusion: *Delivery and immediate surgical repair in the operating room appear to be safe and feasible. Delivery-operation interval was decreased. The repair was easier and increased the possibility of primary fascial closure. The patients ate sooner and were discharged earlier. A policy of making immediate surgical repair upon the delivery in the operating room leads to decreased morbidity in infants with gastroschisis. A well prepared team is an important factor for this policy.*

Keywords: *Gastroschisis, Delivery, Delivery- operation interval, Immediate repair, Operating room, Primary closure, Staged repair*

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Gastroschisis is a congenital anterior abdominal wall defect with the uncovered abdominal contents (usually small and large bowel) protruding through the defect. The defect is usually less than 4 cm. The opening is usually to the right of the umbilicus but cases of left-sided gastroschisis have been reported in the literature[1]. Reduction of the abdominal contents is required within hours after birth as the infant is at risk for water and heat loss from the exposed bowel, compromised gut circulation, and infection. Early closure also prevents the development of bowel edema and covering with fibrinous exudates. The faster the bowel can be reduced, the more likely primary closure can be achieved and the less bowel wall edema and fibrinous coating will accumulate. In an effort to obtain earlier closure of the abdominal wall, delivery room

Correspondence to: Saranrittichai S, Department of Surgery, Khon Kaen Regional Hospital, Khon Kaen 40000, Thailand. Phone: 043-336-789, Fax: 043-336-789 ext. 1220, E-mail: sarans@kknet.co.th, susarans@hotmail. com

repair of gastroschisis have been reported[2,3]. In the situation where the delivery room has no facility for the procedure, delivery and immediate repair in the operating room is an alternative. The purpose of the present study was to compare the outcome of gastroschisis neonates group that underwent delivery and immediate surgical repair in the operating room (IOR group) with another group that underwent delivery outside the operating room and had urgent surgical repair in the operating room later (OOR group).

Material and Method

A retrospective data was collected on 49 neonates with gastroschisis in a three-year period from January 1, 2005 to December 31, 2007 at Khon Kaen Regional Hospital. All of these patients were treated by one pediatric surgeon. The records of all patients were reviewed. Data collected included: maternal age, prenatal history, gender, gestational age, birth weight, mode of delivery, place of delivery, associated anomalies, delivery-operation interval, operative procedure, size of defect, days to extubation, days to full enteral feedings, length of stay, morbidity and mortality.

All of the 49 infants were managed with either delivery and immediate surgical repair in the operating room (IOR group) or delivery outside the operating room and urgent surgical repair in the operating room later (OOR group).

All the patients of the IOR group were diagnosed with gastroschisis before birth from prenatal ultrasonography. Delivery was performed when the mothers were in labor. Our policy dictates that fetuses with prenatal diagnosis of abdominal wall defect may safely be delivered vaginally, and cesarean delivery should be performed for obstetric indications only. Vaginal delivery was also performed in the operating room. Two rooms were prepared, one for delivery and one for operation of the infant after birth. The team included a staff obstetrician and fellow, a staff pediatrician and fellow, a staff anesthesiologist and fellow, a staff pediatric surgeon and fellow and nurses. The infants were delivered by cesarean section or vaginally, showed to the mother, and carried directly to another operating room. The baby was placed in an overhead warmer or operating table and resuscitated if necessary by the anesthesiologist. Nasogastric tube or orogastric tube was passed. Early endotracheal intubation, fixation of the endotracheal tube, and placement of peripheral intravenous line for anesthetic and paralysis were performed subsequently. Temperature, electrocardiogram, pulse, blood pressure, and oxygen saturation were continuously monitored. The operation proceeded with an attempt for primary fascial closure. When this could not be done, staged repair with artificial sac (stockinett and steridrape) to form a silo would be considered. After surgery, the baby was transferred to the neonatal intensive care unit.

The OOR group of gastroschisis was managed in a standard fashion by protecting the eviscerated intestine in a plastic bag or wrapped with gauze, decompressing the stomach by a nasogastric tube and keeping the baby in a warm incubator. In addition, prophylactic antibiotics and fluid resuscitation was given through an intravenous line. Routine preoperative blood examination, serum electrolyte and glucose monitoring of these babies were carried out. When these babies were stable and operating room prepared, they were moved to the operating room for primary reduction or placement of artificial sac to form a silo as staged repair. After surgery, the babies were transferred to the neonatal intensive care unit or newborn ward depending on their clinical status.

During the study period, overall management of infants with gastroschisis was similar in both groups.

From the collected data, SPSS software program was used for statistical analysis (Version 15.0; SPSS Inc., Chicago, IL, USA).The unpaired *t* test for continuous variable and Fisher's exact test for dichotomous variable were used when testing statistical significance was possible. P-value < 0.05 was considered significant.

Results

Of the 49 neonates with gastroschisis encountered during the study period, there were 24 boys and 25 girls. There were 13 neonates in the IOR group. This group was diagnosed before birth from prenatal ultrasonography. Five neonates of this group were transferred with their mothers from other provincial hospitals before birth. For the OOR group, there were 36 neonates. Only two neonates were diagnosed correctly before birth from prenatal ultrasonography. Thirty-two neonates in this group were transferred after birth from other provincial hospitals (outborn). Four neonates of this group were born in K.K.R, H hospital (inborn).

In IOR group, nine neonates were delivered by cesarean section and four neonates were delivered vaginally. On the other hand, four neonates in the OOR group were delivered by cesarean and 32 neonates were delivered vaginally. There were no significant demographic differences between the two groups

regarding maternal age, (19.3 ± 3.5 vs. 20.4 ± 3.9, p < 0.687), gestational age, (36.2 ± 1.9 vs. 36.6 ± 2.2, p < 0.560), and birth weight (2254.2 ± 342.4 vs. 2115.1 ± 448.5, p < 0.316). More associate anomalies were presented in OOR groups. There were two cases of stomach perforation, two cases of small bowel perforation, a case of colonic atresia, two cases of VSD, four cases of PDA, and two cases of undescended testis. Only a case of PDA and a case of hydrocele were found in the IOR group. The comparison of the two groups is shown in Table 1.

Statistical significance was observed between both groups with regard to deliver-operation interval and operative procedure. The time interval from birth to operative repair of IOR group was shorter (0.8 ± 0.4 vs. 11.4 ± 4.2, p < 0.001). No difference was seen in the size of the abdominal wall defect. The abdominal wall defect of all neonates in the IOR group can be repaired by primary fascial closure compared to only 61.1% (22 of 36) in the OOR group (p < 0.01). The operative and postoperative features of the two groups are shown in Table 2.

In Table 3, seven dead cases were excluded. Although there were no statistical significant difference between the two groups regarding days to extubation (4.7 ± 2.7 vs. 8.3 ± 6.3, p < 0.058), days to full enteral feedings (10.5 ± 4.5 vs. 13.7 ± 5.9, p < 0.092) and length of stay (21.7 ± 9.9 vs. 28.7 ± 19.6, p < 0.235), there was a trend in the IOR group toward earlier extubation, toleration of enteral feeding, and discharge.

Table 1. Characteristic of infants with gastroschisis

	IOR group (n = 13)	OOR group (n = 36)	p-value
Maternal age (year)*	19.3 ± 3.5	20.4 ± 3.9	0.687
Prenatal diagnosis (case)	13	2	
Place of delivery			0.001
Inborn (case)	13	4	
Outborn (case)	0	32	
Gestational age (week)*	36.2 ± 1.9	36.6 ± 2.2	0.560
Prematurity, < 37weeks (case)	7	19	
Birth weight (gram)*	2254.2 ± 342.4	2115.1 ± 448.5	0.316
Mode of delivery (case)			0.001
Cesarean	9	4	
Vaginal	4	32	
Associated anomalies (case)			0.297
Stomach perforation		2	
Small bowel perforation		2	
Colonic atresia		1	
VSD		2	
PDA	1	4	
Undescended testis		2	
Hydrocele	1		

* Data presented as mean ± standard deviation

Table 2. Operative and postoperative features of 2 groups in all patients

	IOR group (n = 13)	OOR group (n = 36)	p-value
Delivery-operation interval (hour)*	0.8 ± 0.4	11.4 ± 4.2	0.001
Size of defect (cm)*	3.08 ± 0.64	3.00 ± 0.62	0.706
Operative procedure			0.010
Primary closure (case)	13	22	
Staged repair (case)	0	14	
Mortality (case [%])	0 [0%]	7 [19%]	0.167

* Data presented as mean ± standard deviation

Table 3. Operative and postoperative features of 2 groups who survived

	IOR group (n = 13)	OOR group (n = 29)	p-value
Days to extubation (day)*	4.7 ± 2.7	8.3 ± 6.3	0.058
Days to full enteral feedings (day)*	10.5 ± 4.5	13.7 ± 5.9	0.092
Length of stay (day)*	21.7 ± 9.9	28.7 ± 19.6	0.235

* Data presented as mean ± standard deviation

Complications of both groups were wound infection, pneumonia, gut obstruction due to adhesion, wound dehiscence, and enterocutaneous fistula. Escherichia coli, Klebsiella pneumonii, Staphylococcus aureus, Enterobacter cloacae, Acinetobacter baumannii, and Acinetobacter iwoffii were found in serosal of bowel swab culture before operation.

Overall mortality rate was 14% (7 of 49). All of the IOR group survived. There were seven deaths in the OOR group (19%). Four of them died of presumed Escherichia coli septicemia. One neonate's mother underwent appendectomy 5 days before delivery. One infant died of renal failure after developing abdominal compartment syndrome. Three deaths in the OOR group had associated anomalies. There were stomach perforation, colonic atresia, bowel perforation, and gangrene.

Discussion

Gastroschisis is a congenital defect of the periumbilical abdominal wall, through which the abdominal organs protrude. The etiology is unclear. The incidence is increasing throughout the world. Previous study showed the incidence of approximately 0.6-1:10,000 live births[4-6], with an increased incidence in younger women of up to 7: 10,000 live births in mothers less than 20 years of age[7]. In Thailand, the report from Siriraj Hospital was about 1:10,000 live births[8]. From Khon Kaen Hospital was about 2.5: 10,000 live births[9] which was close to the report from Washington D.C. USA. (2.2:10,000)[10]. In the present study, 79.6% of mothers were less than 20 years old (range 15-31 years old).

Because of the widespread use of prenatal ultrasonography, most cases were diagnosed before delivery. A major controversy in the perinatal management of these conditions is whether cesarean delivery leads to an improved neonatal outcome. The available data do not provide evidence to support a policy of cesarean delivery for infants with abdominal wall defects[11].The present study showed that IOR group has four cases of giving birth from the vagina although they had prenatal diagnosis. Eight neonates who underwent emergency cesarean delivery were due to suspected fetal distress and one neonate was due to cephalopelvic disproportion (CPD). The author agrees that women carrying a fetus with an abdominal wall defect should be delivered vaginally, and cesarean delivery should be reserved for usual obstetric indications[11].

The mortality rate of this present report was 14%.This outcome has improved from a previous author's report, in which the mortality rate was 20%[9]. This has been due to improvement in surgical techniques and neonatal care, the use of post-operative ventilation in cases with respiratory compromise, treatment of sepsis, the use of parenteral nutrition until enteral feeds is established and prenatal diagnosis. However, the mortality was still high if compared to other reports that mortality rate was about 2%[12] to 4%[7,13]. The important thing is the duration from birth until operation (delivery- operation interval). It is still long. It was shown from the present study that the average duration of all cases was about 8.59 hours (range from 0.33-22.00 hours). In the dead group (7 neonates in the OOR groups), the mean time was 13.6 hours (range 9-22 hours). As expected, there was a highly significant difference between the two groups in delivery- operation interval. The mean time for the IOR group was 0.8 hour, whereas it was 11.4 hours for the OOR group ($p < 0.001$). Some studies advocate immediate surgical repair of gastroschisis following birth to increase the chance for immediate fascial closure[2,14]. It was suggested that operation should start within 6 hours[7] or having the operation in the delivery room. Coughlin[2] reported good outcome of 13 cases of gastroschisis who underwent surgical repair in the delivery room. The present study also addresses this concept by delivery and immediate surgical repair in operating room. In Thailand, there is a lack of pediatric surgeons who work in only regional hospitals in the urban area. It was found from the present study that the patients were referred from

remote areas about 100-300 km away. The strategy for better result is to decrease the delivery- operation interval particularly from prenatal diagnosis. In addition, results from the present study showed higher mortality rate of the OOR group than the IOR group (19% vs. 0%). One important reason is that, there were associated anomalies such as stomach perforation, colonic atresia and bowel perforation and gangrene. Stomach perforation, bowel perforation and gangrene may result from the prolonged referral time and delayed operations.

The traditional approach to management has been attempted reduction of the gut under general anesthesia (GA) in the operating room. Surgeons utilize either a primary or staged repair. Several measures to help accomplish primary repair are available including irrigating the meconium from the intestines, stretching the abdominal wall, and enlarging the defect. If a primary repair does not seem safe, a silo is fashioned or a prosthetic device applied so that the intestines can be placed in the abdominal cavity in a delayed, staged repair. Primary closure should be done when possible[15]. Bedside or ward reduction of eviscerated bowel and closure of gastroschisis without the need for GA is a feasible alternative technique. This method was introduced by Bianchi and Dickson in 1998[16]. Infants who had ward reduction do better in terms of avoiding GA/ventilation, establishing feeds, and going home earlier[17]. The only worrying aspect was an increased incidence of septicemia seen in infants who had a ward reduction. Gastroschisis closure without GA is as safe and effective a technique as reduction with GA. Its application needs careful selection of suitable cases and exclusion of at-risk neonates[18]. Further caution was urged after a report of four patients where only one had an uncomplicated course after ward reduction. Ward reduction can be effective in only some patients who have gastroschisis. that this approach is not satisfactory in all cases. The selection criteria are needed before this method can be recommended[19]. Case series describing the traditional approach usually report outcomes on all cases of gastroschisis, whereas those reporting ward reduction are selective and the outcomes are usually better. A recent Cochrane systematic review found no evidence from randomized, controlled trials (RCTs) to either support or refuse the practice of ward reduction[20]. The author suggests performing delivery and immediate operation in the operating room with general anesthesia. The present study showed performing operation immediately in the operation room after giving birth decreases the duration before having an operation and increases the opportunity to perform primary closure even the duration of endotracheal tube extubation, the time before for start eating, and the time before discharge are not different.

Conclusion

Forty-nine neonates with gastroschisis encountered from January 1, 2005 to December 31, 2007. Delivery and immediate surgical repair in the operating room occurred in 13 infants. The present study would emphasize the importance of rapid repair after birth. This approach appears to be safe and feasible. Delivery-operation interval was decreased. The repair was easier and increased the possibility of primary fascial closure. The patients ate sooner and were discharged earlier. A policy of delivery and immediate surgical repair in the operating room leads to decrease morbidity in infants with gastroschisis. A well-prepared team is an important issue for this policy.

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การผ่าตัดรักษาผู้ป่วย Gastroschisis ทันทีหลังจากคลอดในห้องผ่าตัด

สุรชัย สราญฤทธิชัย

ภูมิหลัง: *Gastroschisis เป็นความผิดรูปแต่กำเนิดของผนังหน้าท้อง มีอวัยวะภายในช่องท้องที่ผ่านช่องนี้ออกมานอกช่องท้อง ส่วนใหญ่เป็นกระเพาะอาหาร ลำไส้เล็ก และลำไส้ใหญ่ การผ่าตัดนำลำไส้เข้าช่องท้องทันทีเมื่อผู้ป่วยได้รับการดูแลเบื้องต้นพร้อมย่อมดีที่สุด เพราะลดการสูญเสียความร้อน น้ำ การติดเชื้อและไม่ให้ลำไส้บวมมาก ควรเย็บปิดแผลหน้าท้องทันทีเมื่อทำได้*

วัตถุประสงค์: *เพื่อเปรียบเทียบผลการผ่าตัดรักษาผู้ป่วย Gastroschisis กลุ่มที่คลอดในห้องผ่าตัดและผ่าตัดรักษาทันทีกับกลุ่มผู้ป่วยที่คลอดนอกห้องผ่าตัดแล้วจึงผ่าตัดรักษาภายหลัง*

วัสดุและวิธีการ: *ศึกษาข้อมูลผู้ป่วยทารกจำนวน 49 ราย ที่เป็น gastroschisis ที่มารับการรักษาที่โรงพยาบาลขอนแก่นระหว่างวันที่ 1 มกราคม พ.ศ. 2548 ถึงวันที่ 31 ธันวาคม พ.ศ. 2550 โดยผู้ป่วยทั้งหมดรักษาผ่าตัดโดยกุมารศัลยแพทย์คนเดียวกัน*

ผลการศึกษา: *ผู้ป่วยทารกจำนวน 13 ราย ที่ผ่าตัดรักษาทันทีหลังจากคลอดในห้องผ่าตัดและผู้ป่วย 36 รายที่คลอดนอกห้องผ่าตัดแล้วจึงผ่าตัดรักษาภายหลัง ระยะเวลาก่อนการผ่าตัดนับตั้งแต่หลังคลอดจนถึงการผ่าตัดและวิธีการผ่าตัดมีความแตกต่างกันอย่างมีนัยสำคัญทางสถิติ ระยะเวลาก่อนการผ่าตัดของกลุ่มที่ผ่าตัดรักษาทันทีหลังจากคลอดในห้องผ่าตัดช่วงสั้นกว่า (0.8 ± 0.4 vs. 11.4 ± 4.2, $p < 0.001$) และสามารถผ่าตัดปิดหน้าท้องโดยปิดได้ทันที (primary fascial closure) ได้ทุกราย (ร้อยละ 100) ในขณะที่กลุ่มผู้ป่วยที่คลอดนอกห้องผ่าตัดสามารถได้รับการผ่าตัดปิดหน้าท้องได้ทันที จำนวนเพียงร้อยละ 61.1 ($p < 0.01$) ไม่มีความแตกต่างกันอย่างมีนัยสำคัญทางสถิติในระหว่าง 2 กลุ่มในเรื่องช่วงเวลาการเอาท่อช่วยหายใจออก (4.7 ± 2.7 vs 8.3 ± 6.3, $p < 0.058$) ช่วงเวลาที่ทารกสามารถรับประทานเองได้(10.5 ± 4.5 vs. 13.7 ± 5.9, $p < 0.092$) และช่วงของการอยู่โรงพยาบาล (21.7 ± 9.9 vs. 28.7 ± 19.6, $p < 0.235$) แต่ในกลุ่มที่คลอดในห้องผ่าตัดและผ่าตัดรักษาทันทีมีแนวโน้มที่ใช้ช่วงเวลาน้อยกว่า อัตราเสียชีวิตโดยรวมเท่ากับร้อยละ 14 กลุ่มที่คลอดในห้องผ่าตัดและผ่าตัดรักษาทันทีรอดชีวิตทั้งหมด ส่วนกลุ่มผู้ป่วยที่คลอดนอกห้องผ่าตัดแล้วจึงผ่าตัดรักษาภายหลังมีอัตราเสียชีวิตร้อยละ 19*

สรุป: *การคลอดในห้องผ่าตัดและผ่าตัดรักษาผู้ป่วยทารกที่เป็น gastroschisis ทันทีสามารถทำได้อย่างปลอดภัย ลดช่วงระยะเวลาก่อนการผ่าตัด สามารถผ่าตัดปิดหน้าท้องโดยปิดได้ทันทีง่ายขึ้น ทารกสามารถรับประทานเองได้และกลับบ้านเร็วขึ้นลดอัตราเสียชีวิต ความพร้อมของทีมมีส่วนสำคัญในกระบวนการรักษาด้วยวิธีนี้*