The THAI Journal of SURGERY 2018;39:72-80.
Official Publication of The Royal College of Surgeons of Thailand

Original Article

A Study of Intraabdominal Pressure in Patients with Gastroschisis Before and After Closure of Abdominal Wall Defects

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Abstract

Background: **Ordinary treatments in patients with gastroschisis are primary and staged closure of abdominal wall defects (AWDs). The goal of treatment is to return the visceral organs into the abdominal cavity and minimize risks of increased intraabdominal pressure (IAP). Abdominal compartment syndrome (ACS) is the serious complication which induces to develop renal failure, bowel ischemia, respiratory compromise and death. IAP over 10 mmHg is defined as intraabdominal hypertension (IAH) and may induce to develop ACS.**

Purpose: **The aim of this study is to analyse IAP before and after closure of AWDs in patients with gastroschisis and investigate the factor affected increment of IAP.**

Materials and Methods: **The patients with gastroschisis who were treated at Queen Sirikit National Institute of Child Health from January 2017 to December 2017 were enrolled into the study. IAP was measured by using of urinary bladder pressure between before and after closure of AWDs in both primary and staged closure procedures. Demographic data, IAP and complications were collected in order to demonstrate the relationship by using statistical analysis with SPSS program. The level of p-value less than 0.5 was considered statistical significance.**

Results: **Twenty-six patients (15 males, 11 females) were enrolled in the study. The patients were treated by primary closure procedure in 3 cases and staged closure procedure in 23 cases. In the primary closure group, median IAP before treatment was 8.09 mmHg (range 4.41-8.09 mmHg), whereas median IAP after closure of AWDs was 10.3 mmHg (range 4.41-20.96 mmHg). In the staged closure group, median IAP before treatment was 5.88 mmHg (range 2.21-22.07 mmHg), whereas median IAP after closure of AWDs was 8.46 mmHg (range 2.94-22.07 mmHg). Of the total 26 patients, 8 cases (30.76%) had IAH after closure of AWDs with the IAPs ranging from 10.3 to 22.07 mmHg. Two of the 8 cases with IAH (7.69% of all the patients) cases developed ACS with acute respiratory insufficiency, one case in the primary closure group (IAP 20.96 mmHg) and the other one in the staged closure group (IAP 22.07 mmHg). Both cases were treated by endotracheal intubation and respiratory support until they recovered within 3 days. There was not statistically significant in comparing of IAP between primary and staged closure procedures in the periods of before and after closure of AWDs ($p > 0.05$). Demographic data, type of operative procedures and complications were not associated to high IAP (> 10 mmHg) in this study.**

Conclusion: **Comparison between primary and staged closure procedures, there was no statistically significant of IAP in patients with gastroschisis before and after closure of AWDs. However, approximately 8 % of the patients developed ACS immediately postoperative closure of AWDs. Demographic data, type of operative procedures and comorbidities were not statistically associated with IAH after closure of AWDs.**

Keywords: **Gastroschisis, intraabdominal pressure, intraabdominal hypertension, abdominal compartment syndrome, primary closure procedure, staged closure procedure**

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Introduction

Gastroschisis is the most common disease of congenital abdominal wall defect (AWD) in neonates with the incidence ranging from 1 : 2000 to 1 : 3000 livebirths[1,2]. This anomaly is associated with young maternal age. The etiology of gastroschisis is idiopathic. One theory suggests that gastroschisis results from failure of the mesoderm to form in the anterior abdominal wall, possible because of the relatively unsupported right side of the umbilicus as a result of resorption of the right umbilicalvein[3]. There is no membranous sac covering the herniated organs. The small and large intestines are the most common herniated viscera which are inflamed, swollen and matted loop appearance.

Gastroschisis requires surgical treatment in order to return the viscera into the abdominal cavity and close AWD with minimizing the risks of damage due to trauma or increased intraabdominal pressure (IAP). There are two most commonly used for the treatment options[4]. The first one is primary closure of AWD. The second one is staged closure procedure by placement of a silo, serial reduction of the herniated viscera and delayed closure of AWD[4].

Increased IAP may occur after closure of AWD. Intraabdominal hypertension (IAH) is called when the IAP is higher than normal limit. IAH reflects to develop abdominal compartment syndrome (ACS) which is the serious complication and induces to develop acute renal failure, bowel necrosis, respiratory compromise and death. In 2013, the World Society of Abdominal Compartment Syndrome (WSAC)[5] updated thatIAH in children is defined by a sustained and repeated pathological elevation in IAP over 10 mmHg and ACS in children is defined as a sustained elevation of IAP of greater than 10 mmHg associated with new or worsening organ dysfunction. IAP is approximated from either the bladder pressure or stomach pressure and can be used to guide the treatment. The reference standard for IAP measurement in children is introduced via the bladder by using 1 ml of saline / 1 kg as an instillation volume.

Many neonates with gastroschisis are transferred from the other hospital to treat at Queen Sirikit National Institute of Child Health (QSNICH), but no one mentioned about IAP for the treatment of gastroschisis in the previous studies of our institute[6-8]. Herein, we originate the research to study about this problem. The aim of this study was to analyse the IAP before and after closure of AWDs in our patients with gastroschisis and investigate the factors affected with increased IAP.

Materials and Methods

This study was a prospective pilot study of patients with gastroschisis who were treated at QSNICH from January 2017 to December 2017. The exclusion criteria is patients with urinary tract infection or unable to retain urethral catheter. Patients' data were collected including gender, gestational age, birth weight, size of AWD, eviscerated contents, intraoperative peak inspiratory pressure (PIP), IAP, operative procedures and comorbidities.

IAP was measured through the bladder pressure. This intravesical pressure measurement was performed under sterile technique by pediatric surgeons. Ordinarily, all of the patients with gastroschisis were retained urethral catheters. We used simple equipment which could be found in the ward and applied to measure IAP (Figure 1). Sterile normal saline solution (NSS) was instilled into the bladder via the urethral catheter in amount of 1 ml/1 kg with the minimum of 3 ml. The pubic symphysis was used as the reference of this method. The unit of IAP measured by NSS is cm H_2O. We want to use the unit of IAP in mmHg for comparison in the study and 1 cmH_2O is approximately 0.735 mmHg[9].

For the primary closure group, IAP was measured

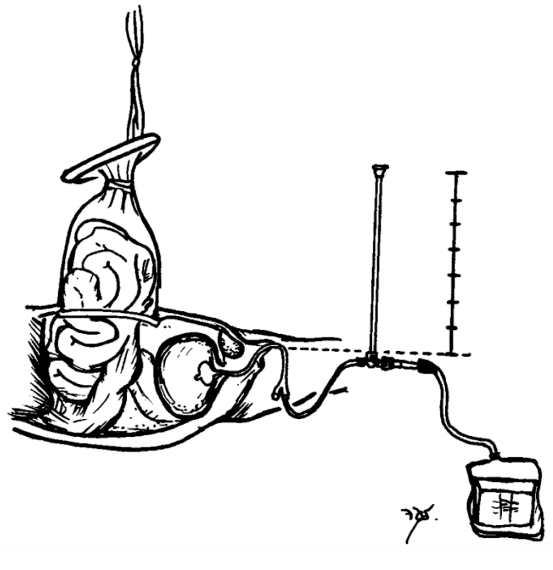

Figure 1 Diagram of intravesical pressure measurement

at the time of first admission (pretreatment period), immediate postoperation (Day 0) and 2 days after closure of AWD (Day 1 and Day 2). For the stage closure group, IAP was measured at the time of admission, and 2 days after placement of artificial sac or silo. IAP was recorded again before closure of AWD, immediate postoperation and 2 days after closure of AWD (Figure 2).

The collected data were analyzed by using SPSS(r) version 20 (IBM SPSS statistic). Demographic data were demonstrated by percentage, median, mean and standard variation. The Chi-square test and Pearson correlation were used to compare data in this study. A *p*-value less than 0.05 was considered statistically significant.

The study was approved by Ethic Committees of our institute. Document No. 59-081.

Results

A total of 29 patients with gastroschisis were treated at QSNICH during January 2017 to December 2017. Three cases were excluded due to unable retain urethral catheter. Therefore, 26 patients (15 males and 11 females) were enrolled in the study (Figure 3). Gestational age ranged from 30 to 36 weeks (median 36 weeks). Their birth weights ranged from 1,420 to 3,130 grams (median 2,090 grams). Premature and low birth weight neonates were noted in 18 cases (69.2%). Diameters of AWD ranged from 0.5 to 3.5 cm (median 2.5 cm).

The top 5 eviscerated contents were the small and large intestines, stomach, urinary bladder and uterus in 24 (92.3%), 19 (73.1%), 10 (38.5%), 7 (26.9%) and 5 cases (19.2%), respectively. The other eviscerated contents were gallbladder (4 cases), liver and testis (one case, each). Characteristics of gastroschisis were classified in antenatal (15 cases or 57.7%) and perinatal types (11 cases or 43.3%) based on the features of eviscerated contents. Fourteen cases had morbidities since birth including respiratory distress syndrome or RDS (7 cases), birth asphyxia (4 cases) and meconium aspiration syndrome (3 cases). Duration from birth until arrival at QSNICH ranged from 1.5 to 16 hours

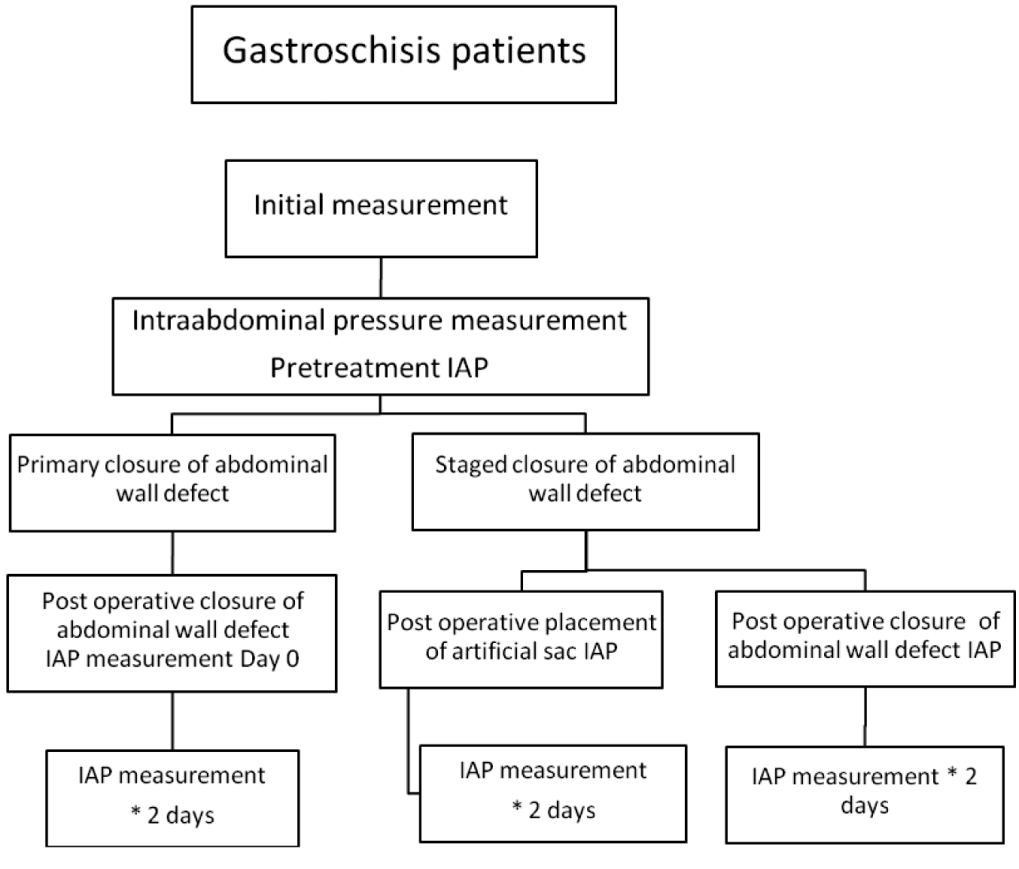

Figure 2 Algorithm of intraabdominal pressure measurement in this study

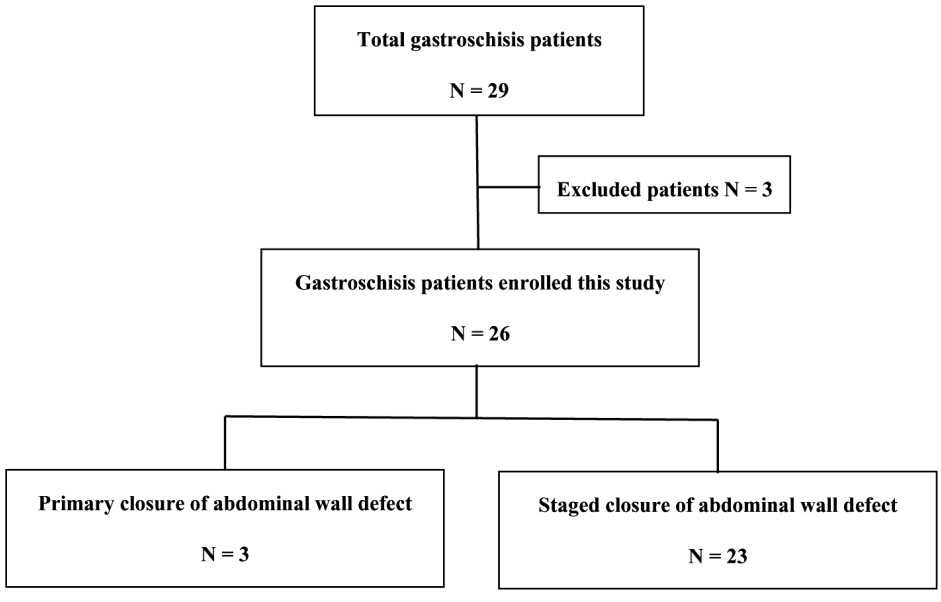

Figure 3 Schematic diagram of gastroschisis management

(median 7.5 hours).

Three cases (11.5%) were treated by primary closure procedure, while 23 cases (88.5%) were treated by staged closure of AWD. Demographic data of patients in two groups were not statistically different (Table 1).

In the primary closure group, median IAP at the pretreatment period was 6.25 mmHg, while IAPs after closure of AWDs at Day 0, 1 and 2 were 10.30, 6.62 and 7.36 mmHg, respectively (Figure 4). One case had mildly increased IAP (10.30 mmHg), another one developed ACS with respiratory distress, CO_2 retention and acidosis (IAP 20.96 mmHg) at immediate postoperation and was treated with ventilatory support, intravenous sedative (midazolam) and analgesic (fentanyl). IAPs of the 2 cases were decreased to normal level within the second postoperative day.

In the staged closure group, IAPs of various treatment periods were shown in Figure 5. Although most of the patients had IAPs within normal limit (≤10 mmHg), but 6 cases had increased IAP over 10 mmHg (IAH). IAPs of 5 cases were mildly elevated between 12.50 and 14.71 mmHg at immediate postoperative closure of AWDs without any symptoms and required closed observation only. The last one developed ACS with acute respiratory insufficiency (IAP 22.07 mmHg at immediate postoperation) and treated with ventilator support, intravenous midazolam and fentanyl. The IAP was decreased to normal limit in the third postoperative day.

IAPs of both groups in various periods of time were shown in Table 2. There was no statistical difference of IAPs between the primary and staged closure groups in all of the periods of pretreatment and postoperative closure of AWD (Day 0-2). Median pressure differences between the pretreatment and immediate postoperative treatment (Day 0) were 2.21 mmHg in the primary closure group and 5.00 mmHg in the staged closure group ($p = 0.99$).

Median PIP during intraoperative closure of AWD were 20 cmH_2O (range 18-24 cmH_2O) in the primary closure group and 18 cmH_2O (range 15-25 cmH_2O) in the staged closure group ($p = 0.28$).

Of the total 26 patients, 9 cases had endotracheal (ET) intubation after delivery due to RDS and continued ET intubation until postoperative closure of AWD. Another 5 cases were intubated after closure of AWD, 3 cases in the primary closure group and 2 cases in the staged closure group. The remainders 12 cases did not require postoperative ET intubation. Median IAPs at the periods of pretreatment and immediate postoperative closure of AWD of the 5 cases with ET-intubation were higher than those of the 12 non-intubate cases (7.50 vs 5.10; $p = 0.04$ and 13.46 vs 7.36; $p = 0.04$). Median duration of intubation in all of the 14 cases was 10 days (range 3-21 days).

The factors which associated to high IAP in the 26 patients were analysed. These factors included birth weight, gestational age, types of gastroschisis, size of

Table 1 Demographic data between primary and staged closure of abdominal wall defect group in patients with gastroschisis

Patient characteristic	Primary (N=3)	Staged (N=26)	*P*-value
Gestational age (weeks)			
Range	35-36	30-39	0.85
Median	36	36	
Mean ± SD	35.67 ± 0.5774	35.43 ± 2.0851	
Birth weight (grams)			
Range	2,000-2,600	1,420-3,130	0.54
Median	2,510	2,080	
Mean ± SD	2,370.00 ± 323.5738	2,199.22 ± 458.4364	
Male: Female (N, %)	3: 0 (100:0)	12: 11 (52:48)	0.18
Maternal age (year)			
Range	14-20	13-32	0.15
Median	15	19	
Mean ± SD	16.33 ± 3.2146	21.22 ± 5.4602	
Mode of delivery			
Normal delivery (N, %)	3 (100)	15 (65.2)	0.31
Cesarean section (N, %)	0 (0)	8 (34.8)	
Prenatal diagnosis (N, %)	1 (33.3)	8 (34.8)	
Type of gastroschisis			
Perinatal type (N, %)	1 (33.3)	10 (43.5)	0.62
Antenatal type (N, %)	2 (66.7)	13 (56.5)	

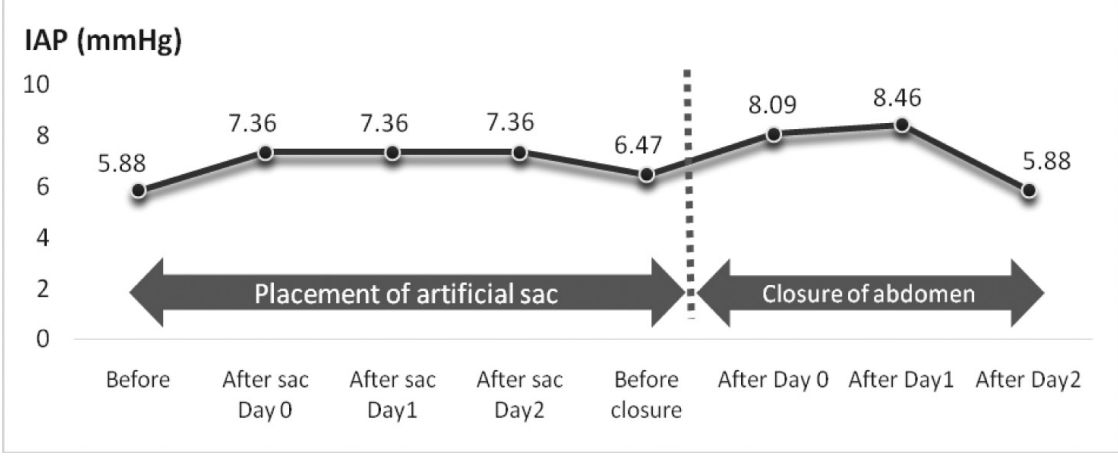

Figure 4 Linear graph of median intraabdominal pressure and range in primary closure of abdominal wall defect group (n=3)

AWD, eviscerated contents, preoperative and postoperative intubation, comorbidities, treatment procedure and intraoperative PIP. The level of IAP at 10 mmHg was used to analysed and revealed no any significant factor associated to high IAP.

DISCUSSION

Operative treatment of gastroschisis is primary and staged closure procedures. Increasing of IAP after closure of AWD of both techniques is the important issue. From the previous study of Lacey[10] in 1993, IAPs higher than 10-15 mmHg induced to have decreased renal and intestinal perfusion, and a silo or prosthetic patch might be needed. Ein[11] suggested that IAP higher than 20 mmHg could develop renal failure and bowel ischemia. Divarei[12] used the point at IAP 15 mmHg, the incidences of IAH and ACS in children were 9% and 4%. Whereas the incidence of IAH and ACS in gastroschisis patients were 1.33% and 0.67%,

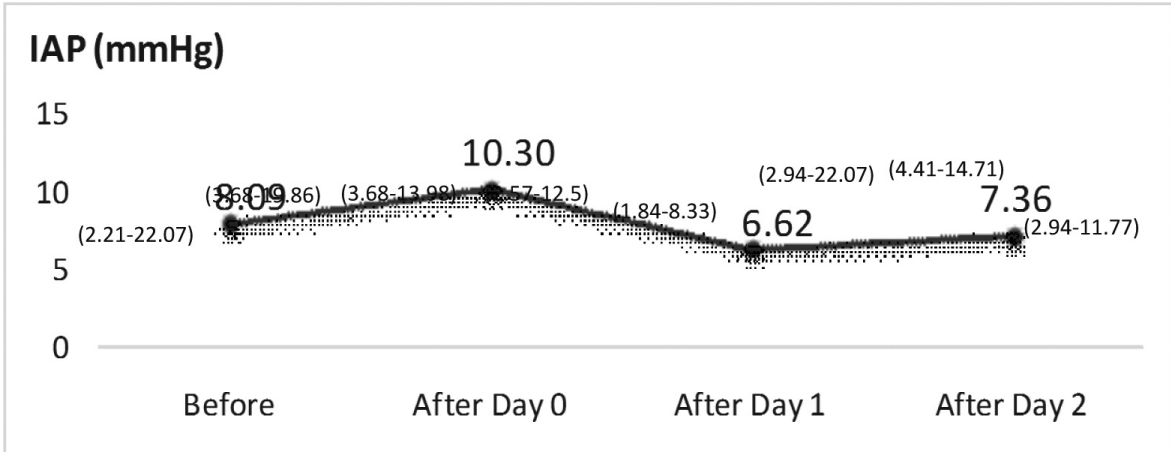

Figure 5 Linear graph of median intraabdominal pressure and range in staged closure of abdominal wall defect group (n=23)

Table 2 Comparison of intraabdominal pressure between primary and staged closure of abdominal wall defect group

Intraabdominal pressure (mmHg)	Primary closure group (N=3)	Staged closure group (N=23)	*P*-value
Pretreatment			
Range	4.41-8.09	2.21-22.07	0.95
Median	8.09	5.88	
Mean ± SD	6.87 ± 2.1233	6.72 ± 4.2482	
After closure of abdominalwall defect (Day 0)			
Range	4.41-20.96	2.94-22.07	0.36
Median	10.30	8.09	
Mean ± SD	11.89 ± 8.3893	9.16 ± 4.2060	
After closure of abdominalwall defect (Day 1)			
Range	5.88-8.09	4.41-14.71	0.26
Median	6.62	8.46	
Mean ± SD	6.87 ± 1.1236	8.58 ± 2.5088	
After closure of abdominalwall defect (Day 2)			
Range	4.78-11.03	2.94-11.77	0.61
Median	6.62	5.88	
Mean ± SD	7.48 ± 3.2133	6.61 ± 2.6533	
Pressure difference (postoperative Day 0 - pretreatment)			
Range	0 -12.87	1.10-11.77	0.99
Median	2.21	5	
Mean ± SD	5.02 ± 6.8838	5.02 ± 2.9088	

respectively[12].

From the WSACS5 in 2013, the Pediatric Guidelines Sub-committees updated the definition of normal level of IAP, IAH and ACS. Normal level of IAP in critically ill children was approximately 4-10 mmHg. The IAH in children was defined by a sustained or repeated pathological elevation in IAP over 10 mmHg. The ACS in children was defined as a sustained elevation in IAP of greater than 10 mmHg associated with new of greater than 10 mmHg associate with new or worsening organ dysfunction[5]. The most accuracy method of IAP study is intravesical pressure measurement using 1 ml of normal saline/kg[10,13,14]. In this study, we originally used cmH_2O as the unit of IAP and convert to mmHg for analysis and 1 cmH_2O is approximately 0.735 mmHg[9].

From the present study, mean pressure difference between immediate postoperative closure of AWD and

Table 3 Reviewed the previous and present studies regarding intraabdominal pressure using for treatment of gastroschisis

Investigators	Year Study design	Patients' data		IAP post AWD closure (mmHg)
		GA (weeks)	BW (grams)	
Lacey[10]	1933 experimental	mean 36 range 25-40	mean 2,461 rang 930-4,110	staged closure > 20
Olesevich[15]	2005 experimental	primary closure mean 37 range 36-38 staged closure mean 35 range 34-37.5	primary closure mean 2,500 range 2,200-2,800 staged closure mean 2,600 range 2,300-2,700	primary closure 16 staged closure 27
Schmidt[16]	2011 experimental	primary closure mean 35 range 37 staged closure mean 37	primary closure mean 2,154 range 2,237 staged closure mean 2,237	primary closure <15* staged closure > 15*
The present study	2018 Observational	mean 36 range 30-38	primary closure mean 2,370 range 2,000-2,600 staged closure mean 2,080 range 1,420-3,130	primary closure mean 6.87 range 4.41-20.96 staged closure mean 9.16 range 2.94-22.07

Abbreviation : GA = gestational age BW = birth weight IAP = intraabdominal pressure

* performed primary closure procedure if intraabdominal pressure at the pretreatment period under 20 cmH_2O (15 mmHg)

* * performed staged closure procedure if intraabdominal pressure at the pretreatment period over 20 cmH_2O (15 mmHg)

pretreatment period were 5.02 ± 6.88 mmHg in the primary closure group and 5.02 ± 2.91 mmHg in the staged closure group (Table 2). It seemed to be safe from the risk of IAH and ACS after closure of AWD. However, 8 cases (30.76% of all the patients) in both groups had increased IAP over 10 mmHg after closure of AWD. Six cases (23.07% of all the patients) mildly evaluated IAP ranging 10.30 to 14.71 mmHg without any abnormal symptoms. Two cases developed ACS (7.64 % of all the patients). One case in the primary closure group had increased IAP from 8.09 to 20.96 mmHg and the other one in the staged closure group had increased IAP from 10.30 to 22.07 mmHg. Both cases developed respiratory distress which required postoperative ET-intubation, mechanical ventilation, midazolam and fentanyl administration. They successfully treated until the IAP was returned to normal limit within 3 postoperative days.

Over the past three decades, many investigators studied about IAP in patients with gastroschisis. In 1993, Lacey10 used IAP at the level of 20 mmHg as aguideline for treatment including type of operative procedures, duration of staged closure procedure and also administration of analgesic, sedative or paralytic medications. In 2005, Olesevich[15] used IAP at the level of 20 mmHg for selection of the appropriated operative treatment. He advocated that primary closure was safely accomplished in 100% of neonates with gastroschisis whose bladder pressure measured 20 mmHg or less. Schmidt[16] studied the outcome after treatment by using IAP guide. He chose delayed primary closure if IAP below 20 cmH_2O (approximately 15 mmHg) and staged closure if IAP equal or higher than 20 cmH_2O. The results were no statistical difference between both groups of children. Table 3 revealed the previous and present studies about IAP in gastroschisis management. All of the previous studies used IAP as the guideline for selection of the appropriated operative procedure, but the present study was just observation of IAP between before and after closure of AWD and did not change the decision making of the surgeons in operative procedure. We found that IAP of our patients

was lower than the cut point of IAP using in the previous studies. Most of patients with gastroschisis at our institute tend to treat with staged closure procedure in order to reduce the risks of developing IAH and ACS. It is the limitation for comparative study of both procedures because of small amount of cases in the primary closure group. We hope to increase patients who will be treated by primary closure procedure and used IAP as the guideline in the future.

Conclusion

IAPs before and after closure of AWDs were not statistically different either primary and staged closure procedures. Approximately 23% of all the patients with gastroschisis had mild IAH without any symptoms and 8% of the patients developed ACS and required ventilator support, sedative and analgesia after closure of AWDs. Demographic data, type of operative procedures and complications were not statistically associated to IAH (> 10 mmHg) after closure of AWDs.

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บทคัดย่อ **การศึกษาความดันในช่องท้องของผู้ป่วย Gastroschisis ก่อนและหลังการเย็บปิดผนังหน้าท้อง**

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**กลุ่มงานศัลยศาสตร์ สถาบันสุขภาพเด็กแห่งชาติมหาราชินี กรุงเทพฯ*

ความเป็นมา: การรักษาผู้ป่วย Gastroschisis มี 2 วิธี คือ การผ่าตัดเย็บปิดผนังหน้าท้องในครั้งแรก และเย็บปิดแบบเป็นขั้นตอน โดยหลักการการรักษาที่สำคัญคือการนำส่วนของอวัยวะในช่องท้องที่ออกมากลับเข้าไปไว้ภายในช่องท้องโดยให้มีความเสี่ยงน้อยที่สุดต่อการเกิดภาวะความดันในช่องท้องสูง ภาวะความดันในช่องท้องสูงเป็นภาวะแทรกซ้อนที่สำคัญ ทำให้เกิดภาวะไตวาย ลำไส้ขาดเลือด ระบบหายใจล้มเหลว จนถึงเสียชีวิตได้

วัตถุประสงค์: เพื่อศึกษาค่าความดันในช่องท้องผู้ป่วย gastroschisis ก่อนและหลังผ่าตัดปิดผนังหน้าท้อง และหาปัจจัยที่มีผลต่อการเพิ่มความดันในช่องท้องของผู้ป่วย gastroschisis

วัสดุและวิธีการ: เป็นการศึกษาในผู้ป่วยเด็ก gastroschisis ที่มารับการรักษาในสถาบันสุขภาพเด็กแห่งชาติมหาราชินีตั้งแต่ 1 มกราคม 2560 ถึง 31 ธันวาคม 2560 ทั้งที่ได้รับการรักษาโดยวิธีผ่าตัดปิดผนังหน้าท้องแบบครั้งเดียวและแบบเป็นขั้นตอน โดยการวัดความดันในช่องท้องจะวัดผ่านสายสวนปัสสาวะทั้งก่อนและหลังผ่าตัดปิดผนังหน้าท้อง ข้อมูลที่ศึกษาได้แก่ ข้อมูลทั่วไปของผู้ป่วย ความดันในช่องท้อง และภาวะแทรกซ้อนที่เกิดขึ้น นำข้อมูลมาวิเคราะห์ทางสถิติด้วยโปรแกรม SPSS โดยกำหนดให้มีนัยสำคัญทางสถิติเมื่อ p-value น้อยกว่า 0.05

ผลการศึกษา: ผู้ป่วย 26 ราย (ชาย 15 ราย หญิง 11 ราย) ถูกนำเข้ามาในการศึกษาครั้งนี้ ผู้ป่วยที่รักษาโดยวิธีผ่าตัดเย็บปิดผนังหน้าท้องแบบครั้งเดียวมี 3 ราย ผู้ป่วยที่รักษาโดยเย็บปิดผนังหน้าท้องแบบขั้นตอน 23 ราย ในผู้ป่วยกลุ่มแรกค่ามัธยฐานของความดันในช่องท้องก่อนการรักษาเท่ากับ 8.09 มิลลิเมตรปรอท (พิสัย 4.40-8.09 มิลลิเมตรปรอท) ขณะที่ค่ามัธยฐานหลังผ่าตัดปิดหน้าท้องทันทีเท่ากับ 10.30 มิลลิเมตรปรอท (พิสัย 4.41-20.96 มิลลิเมตรปรอท) ในผู้ป่วยกลุ่มที่สองค่ามัธยฐานของความดันในช่องท้องก่อนการรักษาเท่ากับ 5.88 มิลลิเมตรปรอท (พิสัย 2.21-22.07 มิลลิเมตรปรอท) ขณะที่ค่ามัธยฐานหลังผ่าตัดปิดหน้าท้องทันที่เท่ากับ 8.46 มิลลิเมตรปรอท (พิสัย 2.94-22.07 มิลลิเมตรปรอท) ในจำนวนผู้ป่วยทั้งหมด 26 ราย มีอยู่ 8 ราย (ร้อยละ 30.76) มีค่ามัธยฐานของความดันในช่องท้องสูงกว่าปกติ สูงตั้งแต่ 10.30 ถึง 22.07 มิลลิเมตรปรอท มีผู้ป่วย 2 ใน 8 รายที่มีความดันในช่องท้องสูงหลังผ่าตัดเย็บปิดช่องท้อง (ร้อยละ 8 ของผู้ป่วยทั้งหมด) เกิดภาวะ abdominal compartment syndrome หนึ่งรายเป็นผู้ป่วยที่ผ่าตัดโดยวิธีแรก (ความดันในช่องท้องสูง 20.96 มิลลิเมตรปรอท) และอีกหนึ่งรายเป็นผู้ป่วยที่ผ่าตัดปิดช่องท้องโดยวิธีที่สอง (ความดันในช่องท้องสูง 22.07 มิลลิเมตรปรอท) ผู้ป่วยทั้งสองรายนี้ ได้รับการรักษาโดยการใส่เครื่องช่วยหายใจ ได้รับยาฉีด midazolam และ fentanyl ทางหลอดเลือดดำ และความดันในช่องท้องกลับมาเป็นปกติภายในเวลา 3 วันหลังผ่าตัดปิดช่องท้อง ไม่มีความแตกต่างอย่างมีนัยสำคัญทางสถิติในการเปรียบเทียบความดันในช่องท้องระหว่างการผ่าตัดปิดผนังหน้าท้องแบบครั้งเดียวและการผ่าตัดเย็บปิดผนังหน้าท้องแบบเป็นขั้นตอนทั้งก่อนและหลังการเย็บปิดผนังหน้าท้อง ($p > 0.05$) ข้อมูลทั่วไปวิธีการผ่าตัดเย็บปิดผนังหน้าท้องและภาวะแทรกซ้อน ไม่มีความสัมพันธ์กับการทำให้เกิดความดันสูงในช่องท้อง (มากกว่า 10 มิลลิเมตรปรอท) ในการศึกษาครั้งนี้

สรุป: เปรียบเทียบระหว่างการผ่าตัดเย็บปิดผนังหน้าท้องแบบขั้นตอนเดียว และการผ่าตัดปิดผนังหน้าท้องแบบเป็นขั้นตอน ไม่มีความแตกต่างอย่างมีนัยสำคัญของความดันในช่องท้อง ทั้งก่อนและหลังผ่าตัดปิดผนังหน้าท้อง อย่างไรก็ตาม ประมาณร้อยละ 8 ของผู้ป่วยทั้งหมดเกิดความดันในช่องท้องสูงจนกลายเป็น abdominal compartment syndrome ทันทีหลังผ่าตัดปิดผนังหน้าท้อง ข้อมูลพื้นฐานชนิดของการผ่าตัดปิดผนังหน้าท้องและภาวะแทรกซ้อนไม่มีสัมพันธ์ทางสถิติกับการเกิดความดันสูงในช่องท้อง ภายหลังผ่าตัดปิดผนังหน้าท้อง