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Original Article

Tension Gastrothorax in Diaphragmatic Injuries: The Incidence and Case Series on a Trauma Center Level I of Northern University Based Hospital in Thailand

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Abstract

Background: **Tension gastrothorax is a rare complication but life-threatening condition in case of diaphragmatic injury. However, there was no report on this condition in Thailand. Therefore, the objective of this study was to find the incidence and describe tension gastrothorax in blunt diaphragmatic injuries in our setting.**

Materials and Methods: **We reviewed a five-year retrospective data from a trauma center level I of Northern University-based hospital in Thailand. The baseline data, mechanism of injury, and radiologic study results were collected. Details of cases were described and summarized.**

Results: **During the five-year period, there were 53 cases of diaphragmatic injury and only 3 (5.7%) suffered from tension gastrothorax. All the patients had the same mechanism of injury (the blunt injury from high-speed vehicle collisions). The pelvic fractures were the associated injuries of all patients. All of the cases could be identified the condition by chest radiography. One patient had a miss diagnosis on initial diagnosis as tension pneumothorax. The decompression of stomach by nasogastric tube was an initial adjunctive intervention during resuscitation. The emergency surgery was necessary in cases of severe hemodynamic and respiratory compromise as well as non-success of decompression of the gastric volume.**

Conclusion: **Tension gastrothorax is a rare life threatening condition in diaphragmatic injury. Severe blunt injury with pelvic fracture is common mechanism and concomitant injury. The gastric decompression with nasogastric tube is an initial adjunctive therapy during resuscitation.**

Keywords: **Tension gastrothorax, diaphragmatic injury, life threatening condition, multiple injuries.**

INTRODUCTION

Post-traumatic tension gastrothorax was first described in 1984, and it is a rare complication of diaphragmatic injury[1]. This occurs in case of diaphragmatic injury when a dilated stomach herniates into the thoracic cavity causing cardiopulmonary instability due to a mediastinal shift to the unaffected side[2]. Most previous data on acute post-traumatic tension gastrothorax was a case report or case series. The incidence was unknown and no previous report in Thailand[3-10]. Therefore, the primary objective of this study was to estimate the incidence of tension

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gastrothorax in patient who suffered from blunt diaphragmatic injuries. The second objective were was common findings on these cases including the mechanism of injury, clinical presentation, radiographic results.

Materials and Methods

The trauma center database was retrieved and reviewed for all diaphragmatic injuries in Maharaj Nakorn Chiang Mai Hospital. This hospital is a University-based hospital and a level-I trauma center in the Northern region of Thailand. We reviewed all cases for a five years' period between 2009 and 2013. The baseline data were collected including age, gender, mechanism of injury, Trauma Score-Injury Severity Score (TRISS-score), associated injury, length of hospital stay (LOS), result of treatment and cause of death. The descriptive data of continuous variables were reported as mean and the categorical variables were reported as percent. The Ethic Committee of Faculty of Medicine, Chiang Mai University approved this study (Research ID: 2091/Study code: SUR-2557-02091).

Results

During the study period, a total of 53 cases were diagnoses with traumatic diaphragmatic injury. The baseline characters were summarized in Table 1. Most of the patients were male (81%), the mean age of the patients was 28 years (range 1 - 74), mean of TRISS score was 0.908, and length of hospital stay was 16 days. Penetrating injuries (stab and gunshot wound) were the most common mechanism of injury [blunt:14 (70%)], Of these, only a total of 3 cases had tension gastrothorax. The left diaphragmatic injury was more common than the right side. Bilateral diaphragmatic injuries were found on the patient who got penetrating and blunt injuries. Seven cases died due to massive bleeding and multiple organ failure. We reported of these 3 cases of acute posttraumatic tension gastrothorax and described as following.

Table 1 Demographic data of traumatic diaphragmatic injuries

Total (N)	N=53
Gender (%)	
Male	43 (81)
Female	10 (19)
Mean age in year (min - max)	29 (1 - 74)
Mean TRISS score	0.908
Mean length of stay (day)	17
Mechanism of injury (%)	
Blunt	16 (30)
Stab	18 (34)
Firearm	19 (36)
Site of injury (%)	
Left side	30 (56)
Right side	20 (38)
Bilateral	3 (6)
Tension gastrothorax (%)	3 (6)
Death (%)	7 (13)
Massive bleeding	4 (7)
Multi-organ failure	3 (5)
Associated injuries (%)	
Pneumothorax - hemothorax	43 (81)
Liver	25 (51)
Spleen	15 (30)
Stomach	12 (26)
Small bowel	7 (9)
Large bowel	6 (11)
Bone Fracture	6 (11)
Kidney	5 (8)
Pelvic	5 (6)
Bladder	3 (6)
Head	2 (4)
Heart	2 (4)
Spinal cord	1 (2)

Case 1

A 15-year-old girl who was riding on her motorcycle, she crashed into the back of a pick-up car and she was sent to a primary care hospital. Initial assessment revealed mild hypoxemia (Oxygen saturation was 91%), which was corrected by oxygen support and both lungs were clear. Tachycardia was detected (pulse rate 135/min) but blood pressure was normal. There was a large laceration in the lower anterior abdomen approximately 20 cm. in length exposing an open pelvic fracture site. Moreover, she had got gross hematuria and a deformity of the right thigh. At the time of transfer, her blood pressure had dropped to 70/40 mmHg so the patient was intubated and resuscitation with normal saline solution 2,000 ml. When she arrived at the emergency department, emergency doctor detected a minimal decrease in breath sound in the right chest, pulse rate was 150/min, blood pressure was 86/57 mmHg, oxygen

saturation was 100% and FAST (focus assessment sonography in trauma patient) was positive. The trauma surgeons planned for an emergency laparotomy and a chest x-ray was taken with a portable machine before the patient was taken to the operating theatre. We detected an abnormality of chest x-ray in operative room. On examination the X-ray film showed no lung marking in the left thoracic cavity, and we could not see the left border of the diaphragm (Figure 1). The first diagnosis was tension pneumothorax. The needle decompression was carried out. Air and gastric contents were drained from the needle thoracentesis. An intercostal tube was inserted but no air was reached from the chest drain. Therefore, the diagnosis was tension gastrothorax. A nasogastric tube was inserted and the gastric content was drained. The vital signs were stabilized after resuscitation. An emergency laparotomy was performed immediately to reduce the stomach, repair diaphragm, repair urinary bladder and temporarily close the abdomen. Injury in this patient includes bilateral diaphragmatic injury with left tension gastrothorax, liver injury grade 1, splenic injury grade 2, colonic injury, intra-peritoneal urinary bladder rupture, open comminuted pelvic fractures with fractured acetabulum and left ureter injury.

Most of injuries (except ureter injury) were detected and treated by an emergency laparotomy for damage control procedure with an external fixation of the pelvic fracture. Treatment of ureter injury was carried out with percutaneous drainage and cystoscopy with a double J-stent insertion. After first treatment about 5 months, complete left upper ureter stricture was detected and surgical correction was done. This patient was admitted in hospital for a total of 36 days.

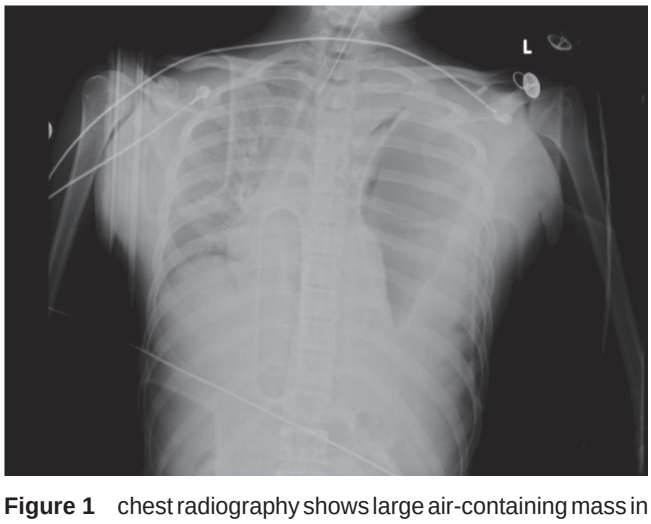

Figure 1 chest radiography shows large air-containing mass in left thorax, loss of lung marking and diaphragmatic outline with mediastinum shift to the right. Initial diagnosis was tension pneumothorax.

Case 2

A 58-year-old man who was riding on a motorcycle and crashed into a truck. In the primary care hospital, he had cyanosis, hypotension (blood pressure 85/58 mmHg) and bradycardia (pulse rate 57/min). Initial management was intubation and fluid resuscitation. The other injuries detected included a laceration of the scrotum, deformity of left thigh and gross hematuria. Chest radiography revealed a left diaphragmatic injury and herniation of the stomach into the left thoracic cavity, which caused a mediastinum shift to the right (Figure 2). On arrival at the Emergency Department, his blood pressure was 80/40 mmHg, pulse rate was 60/min, oxygen saturation was 79%, FAST was positive and sphincter tone was loose. The nasogastric tube was inserted but it did not success. We performed emergency laparotomy. The intra-operative findings were left diaphragmatic injury with tension gastrothorax, open book pelvic fracture, splenic injury, intra-peritoneal urinary bladder rupture, closed fracture in the shaft of the left femur.

In operative theater, pulseless electrical activity (PEA) was detected and the cardio-pulmonary resuscitation (CPR) was initiated. After reduced stomach into abdominal cavity, arrhythmia was temporary improve. The CPR was performed for three times, the estimated blood loss was 4,000 ml. The patient passed away at 2 hours after surgery.

Case 3

A 3-year-old girl was a messenger on the pillion of motorcycle. She was thrown from the motorcycle after frontal impact with a car. Her mother died at the scene and her father had the severe head injuries. At the community-hospital, her pulse rate was 150/min, she had tachypnea and abdominal distension. On arrival at the emergency department, her blood pressure was 100/70 mmHg, pulse rate was 155/min, oxygen saturation was 91% and breath sound of left chest was decrease. The tension gastrothorax was detected with chest x-ray (Figure 3). An emergency laparotomy was

performed without any initial decompression of stomach on emergency department. Her pelvic fracture was successful treated conservatively. She was discharged after 7 days and her recovery was uneventful.

For summarization (Table 2), the blunt mechanism was the cause of all tension gastrothorax in our series, hypoxemia with unstable hemodynamic were the life-threatening condition at hospital presentation. The pelvic fracture was an associated injury. The vital signs were prone to disturb on a toddler. The possible pathophysiology was the greater risk of developing tension gastrothorax because of an unfixed mediastinum. The possible cause of mortality was massive bleeding and tension gastrothorax induced mediastinal shift and led to cardiac arrest. Regarding the diagnostic modality, chest X-rays were an initial tool at adjunctive investigation but misdiagnosis with tension pneumothorax should be concerned. For initial treatment, nasogastric tube decompression could be

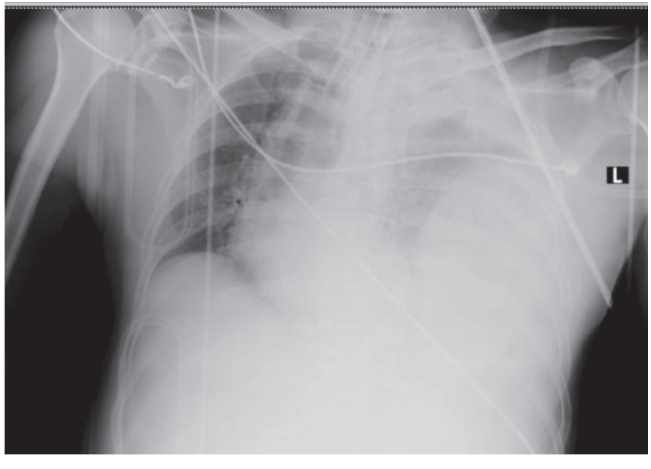

Figure 2 chest radiography shows marked elevation of left side of the diaphragm, haziness of left hemithorax and mediastinum shift to the right.

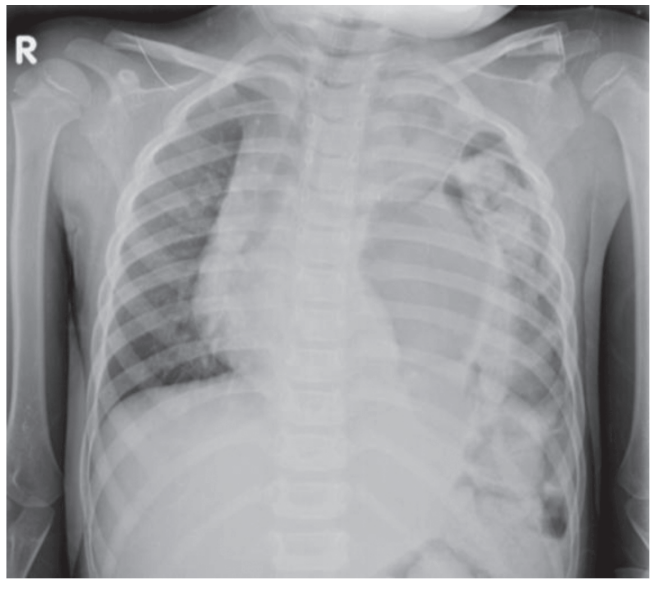

Figure 3 chest radiography shows a dilated stomach and the transverse colon herniated into the left thoracic cavity and mediastinum shift to contralateral side

Table 2 the summarized of clinical presentation, treatment and outcome in tension gastrothorax

Clinical presentation and outcmoes	Case 1	Case 2	Case 3
Mechanism of injury	Blunt	Blunt	Blunt
Age	15 year-old	58 year-old	3 year-old
Associated injury	Pelvic fracture Urologic injury Liver, spleen, colon injury	Pelvic fracture Urologic injury Lower extremity fractrue	Pelvic fracture
Oxygenation at ED	Hypoxemia	Hypoxemia	Hypoxemia
Hemodynamic at ED	Unstable	Unstable	Unstable
Diagnosis modality	Chest X ray	Chest X ray	Chest X ray
Miss diagnosis at ED	Yes (Tension pneumothorax)	No	No
Gastric decompression at ED	No (miss diagnosis)	No (unsuccessful insertion)	No
Surgical treatment	Yes (Repair diagram, bladder and temporary abdominal closure)	Yes (cardiac arrest at operative theater)	Yes (Repair diaphragm)
Treatment outcomes	Survive	Non-survive (massive bleeding, cardiac arrest)	Survive

ED, emergency department

used for stabilization of the patient. However, this intervention might be non-success due to tube kinking and insertion difficulty. The emergency laparotomy for reduction of visceral organs is the treatment of choice. This is the life-saving procedure especially in case of decompression failure with nasogastric tube.

Discussion

Bedside traumatic patients, the tension gastrothorax could be found in others conditions such as a congenital diaphragmatic hernia, a large hiatal hernia and also after thoracoabdominal surgery[3,11,12]. Regarding the trauma cases, the incidence of tension gastrothorax accounted for 6 percent of diaphragmatic injuries in our database. acute post-traumatic tension gastrothorax are mostly associated with blunt mechanism[3-10]. Delayed tension gastrothorax could be found in both blunt and penetrating injuries including postsurgical repairment[1,2,11-22].

In our series, all of the post-traumatic tension gastrothorax were associated with high-speed vehicle collisions. These might be a result of a large force impact on the anterior abdominal wall which lead to an abrupt increase in intra-abdominal pressure and a high-pressure gradient across the diaphragm. The diaphragm is the weakest point of abdominal cavity and these high pressure results in a large diaphragmatic laceration especially on left sided diaphragm[5]. In normal physiology the intrathoracic pressure is usually negative and pressure in abdomen is higher than thoracic cavity. When the diaphragm has a defect, visceral organs would be sucked and herniated from the abdominal cavity into the thoracic cavity. The most common herniated organ is the stomach[3]. A distended stomach can then cause lung collapse and increase intrathoracic pressure. These result in patients developing dyspnea and hypoxia. The cardiovascular collapse in tension gastrothorax may result from mediastinal shift as well as massive bleeding due to associated organ injuries especially in pelvic fracture. In our series, the symptom of dyspnea, hypoxia and hypotension are clinical presentations of acute post-traumatic tension gastrothorax which mimics tension pneumothorax[3,5-8,10].

Although audible bowel sounds in the chest help to diagnose intra-abdominal organ herniation but it is rarely detected[1,6,19,20]. Chest radiography is a useful for diagnosis. The hallmark findings for diagnosis are the loss of diaphragmatic outline and a large gastric shadow occupying in the left thorax with mediastinal shift to the right[5,6]. (Table 3)

Table 3 Hallmark to suspect traumatic tension gastrothorax

Severe mechanism of injury (mostly in blunt)
Unstable hemodynamic and respiratory compromise
Severe associated injuries (mostly having pelvic fracture)
Audible bowel sounds in chest examination (rare)
Chest X ray diagnostic signs
- Loss of diaphragmatic outline
- Large gastric shadow occupying in the left thorax
- Mediastinal shift to the right
Symptom improve after gastric decompression

The definitive treatment is the emergency laparotomy for reduction of the visceral organs and repair of the diaphragmatic injury[4-7,9,10]. However, in patients with severe unstable hemodynamics, nasogastric decompression is an essential procedure but may be nonsuccess due to tube kinking and tube could not be reach to stomach because of stuck with lower esophageal sphincter at diaphragmatic level[3,4].

Another decompression procedure may be considered if nonsuccess nasogastric decompression, such as needle thoracenthesis and insertion of a chest drain.[3,5-7,17].

The most common cause of death in diaphragmatic injuries is massive bleeding due to associated injuries but tension gastrothorax may aggravate the cause of death due to the promotion of cardiovascular collapse by mediastinal instability.

Conclusion

Acute post-traumatic tension gastrothorax should be considered following high speed vehicle crashes with multiple injuries. Patients present with hypoxia, shock and decreased breath sound in left hemithorax which may mimic tension pneumothorax. Chest radiography is useful for diagnosis and emergency laparotomy for reduction of the visceral organs with repair of the diaphragmatic injury are the treatments of choice. In severe hemodynamic instability, nasogastric decompression is necessary as initial intervention. However, this might be nonsuccess due to tube kinking and stuck with lower esophageal sphincter.

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บทคัดย่อ **ภาวะแรงดันสูงในช่องอกจากกระเพาะเคลื่อนเข้าสู่ช่องอกและโป่งตัวในการบาดเจ็บของกะบังลม: อุบัติการณ์และกลุ่มผู้ป่วยในศูนย์อุบัติเหตุระดับ 1 ของโรงพยาบาลมหาวิทยาลัยทางภาคเหนือของประเทศไทย**

ธิดารัตน์ จิระพงศ์เจริญลาภ, นเรนทร์ โชติรสนิรมิต, กวีศักดิ์ จิตตวัฒนรัตน์, กำธน จันทร์แจ่ม
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ภูมิหลัง: ภาวะกระเพาะเคลื่อนเข้าสู่ช่องอกและโป่งตัวจนทำให้เกิดแรงดันสูงในช่องอกเป็นภาวะแทรกซ้อนที่พบได้น้อยแต่เป็นภาวะคุกคามแก่ชีวิตในผู้ป่วยที่มีการบาดเจ็บของกะบังลม อย่างไรก็ตาม ไม่เคยมีรายงานภาวะดังกล่าวในประเทศไทย ดังนั้น การศึกษานี้มีวัตถุประสงค์เพื่อหาอุบัติการณ์และบรรยายภาวะกระเพาะเคลื่อนเข้าสู่ช่องอกและโป่งตัวจนเกิดแรงดันสูงในช่องอกในสถานพยาบาลของผู้วิจัย

วิธีการศึกษา: ผู้วิจัยได้ทบทวนผู้ป่วยจากฐานข้อมูลของศูนย์อุบัติเหตุระดับ 1 ของโรงพยาบาลมหาวิทยาลัยในภาคเหนือระยะเวลา 5 ปี โดยทำการเก็บข้อมูลพื้นฐาน กลไกการบาดเจ็บ ภาพถ่ายรังสี โดยผู้วิจัยได้บรรยายลักษณะและสรุปผลป่วยที่มีภาวะดังกล่าว

ผลการศึกษา: ระหว่างระยะเวลา 5 ปี มีผู้ป่วยที่มีการบาดเจ็บของกะบังลมจำนวน 53 ราย และพบว่ามีเพียง 3 ราย (ร้อยละ 5.7) ที่มีภาวะกระเพาะเคลื่อนเข้าสู่ช่องอกและโป่งตัว ผู้ป่วยเหล่านี้มีกลไกการบาดเจ็บที่เหมือนกัน (การกระแทกจากอุบัติเหตุการจราจรที่ใช้ความเร็วสูง) ผู้ป่วยเหล่านี้มีการบาดเจ็บของกระดูกเชิงกรานร่วมด้วยทุกราย และสามารถทำการวินิจฉัยจากภาพถ่ายรังสี ผู้ป่วย 1 รายให้การวินิจฉัยผิดในครั้งแรกเป็นลมในช่องหุ้มปอด การใส่สายจมูกเพื่อลดขนาดของกระเพาะอาหารเป็นการรักษาเบื้องต้นระหว่างทำการช่วยชีวิต การผ่าตัดฉุกเฉินเป็นสิ่งที่จำเป็นในผู้ป่วยที่ภาวะไหลเวียนและการหายใจผิดปกติรวมถึงไม่สามารถลดขนาดกระเพาะได้จากการใส่สายจมูก

สรุป: ภาวะกระเพาะเคลื่อนเข้าสู่ช่องอกและโป่งตัวเป็นภาวะที่คุกคามแก่ชีวิตที่พบได้น้อยการบาดเจ็บของกะบังลม การกระแทกที่รุนแรงร่วมกับกระดูกเชิงกรานหักเป็นกลไกที่พบได้บ่อยและการบาดเจ็บที่พบร่วมกัน การใส่สายจมูกเข้าไปกระเพาะอาหารเพื่อลดขนาดเป็นการรักษาเบื้องต้นในระหว่างการช่วยฟื้นชีพ