# Significance of a Widened Mediastinum in Blunt Chest Trauma Patients

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**Abstract**

Eighteen blunt chest trauma patients who had mediastinal widening on chest roengenogram were studied for the correlation with traumatic ruptured of the aorta or its major branches. Seventeen patients were male and one was female. The age ranged from 18 to 39 years, mean 26.17± 6.85SD. The Injury Severity Score (ISS) ranged from 9 to 34, mean 25.5±6.49SD. Fourteen patients (77.8%) sustained motorcycle accidents, 3 patients (16.7%) sustained car accidents and 1 patient (5.5%) fell from a 4 storey building. All patients underwent aortography to search for traumatic rupture of the aorta or its major branches. Six patients had computed tomography of the chest before aortography. Nine patients (50%) had normal aortography. The remaining 9 patients who had positive aortography underwent urgent thoracotomies, 8 of them had traumatic rupture of the aorta or its major branches, the remaining 1 patient had normal operative finding. Of the 8 patients who had traumatic rupture of the aorta or its major branches, 1 patient died. The mortality was 12.5 per cent.

The rate of traumatic rupture of the aorta or its major branches in patients who had blunt chest trauma and widening of the mediastinum on chest roengenogram in our study was 44.4 per cent. The sensitivity of aortography for diagnosis of traumatic rupture of the aorta or its major branches was 100 per cent and the specificity was 90 per cent. On the basis of this study, we conclude that blunt chest trauma patients with widened mediastinum on chest roengenogram have a significantly high rate of traumatic rupture of the aorta or its major branches. All blunt chest trauma patients who have widened mediastinum on chest reongenogram should undergo further investigations to exclude traumatic rupture of the aorta or its major branches. We recommend aortography as the investigation of choice due to its accuracy and usefulness in management plan.

**Key word :** Widened Mediastinum, Blunt Chest Trauma, Traumatic Rupture of the Aorta, Aortography

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Traumatic rupture of the thoracic aorta and its major branches are catastrophic sequelae following blunt chest trauma. It has been estimated that 80 per cent to 90 per cent of patients with rupture of the thoracic great vessels, particularly the aorta, due to blunt chest trauma die at the scene and up to 50 per cent of the remaining patients will die within 48 hours if not properly treated[1]. Therefore, early diagnosis and prompt treatment is extremely important for survival of these seriously injured patients. Currently, aortography is still the gold standard for definite diagnosis of this entity[2-4]. Since aortography is an invasive procedure which requires special equipment and personnel and could be dangerous for critically injured patients who are not adequately resuscitated in the angiography suite, selection of patients for such a procedure remains an important decision to make. The indications for performing aortography vary from institute to institute. Among them, widening of the mediastinum on chest roengenogram which is one of the most frequent radiological findings suggestive of traumatic rupture of the aorta is commonly used as an indication for further investigation including aortography. The percentage of positive aortography in patients with widened mediastinum has been reported from 10 per cent to 20 per cent[5]. In Thailand, significance of the widened mediastinum in blunt chest trauma in association with intrathoracic great vessels injury has not been previously studied. The purpose of this study was to examine the significance of widened mediastinum on chest roengenogram in blunt chest trauma patients in a teaching hospital in Bangkok, Thailand.

## PATIENTS AND METHOD

This is a retrospective study of blunt chest trauma patients with a widened mediastinum on chest roengenogram who were admitted to Chulalongkorn Hospital, Bangkok, Thailand from August 1994 to December 1998. During the study period, all stable patients who had widened mediastinum on chest roengenogram were sent to the angiography suite for aortography to exclude traumatic rupture of the aorta or its major branches. Some patients were sent for computed tomography (CT scan) of the chest before obtaining aortography. The "widened mediastinum" on chest roengenogram was defined as 1. widening of the superior mediastinum of more than 8.0-8.5 centimeters, 2. abnormal appearance of the mediastinum or "funny looking" mediastinum in spite of a mediastinum width of less than 8.0 centimeters. The chest roengenogram was either posteroanterior view or anteroposterior view depending on the patient's condition. When traumatic rupture of the thoracic aorta or its major branches was diagnosed from aortography, urgent thoracotomies were subsequently performed. For patients who had normal aortography further hospitalization depended on the necessity to treat the associated injuries.

## RESULTS

During the study period (53 months), 18 patients were entered into the study. Seventeen patients were male and 1 was female. The age ranged from 18 to 39 years, mean 26.17 ± 6.85 SD. The Injury Severity Score (ISS) ranged from 9 to 34, mean 25.5 ± 6.49 SD. Fourteen patients (77.8%) sustained motorcycle accidents, 3 patients (16.7%) sustained car accidents and 1 patient (5.5%) fell from a 4 storey building. All patients had multiple injuries and details of the associated injuries apart from the widened mediastinum are shown in Table 1. Six patients underwent computed tomography (CT scan) of the chest before obtaining aortography, all of them had mediastinal hematoma on CT scan but inconclusive for the diagnosis of traumatic rupture of the aorta or its major branches. Two of them were subsequently diagnosed as traumatic rupture of the proximal descending aorta from aortography and operation. Nine patients (50%) had normal aortography. The remaining 9 patients were diagnosed as having traumatic rupture of the aorta or its major branches and they all underwent urgent thoracotomy. Five patients had traumatic rupture of the proximal descending aorta. One patient had traumatic rupture of the proximal descending aorta and proximal left subclavian artery. Two patients had traumatic rupture of the proximal innominate artery. The remaining 1 patient had normal operative finding. The false aneurysm-like appearance of the proximal descending aorta on aortography in this patient was subsequently reviewed by an experienced radiologist as "the ductus bump" or "diverticulum" which is the normal variant of the aortic arch at the insertion of the ligamentum arteriosum. Details of the injuries and treatments are shown in Table 2. Our study demonstrated that 44.4 per cent of blunt chest trauma patients with widened mediastinum on chest roengenogram had traumatic rupture of the aorta or its major branches. The sensitivity of aortography for diagnosis of traumatic rupture of the

**Table 1. Age, sex, causes of injury, injury severity score (ISS) and associated injuries apart from widened mediastinum.**

| Patient Number | Age | Sex | Causes of injury | ISS | Associated injuries |
|---|---|---|---|---|---|
| 1. | 19 | male | MCA | 29 | 1. hemothorax 2. multiple long bone fractures |
| 2. | 36 | male | CA | 29 | 1. hemothorax 2. multiple rib fractures 3. long bone fractures |
| 3. | 26 | male | MCA | 18 | 1. head injury 2. spine fractures 3. long bone fractures |
| 4. | 39 | male | MCA | 17 | 1. hemothorax 2. head injury 3. multiple rib fractures |
| 5. | 18 | male | MCA | 17 | 1. multiple soft tissue injuries |
| 6. | 29 | female | MCA | 25 | - |
| 7. | 17 | male | MCA | 27 | 1. head injury 2. hemothorax 3. multiple rib fractures 4. cardiac contusion 5. splenic injury |
| 8. | 26 | male | fall | 22 | 1. hemothorax 2. long bone fractures 3. liver injury |
| 9. | 25 | male | CA | 27 | 1. head injury 2. long bone fractures 3. spine fractures |
| 10. | 28 | male | MCA | 27 | 1. long bone fractures 2. spine fractures 3. facial fractures |
| 11. | 20 | male | MCA | 34 | 1. hemothorax 2. multiple rib fractures 3. facial fractures 4. spine fractures 5. cord transection |
| 12. | 18 | male | CA | 29 | 1. head injury 2. long bone fractures |
| 13. | 27 | male | MCA | 29 | 1. lung contusion 2. long bone fractures |
| 14. | 38 | male | MCA | 29 | 1. hemothorax 2. long bone fractures |
| 15. | 25 | male | MCA | 9 | 1. hemothorax |
| 16. | 28 | male | MCA | 28 | 1. hemothorax 2. multiple rib fractures |
| 17. | 32 | male | MCA | 29 | 1. hemothorax 2. multiple rib fractures 3. long bone fractures 4. spine fractures 5. cord transection |
| 18. | 20 | male | MCA | 34 | 1. multiple rib fractures 2. long bone fractures 3. pelvic fractures |

* MCA = motorcycle accident, CA = car accident

**Table 2. Operative findings, treatments and results.**

| Patient Number | Injuries | Treatments | Results |
|---|---|---|---|
| 1. | Proximal descending aorta | 16 mm Dacron graft | Alive |
| 2. | Proximal descending aorta | 18 mm Dacron graft | Alive |
| 5. | Proximal innominate artery | 10 mm Dacron graft | Alive |
| 6. | Proximal descending aorta and proximal left subclavian artery | Attempted repair | Dead |
| 12. | Proximal innominate artery | 8 mm Dacron graft | Alive |
| 13. | Proximal descending aorta | 18 mm Dacron graft | Alive |
| 14. | Proximal descending aorta | patch aortoplasty | Alive |
| 18. | Proximal descending aorta | 18 mm Dacron graft | Alive |

aorta or its major branches was 100 per cent and the specificity was 90 per cent.

One patient in this study died. This patient had combined traumatic rupture of the proximal descending aorta and proximal left subclavian artery. The patient died from uncontrollable hemorrhage during attempted proximal control of the injured aorta. All patients who survived the operation had uneventful recovery. The mortality rate was 12.5 per cent.

## DISCUSSION

Traumatic rupture of the aorta or its major branches is an extremely dangerous sequelae of blunt chest trauma. Most reported cases of blunt thoracic aortic injury are secondary to motor vehicle accidents[3]. However, most patients in our study sustained injuries from motorcycle accidents as the motorcycle is a popular vehicle in Bangkok owing to its convenience for travelling in traffic congested streets.

It has been estimated that of the 10 per cent to 20 per cent of patients with thoracic aorta injuries who survive long enough to reach a hospital, approximately 30 per cent of these patients will succumb within 6 hours if proper diagnosis and treatment are not undertaken[6]. The seriousness of this entity is underscored by the fact that some patients who did not arrive in the emergency room in extremis died before reaching the operating room for definitive treatment[7]. Time is essentially a critical factor in the management of traumatic rupture of the aorta or its major branches. It has been generally accepted that a high index of suspicion is the cornerstone for survival of these patients.

Although an accurate history and physical examination are an important part in the initial assessment of the trauma patient, the majority of patients with traumatic rupture of the aorta or its major branches have no obvious clinical symptoms and signs. Many studies have shown that more than 90 per cent of patients with traumatic rupture of the aorta or its major branches had widened mediastinum on chest roengenogram[8-11]. However, the reported positive rate of aortography in patients with widened mediastinum on chest roengenogram is in the range of 10 per cent to 20 per cent[10,12,13]. In the current study, 44.4 per cent of patients who had widened mediastinum following a blunt chest trauma had traumatic rupture of the aorta or its major branches. This relatively high rate of great vessels injury was obtained in spite of our liberal policy to include all the abnormal mediastinal shadows on chest roengenograms as widened mediastinum. Although there are some other roengenographic signs indicative of traumatic rupture of the aorta or its major branches such as blunting of the aortic knob, apical caping, deviation of the nasogastric tube to the right, deviation of the bronchus, we believe that widening of the mediastinum is the easiest to interpret and is the most constant sign for suspicion of traumatic rupture of the aorta or its major branches. The liberal interpretation of a mediastinal shadow as "widening" and thus performing further investigations is important for the safety of the patient's life.

Appropriate investigations for diagnosis of traumatic rupture of the aorta or its major branches are also currently an interesting issue. Transesophageal echocardiography (TEE) and CT scan has been recommended by some investigators for initial evaluation of this entity[14-17]. Aortography has long been the "gold standard" with a sensitivity and specificity approaching 100 per cent[2-4,18]. Our study supports the use of aortography for evaluation of traumatic rupture of the aorta or its major branches with a sensitivity and specificity of 100 per cent and 90 per cent respectively. Some patients in our study underwent CT scan of the chest before aortography (6 out of 18). All of them had inconclusive results and had to undergo subsequent aortography. We feel that aortography is superior to other investigations both for diagnosis and management plan in patients suspected of traumatic rupture of the aorta or its major branches.

In conclusion, widening of the mediastinum on chest roengenogram of blunt chest trauma patients is a good indicator for further diagnostic procedures to exclude traumatic rupture of the aorta or its major branches. Since diagnosis and management of this entity require facilities which are available only in large well equipped hospitals in Thailand, we strongly recommend that stable blunt chest trauma patients with a widened mediastinum in hospitals with limited facilities should be immediately transferred to a well equipped hospital for further investigations and timely treatment of traumatic rupture of the aorta or its major branches. For suitable investigations for definite diagnosis, our data supports the use of aortography which is both accurate and useful in management plan.

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# ความสำคัญของการเห็นเงา mediastinum กว้างเมื่อถ่ายภาพรังสีทรวงอกในผู้ป่วยที่รับบาดเจ็บต่อทรวงอกจากแรงกระแทกภายนอก

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ได้รายงานถึงความสัมพันธ์ระหว่างการเห็นเงา mediastinum กว้างจากการถ่ายภาพรังสีทรวงอกกับการบาดเจ็บต่อหลอดเลือดแดงใหญ่ในช่องอกในผู้ป่วย 18 ราย ที่ได้รับบาดเจ็บต่อทรวงอกจากแรงกระแทกภายนอก ผู้ป่วยเป็นเพศชาย 17 ราย เพศหญิง 1 ราย ช่วงอายุอยู่ระหว่าง 18 ปี ถึง 39 ปี เฉลี่ย 26.17 ± 6.85SD Injury Severity Score (ISS) อยู่ระหว่าง 9 ถึง 34 เฉลี่ย 25.5 ± 6.49SD ผู้ป่วย 14 ราย (ร้อยละ 77.8) ได้รับอุบัติเหตุรถจักรยานยนต์ ผู้ป่วย 3 ราย (ร้อยละ 16.7) ได้รับอุบัติเหตุรถยนต์ และผู้ป่วย 1 ราย (ร้อยละ 5.5) ตกจากตึก 4 ชั้น ผู้ป่วยทุกรายได้รับการทำ aortography เพื่อตรวจหาการบาดเจ็บต่อหลอดเลือดแดงใหญ่ในช่องอก ผู้ป่วย 6 ราย ได้รับการทำเอ็กซเรย์คอมพิวเตอร์ของช่องอกก่อนทำ aortography ผู้ป่วย 9 ราย มีผล aortography ปกติ ผู้ป่วยอีก 9 ราย ที่เหลือมี aortography ผิดปกติ และได้รับการผ่าตัด thoracotomy ซึ่งพบว่า 8 ราย มีการบาดเจ็บต่อหลอดเลือดแดงใหญ่ในช่องอกส่วนอีก 1 รายไม่พบความผิดปกติ มีผู้ป่วยที่ได้รับการผ่าตัดซ่อมแซมการบาดเจ็บต่อหลอดเลือดแดงใหญ่ในช่องอกเสียชีวิต 1 ราย คิดเป็นอัตราตายร้อยละ 12.5

จากผลการศึกษาดังกล่าวพบว่าผู้ป่วยที่ถ่ายภาพเอ็กซเรย์ทรวงอกพบว่า มี mediastinum กว้างมีถึงร้อยละ 44.4 ที่มีการบาดเจ็บต่อหลอดเลือดแดงใหญ่ในช่องอก และความไว (sensitivity) ของ aortography ที่จะวินิจฉัยการบาดเจ็บต่อหลอดเลือดแดงใหญ่ในช่องอก สูงถึงร้อยละ 100 โดยมีความจำเพาะ (specificity) ร้อยละ 90

ผู้รายงานมีความเห็นว่าผู้ป่วยที่ได้รับบาดเจ็บที่ทรวงอกจากแรงกระแทกภายนอกที่ถ่ายภาพเอ็กซเรย์ทรวงอกพบว่ามี mediastinum กว้าง ควรได้รับการทำ aortography เพื่อตรวจหาการบาดเจ็บต่อหลอดเลือดแดงใหญ่ในช่องอกแต่เนิ่น ๆ aortography เป็นการตรวจที่มีความไวและความจำเพาะสูงและยังช่วยในการวางแผนการผ่าตัดได้เป็นอย่างดีถ้าพบการบาดเจ็บต่อหลอดเลือดแดงใหญ่ในช่องอก

**คำสำคัญ** : การเห็นเงาเมดิแอสตินั่มกว้างจากการถ่ายภาพรังสีทรวงอก, การบาดเจ็บต่อทรวงอกจากแรงกระแทกภายนอก, การบาดเจ็บต่อหลอดเลือดแดงใหญ่ในช่องอก, เออร์โตกราฟี่

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