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Diagnostic value of mediastinal/chest ratio in acute traumatic aortic injury

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ABSTRACT:

Background: This study aimed to assess the diagnostic efficacy of mediastinum/chest-width ratio (MCR) derived from chest X-rays (CXR) in detecting acute traumatic aortic injury (ATAI) after blunt chest trauma. We compared MCR with standard mediastinal width for ATAI screening.

Method: All adult patients with blunt chest trauma who underwent screening CXR due to suspected ATAI in Chiang Mai University Trauma Center between 2008 and 2022 were included. Definitive diagnosis was confirmed through computerized tomographic angiography (CTA). The diagnostic performance of MCR at the aortic knob level and carina level was evaluated using the Area under the Receiver Operating Characteristic (AuROC) curve.

Result: 421 patients were enrolled, consisting of 357 men and 64 women. 37 patients (8.7%) were diagnosed with the ATAI based on CTA findings. MCR values at the aortic knob level and carina level were significantly higher in ATAI group (0.35±0.05 vs. 0.31±0.04; $p < 0.001$ and 0.37±0.06 vs. 0.33±0.41; $p < 0.001$, respectively). The AuROC of MCR was significantly superior to that of mediastinal width at both measurement levels. AuROC further improved when considering patient age, presence of multiple organ injuries, aortopulmonary opacification on CXR, and MCR at the threshold of 0.35 for aortic knob level and 0.36 for carina level, without statistically significant difference.

Conclusion: MCR can be used as one of the complementary diagnostic tools for ATAI in blunt chest trauma. Combining MCR with other clinical predictors can further enhance its accuracy. However, it cannot replace direct measurement of mediastinal width as a standard screening tool for blunt ATAI cases.

Keywords: Widened mediastinum; Mediastinal chest width ratio; Blunt chest trauma; Aortic injury; Traumatic aortic injury

INTRODUCTION

Acute traumatic aortic injury (ATAI) represents a significant and often fatal injury associated with multiple trauma. It ranks as the second leading cause of mortality, following head injuries, in motor vehicle accidents, with more than 85% of cases resulting in death at the scene [1, 2]. Patients suffering from ATAI typically present with unstable vital signs, and the associated mortality rate ranges from 90% to 98%. However, timely and appropriate treatment can increase the survival rate to 60-70%.

A retrospective analysis conducted at the Trauma Center of Chiang Mai University Hospital, spanning from January 2008 to January 2022, revealed an ATAI incidence of 0.65%, with a mortality rate of 23.4%. The study also noted a significant increase in annual medical treatment expenses. Given the high mortality and associated costs, the rapid initiation of management protocols becomes crucial in reducing morbidity and mortality.

The mechanisms behind blunt severe vessel injuries involve shear forces due to the relative mobility of a vessel segment adjacent to a fixed portion, vessel compression between bony structures, and significant intraluminal hypertension during the traumatic event.

Numerous case series and retrospective studies on traumatic aortic injuries have been published. These studies have consistently identified the thoracic aorta as the most commonly affected site in blunt traumatic aortic injuries, followed by the innominate artery, pulmonary veins, and vena cava. Among aortic injuries, the proximal descending aorta accounts for approximately 56%, the ascending aorta and transverse arch for 10-14%, the mid-distal descending aorta for 12%, and multiple sites for 13-15% [3].

Several radiographic findings associated with blunt injuries of the descending thoracic aorta have been identified through chest anteroposterior (AP) supine radiographs. These findings include a widened mediastinum (90.9%), left bronchus lowering (27.7%), pleural apical cap (18.18%), blurred aortic knob (7%), and tracheal deviation (3%) [4, 5]. The computed tomography angiography (CTA) served as the gold standard diagnostic tool for assessing ATAI, demonstrating a remarkably high sensitivity, nearing 100%, coupled with a specificity exceeding 80% [6-8]. At our trauma center, CTA is triggered not only by radiographic mediastinal widening but also by high-risk mechanisms and physician clinical suspicion — for example, high-energy deceleration injuries (high-speed motor vehicle collisions, patient ejection), significant falls, or multiple-organ trauma. This combined approach aligns with widely accepted recommendations to use CTA liberally for patients with high-energy mechanisms or abnormal initial imaging when blunt thoracic aortic injury is suspected.

We evaluated the mediastinum-to-chest width ratio (MCR) — defined as the mediastinal width divided by the maximal intrathoracic chest width on the same AP-supine radiograph — at the aortic knob and carina. Conceptually, MCR may outperform absolute mediastinal width because it normalizes for patient body habitus and radiographic magnification/projection, both of which can inflate absolute width and reduce specificity in the trauma setting.

KEY MESSAGES:

- The mediastinal-to-chest width ratio (MCR) on CXR demonstrated superior diagnostic accuracy compared to mediastinal width alone in detecting ATAI.
- Optimal diagnostic thresholds were identified as MCR ≥0.35 at the aortic knob and ≥0.36 at the carina level.
- Combining MCR with clinical factors such as patient age, multiple organ injury, and aortopulmonary opacification further improved diagnostic performance, supporting its role as a complementary tool but not a replacement for standard screening methods and CTA confirmation.

MATERIALS AND METHODS

This study received approval from the local Clinical Research Ethics Committee of the Faculty of Medicine at Chiang Mai University, Thailand. (SUR-2567-0212)

This research adopted a diagnostic accuracy cross-sectional study design and utilized data from the Trauma Center and medical records of patients admitted to the trauma unit of Chiang Mai University Hospital. The study period encompassed data from January 2008 to January 2022. The study included all patients who suffered blunt chest injuries and were suspected of having ATAI. These patients underwent both a chest X-ray (CXR) in the AP supine position and a chest CTA.

Patients meeting any of the following criteria were excluded from the study: those with penetrating chest trauma, non-traumatic conditions, age below 15 years, a history of thoracic surgery or radiation therapy involving the chest wall, thoracic aortic aneurysm, aortic dissection, mediastinal diseases, pericardial effusion, cardiomyopathy, collapsed lung consolidation, central lung diseases obstructing the mediastinum, steroid use, mediastinal mass, mediastinal lipomatosis, and significant rotation in the chest radiograph AP supine.

Standard screening protocol: Suspected ATAI for the purposes of this study was defined by the trauma team trigger for CTA: (1) radiographic mediastinal widening exceeding eight centimeters on AP-supine chest radiograph at the aortic knob or carina, or high-risk mechanism or clinical concern (for example: high-speed deceleration injury, patient ejection from vehicle, fall from significant height, or presence of multiple-organ injuries) as judged by the treating physician. Patients meeting any of these criteria proceeded to contrast-enhanced chest CTA, which served as the reference standard. This approach follows established trauma imaging recommendations endorsing CT for high-energy mechanisms and abnormal radiographs.

Data information was retrospectively collected from the patients' medical records, including age, gender, weight, height, underlying medical conditions, mechanism of injury, The body mass index (BMI) was automatically calculated using the standard formula: weight divided by height squared (kg/m^2). The chest radiographs were evaluated by the single-blinded radiologist for mediastinal width measurements at the carina and aortic knob levels, chest width, and MCR. The results of the chest CTA were collected as the final diagnosis.

The primary objective of this study was to assess the diagnostic utility of the MCR derived from CXR in detecting ATAI among patients with blunt chest trauma by comparing mediastinal width measurements. Additionally, the study aimed to determine the optimal cut-off value for MCR in identifying ATAI among patients with blunt chest trauma.

Continuous data in the baseline characteristics were presented as mean ± standard deviation (SD), while categorical data were presented as numbers and percentages. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), diagnostic accuracy, positive likelihood ratio, and receiver operating characteristic (ROC) curves were calculated for mediastinal width measurements at the carina and aortic knob levels when exceeding 8 cm. Logistic regression analysis was employed to identify factors associated with ATAI. Data analysis was conducted using the STATA program version 11.0.

The authors declared that the ChatGPT AI language model was utilized for grammar correction and sentence improvement in this work. The use of this AI tool does not pose any conflicts of interest regarding the research or its outcomes.

Definitions

ATAI: Refers to acute damage to the thoracic aorta, which spans from the aortic valve to the aortic hiatus in the diaphragm crurae anterior to the T12 vertebral body. This damage may include intimal, medial, or complete laceration, pseudoaneurysm, and hematoma [9]. The diagnostic criteria for identifying ATAI relied upon both direct and indirect signs observed through CTA, establishing it as the standard diagnostic tool [7, 10, 11].

Mediastinum width: Refers to the maximum diameter of the mediastinum, measured at the aortic knob level or carina level in CXR AP supine, as shown in figure 1 [12].

Widened mediastinum: Indicates a superior mediastinal width exceeding 8 cm in CXR AP supine, either at the aortic knob level or carina level [13, 14].

Aortic knob: Denotes the most prominent shadow of the aortic arch in a CXR AP supine [2].

Carina: Refers to a transverse shadow located just above the trachea's bifurcation.

Chest width: Represents the maximum diameter of the thoracic cage, measured from the inner border of both side ribs as shown in Figure 1.

RESULTS

The study included 421 patients, comprising 357 men and 64 women. Within this population, 31 men (83.8%) and 6 women (16.2%) were in the ATAI group, while 326 men (84.8%) and 58 women (15.1%) were in the non-traumatic acute aortic injury group (non-TAI group). The mean

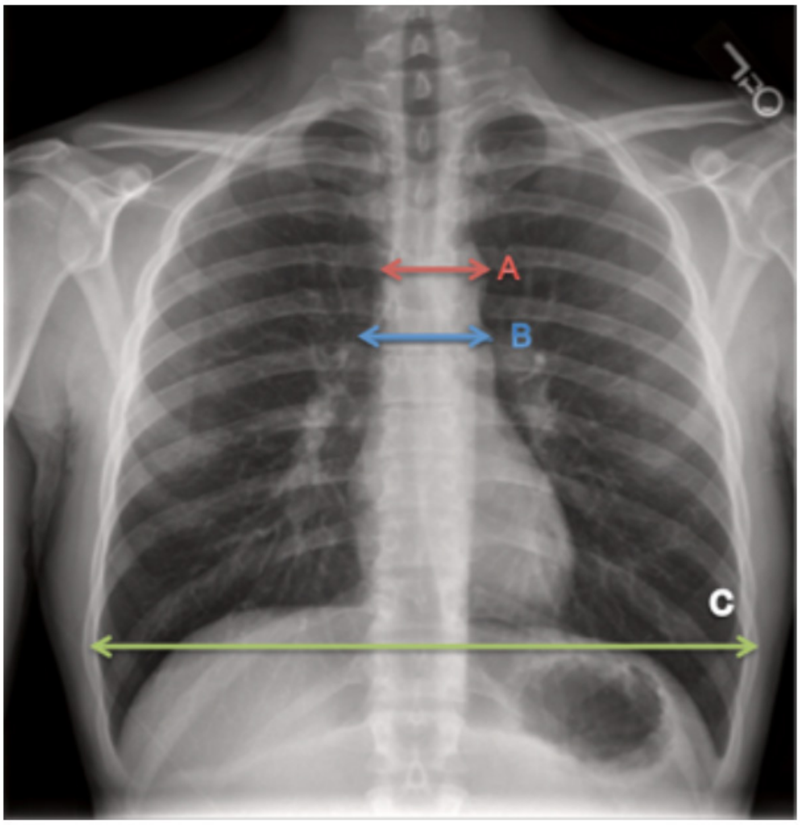

Figure 1. Location of measurement from chest film. A: mediastinal width at the aortic knob level; B: mediastinal width at the carina; C: Chest width.

age was 38.7±13.2 years in the ATAI group and 47.4±16.1 years in the non-TAI group, demonstrating a significant statistical difference.

No significant statistical differences were observed in weight and height between the two groups. Underlying diseases, including hypertension, diabetes mellitus, dyslipidemia, Cushing syndrome, hyperthyroidism, chronic obstructive pulmonary disease, liver cirrhosis, and chronic kidney disease, did not show significant statistical differences between the two groups.

When considering mechanisms of injury, factors such as falls from heights greater than 30 feet, ejection from a car, and multiple organ injuries exhibited significant differences in the ATAI group. However, these findings are preliminary, as the comparisons were based on univariable analysis. Additional baseline patient characteristics are presented in Table 1.

Table 2 highlights radiologic findings comparing both groups. Notably, the MCR, mediastinum width at the aortic knob level and carina level, as well as specific radiologic findings such as irregular aortic knobs, aortic pulmonary opacification, depression of the left mainstem bronchus exceeding 40 degrees, and indistinct contour of the descending thoracic aorta, demonstrated significant differences between the ATAI and non-TAI groups.

Table 3 provides diagnostic indices, including sensitivity, specificity, Area under the Receiver Operating Characteristic (AuROC) curve, and positive likelihood ratio, for various cut-points of the MCR at the aortic knob and carina levels in diagnosing ATAI. The most reliable cut-point number at the aortic knob level was 0.35, as determined by these diagnostic indices. Similarly, at the carina level, the most reliable cut-point number was 0.36.

In order to establish more reliable parameters, we created numerous patterns of combined approaches from every parameter and then tested the accuracy with AuROC. Table 4 presents four established models for detecting ATAI and shows that the combination of MCR ≥ 0.36 at carina levels, patient age, multiple organ injury, and aortopulmonary opacification can improve AuROC up to 0.868 (95%CI; 0.794-0.941). However, Figure 2 illustrates the AuROC curve for diagnosing ATAI for each model and shows no statistically significant differences among the four models (P-value of 0.081).

DISCUSSION

ATAI is not an uncommon occurrence, with a reported incidence of 1.5-2% in patients who experience blunt thoracic trauma [8]. However, trauma patients often present with hemodynamic instability, are uncooperative, or may be unconscious, making diagnosis challenging.

The most crucial aspect of diagnosing ATAI is for the physician to maintain a high index of clinical suspicion at all times, especially in patients with a history and mechanism of injury related to ATAI. Patients in this group often

Table 1. Baseline patient characteristics.

Patient's characteristics	ATAI[a] group (n=37)	Non TAI[b] group (n=384)	P-value
Gender			0.812
Male	31 (83.8)	326 (84.9)	
Female	6 (16.2)	58 (15.1)	
Age (year), Mean ± SD	38.7 ± 13.2	47.4 ± 16.1	0.002
Weight (kg) Mean ± SD	66.4 ± 13.4	66.9 ± 10.1	0.743
Height (m.) Mean ± SD	1.7 ± 0.1	1.7 ± 0.1	1.000
Comorbidities			
Hypertension	8 (21.06)	62 (16.2)	0.363
Diabetic mellitus	2 (5.4)	25 (6.5)	1.000
Dyslipidemia	2 (5.4)	22 (5.7)	1.000
Mechanism of injury			
• Motor vehicle accident	31 (83.8)	280 (72.9)	0.174
• Eject from car	9 (24.3)	45 (11.8)	0.039
• Car crash pedestrian	5 (13.5)	22 (5.7)	0.076
• Fall from height > 30 feet	1 (2.7)	75 (19.5)	0.007
• Car turnover	1 (2.7)	17 (4.4)	1.000
• Overlay from heavy object	0 (0.0)	11 (2.9)	0.609
• Blast injury	0 (0.0)	2 (0.5)	1.000
• Co-death	0 (0.0)	1 (0.3)	1.000
Multiple organ injuries	22 (59.5)	93 (24.2)	<0.001
In hospital death	1 (2.8)	20 (5.2)	1.000

Abbreviations: [a]ATAI: acute traumatic aortic injury; [b]TAI: traumatic aortic injury

Table 2. Radiographic finding between groups and AuROC to diagnose traumatic aortic injury.

Radiographic finding	ATAI[a] (n=37)	Non-TAI[b] (n=384)	p-value	AuROCc (95%CI)
Mediastinal/Chest width Ratio (MCR)				
Aortic knob level	0.35 ± 0.05	0.31 ± 0.04	<0.001	0.693 (0.597-0.788)
Carina level	0.37 ± 0.06	0.33 ± 0.41	<0.001	0.731 (0.633-0.829)
Mediastinal width (cm.)				
Aortic knob level	10.00±1.64	9.33±1.15	0.001	0.611(0.500-0.722)
Carina level	10.70±1.86	9.81±1.27	<0.001	0.631(0.520-0.742)
Irregular aortic knob number (%)	11 (29.7)	36 (9.4)	0.001	0.602(0.525-0.678)
Aorto-pulmonary opacification number (%)	21 (56.8)	34 (8.9)	<0.001	0.740(0.657-0.821)
Rightward displacement of trachea	9 (24.3)	47 (12.2)	0.070	0.560(0.488-0.632)
Depression of left main stem bronchus > 40 degree	7 (18.9)	19 (5.0)	0.004	0.570(0.504-0.635)
Indistinct contour of descending aorta	11(29.7)	30(7.8)	<0.001	0.610(0.534-0.685)

Abbreviations: [a]ATAI, acute traumatic aortic injury; [b]TAI, traumatic aortic injury; [c]AuROC: Area under the receiver operating characteristic

Table 3. Diagnostic indices in each cut-point of MCR[a] to diagnose traumatic aortic injury.

Cut-point	Sensitivity	Specificity	AuROC[b] (95%CI)	Positive likelihood ratio
Aortic knob level				
≥0.33	67.57	62.76	0.652 (0.571-0.732)	1.81
≥0.34	59.46	71.09	0.653 (0.569-0.736)	2.06
≥0.35	51.35	82.29	0.668 (0.584-0.752)	2.9
≥0.36	29.73	88.23	0.590 (0.513-0.666)	2.54
≥0.37	21.62	91.41	0.565 (0.496-0.634)	2.52
≥0.38	18.92	93.75	0.563 (0.498-0.628)	3.03
≥0.39	18.92	95.83	0.574 (0.509-0.639)	4.54
≥0.40	18.92	97.66	0.583 (0.518-0.647)	8.07
≥0.41	18.92	98.7	0.588 (0.523-0.652)	14.53
≥0.42	16.22	98.96	0.576 (0.515-0.636)	15.57
≥0.43	16.22	99.48	0.579 (0.518-0.639)	31.14
≥0.44	13.51	99.48	0.565 (0.509-0.621)	25.95
≥0.45	8.11	99.74	0.539 (0.495-0.584)	31.13
Carina level				
≥0.33	78.38	45.83	0.621 (0.549-0.692)	1.45
≥0.34	75.68	58.07	0.669 (0.594-0.743)	1.8
≥0.35	70.27	69.53	0.699 (0.620-0.777)	2.31
≥0.36	67.57	79.69	0.736 (0.657-0.815)	3.32
≥0.37	48.65	84.11	0.664 (0.580-0.747)	3.06
≥0.38	40.54	84.24	0.639 (0.557-0.721)	3.18
≥0.39	37.84	90.36	0.641 (0.560-0.721)	3.93
≥0.40	29.73	88.36	0.619 (0.543-0.694)	4.96
≥0.41	27.03	95.31	0.612 (0.538-0.685)	5.77
≥0.42	21.62	96.61	0.591 (0.523-0.659)	6.39
≥0.43	16.22	90.5	0.569 (0.509-0.630)	6.92
≥0.44	16.22	98.44	0.573 (0.512-0.634)	10.38
≥0.45	13.51	98.44	0.560 (0.503-0.616)	8.65

Abbreviations: [a]MCR: Mediatinal-to-Chest width Ratio; [b]AuROC: Area under the receiver operating characteristic

Table 4. Combination models for detecting Traumatic aortic injury after blunt trauma.

Patterns of combination model	AuROC[a] (95% CI)
1. Mediastinal width at aortic knob level + age + multiple organ injury + aortopulmonary opacification	0.828 (0.745-0.910)
2. Mediastinal width at carina knob level + age + multiple organ injury + aortopulmonary opacification	0.828 (0.744-0.911)
3. MCR[b] ≥ 0.35 at aortic knob level + age + Multiple organ injury + Aortopulmonary opacification	0.852 (0.777-0.926)
4. MCR[b] ≥ 0.36 at carina level + age + Multiple organ injury + Aortopulmonary opacification	0.868 (0.794-0.941)

Abbreviations: [a]AuROC: Area under the receiver operating characteristic; [b]MCR: Mediastinal/Chest width Ratio

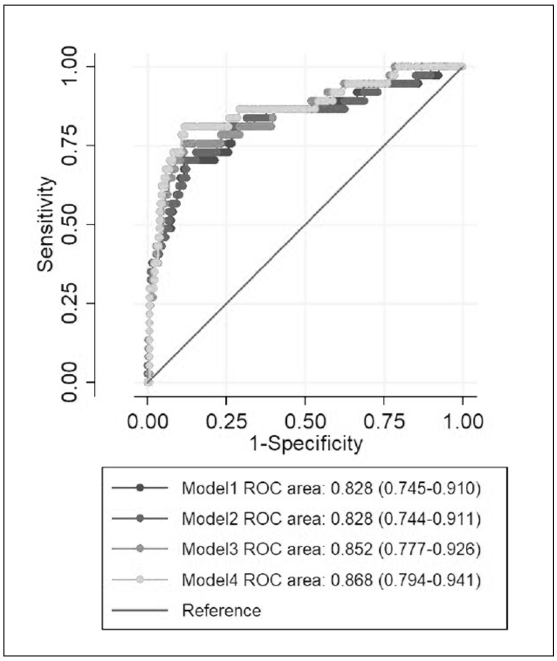

Figure 2. AuROC curve for diagnosis of traumatic aortic injury of each model.
Abbreviations: AuROC: Area under the receiver operating characteristic

sustain multiple injuries, which can make the symptoms or signs of thoracic injury unreliable and less specific. In cases where obtaining a history is possible, whether from witnesses or the patients themselves, it provides insights into the severity of the mechanism of injury. Factors such as the deployment of airbags (if deployed, indicating a direct frontal impact), the use of seatbelts, ejection from the vehicle, deformities in the steering wheel, or the condition of the vehicle involved are all important in assessing the severity of the impact. In cases of falls from heights, the height of the fall itself is significant, with falls greater than 30 feet (11 meters) raising suspicion of ATAI [15].

Although some patients may present with symptoms resembling aortic dissection, such as back-penetrating chest pain, it is often mixed with chest pain resulting from other traumatic injuries. The importance of physical examination findings specific to ATAI is limited. Certain findings may raise suspicion, such as the discovery of fractures that require substantial force to occur (e.g., sternal fractures, flail chest), clear seat belt signs indicating significant deceleration forces, or distinct steering wheel imprints on the chest indicating frontal impact. Physical examination findings, while helpful, may not be definitive in identifying ATAI, especially in patients with multiple injuries and unstable vital signs.

Radiological examination is the primary diagnostic method for this condition, using CXR as the initial diagnostic tool. Patients with ATAI often have severe concomitant injuries. Therefore, chest radiography is typically performed in the supine position (AP supine view). Numerous findings observed in chest radiography can aid in the diagnosis of this condition, such as widening of the mediastinum more than 8 cm, depressing of the left mainstem bronchus more than 140 degree from the trachea, etc. [16]

Widening of the mediastinum is often the most frequently mentioned finding, which can be detected in up to 93% of ATAI patients [17]. It has a negative predictive value of up to 95% [13]. However, it's important to note that the specificity of this radiological finding is very low, making it more suitable as a screening tool. However, it's essential to acknowledge that patients vary in body size, making this measure less accurate in detecting ATAI across different body types. In the realm of medical research, there has also been a valid concern raised regarding the uniform application of an 8 cm fixed mediastinal widening cut-point as a universal standard for all patients [3].

The conventional reference value of mediastinal width, which is commonly set at 8 cm, may not be applicable for the analysis of chest radiographs in the present day. This is because imaging techniques have evolved, including changes in the positioning of the X-ray cassette and the distance between the patient and the radiation source. Gleeson et al. conducted a study and found that the mean mediastinal width measured via CT scan was 6.31 cm. When measuring through conventional radiographic techniques, where the focus-to-film distance (FFD) was approximately 100 cm, the mean mediastinum width was magnified to 7.5 cm. However, in many trauma units, a specialized positioning of the X-ray cassette behind the patient's trolley is used, eliminating the need to move the patient. While the FFD remains the same, the object-to-film distance (OFD), or the distance from the patient to the film, increases. This results in image magnification. On average, measurements from this technique indicated that the average mediastinal width increased to 9.48 cm. However, by increasing the FFD to a range of 140-180 cm and minimizing the OFD to place the film as close to the patient as possible to reduce image magnification, the size could be reduced to an average of 6.92 cm (range 6.76-7.10 cm) [14]. Considering these factors, the reliability of a mediastinal width cutoff at 8 cm is reduced.

In addition to the factors mentioned, the assessment using the MCR can eliminate the effects of image magnification from radiographic techniques as well as differences in patients' body sizes. However, other methods of measurement are still employed. For instance, the measurement of the mediastinal width ratio by Wong et al. [18], which compares the left mediastinal width to the overall mediastinal width, is used. This approach can enhance the predictive value of chest radiographs more effectively than measuring mediastinal width alone.

From our study, we found that the appropriate cut-off values for the MCR at the aortic knob level are 0.35 and 0.36 at the carina level. However, when comparing these values to other studies, the measured values may differ due to variations in measurement methods. For example, Seltzer et al. [19] reported a method for measuring the mediastinal width to chest width ratio at three different positions: Level A at the aortic arch, Level B at the mid-ascending aorta, and Level C at the mid-descending aorta. They found that measuring at Level A with a cut-off value of 0.25 yielded a sensitivity of 95% and a high specificity of up to 75%. The cut-off value obtained from their study does not align with the values measured in our study, primarily because the measurement positions are different. These discrepancies highlight the variability in cut-off values and diagnostic performance depending on the specific study's methodology and patient population. Therefore, it is crucial to consider the context and limitations of each study when interpreting and applying these cut-off values for clinical purposes.

Based on our study, we have identified the most reliable cut-off values for the MCR at all 2 measurement positions by using AuROC diagnostic indices. However, when considering sensitivity and specificity separately, the MCR value at the aortic knob level of 0.35 resulted in a sensitivity of 51.35% and specificity of 82.29%. Similarly, the MCR value at the carina level of 0.36 yielded a sensitivity of 67.57% and a specificity of 79.69%. When compared to previous studies that employed the same measurement method and positions, an MCR of 0.275 provided a sensitivity of 62%, which cannot be equated with the sensitivity of 91% obtained from direct measurement of a widened mediastinum [20]. Therefore, the calculation of MCR appears to be more suitable as an adjunctive diagnostic tool rather than a replacement for the screening tool of direct measurement of a widened mediastinum. These findings align with the study conducted by Marnocha et al. [21], which contradicted the study by Seltzer and colleagues [19]. Despite using the same measurement method and positions, Marnocha et al. [21] reported a sensitivity of 100% but a specificity of only 8%. These discrepancies emphasize the importance of considering multiple factors when determining the diagnostic utility of MCR.

In this study, we identified several factors that can contribute to the diagnosis of ATAI.

Patient Age: We found that patients aged 36 years or older (with a mean age of 38.6±13.2 years) were more likely to have ATAI. Previous studies have suggested that age over 50 years is a predictor of ATAI [22], but they have been unable to establish a direct relationship between age and ATAI. It is possible that older age increases the likelihood of atherosclerotic changes in the thoracic aorta, making it more susceptible to tearing.

Mechanism of Injury: Mechanisms such as falling from a height greater than 30 feet, being ejected from a car, and experiencing multiple organ injuries were associated with an increased risk of ATAI [16]. These mechanisms involve significant force, which can lead to compression of the vessel between bony structures, resulting in increased intraluminal hypertension and subsequent thoracic aortic wall disruption. Rapid deceleration, as seen in acceleration-deceleration injuries, often results in multiple organ injuries. This is consistent with previous research findings.

Radiologic Findings: The use of supine AP CXR as a screening tool for ATAI has been widely discussed in previous literatures [13, 16, 17, 19, 23]. Radiologic findings that raised suspicion for ATAI in our study included aorto-pulmonary opacification, depression of the left mainstem bronchus exceeding 40 degrees, indistinct contour of the descending thoracic aorta, irregular aortic knob, rightward displacement of the trachea, left hemothorax, and direct measurements of mediastinum width.

By combining the parameters mentioned earlier, including medical history, physical examination findings, and chest radiographs, the diagnostic reliability can be significantly enhanced. This study found that the combination of an MCR ≥ 0.36 at the carina level, patient age, the presence of multiple organ injury, and aortopulmonary opacification can improve the AuROC up to 0.868 (95% CI; 0.794-0.941). Although no statistically significant differences were observed among the four different combination patterns studied, this integrated approach holds promise for more accurate diagnoses of mediastinal abnormalities.

These data support a pragmatic screening approach for blunt chest trauma: (1) obtain AP-supine CXR; (2) if mediastinal width is >8 cm or other concerning signs are present, calculate MCR at the aortic knob and carina; (3) MCR ≥0.35 (knob) or ≥0.36 (carina) strengthens the indication for emergent CTA, particularly in patients with high-risk mechanisms, multiple-organ injury, or aortopulmonary opacification. Because sensitivity is modest, sub-threshold MCR should not defer CTA when clinical suspicion remains high.

This study has several limitations, including its retrospective nature, which resulted in some important variables not being available for analysis. Additionally, the data were collected from a single center. We excluded patients with pre-existing thoracic pathology that could alter mediastinal contours. However, we acknowledge that in real-world practice many trauma patients are unconscious, and pre-existing conditions may be unknown. This may reduce test performance in routine practice and underlines the need for broader prospective validation. Therefore, further studies with larger sample sizes and data from multiple centers are warranted to validate and strengthen these findings. The study results may not be a suitable replacement for the use of direct measurement of mediastinal width as a screening tool. This is primarily due to the lower sensitivity observed, even when efforts were made to enhance diagnostic reliability using the AuROC. As such, the primary method for diagnosis remains the use of CTA, which provides a more accurate assessment of mediastinal abnormalities.

CONCLUSION

This study demonstrated that the MCR can serve as an additional diagnostic tool for the detection of ATAI in cases of blunt chest injury with mediastinal widening. Moreover, MCR can be used as one of the complementary diagnostic tools for ATAI in blunt chest trauma cases. Combining MCR with other clinical predictors may further enhance the accuracy of ATAI detection.

CONFIDENTIALITY

I affirm the originality of this manuscript, which has not been previously shared beyond this intended submission. I commit to the journal's confidentiality policies, ensuring all unpublished content, including participant data, is secured and handled ethically and legally. Ethical approval and informed consent from all human participants were secured for this study.

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The authors declared that the ChatGPT AI language model was utilized for grammar correction and sentence improvement in this work. The use of this AI tool does not pose any conflicts of interest regarding the research or its outcomes.

AUTHORS' CONTRIBUTIONS

(I) Conceptualization: Noppon Taksaudom, Chawakorn Leampriboon, Thitipong Tepsuwan, Amarit Phothikun, Apichat Tantraworasin; (II) Data curation: Chawakorn Leampriboon, Yutthaphan Wannasopha, Noppon Taksaudom, Apichat Tantraworasin, Amarit Phothikun, Yutthaphan Wannasopha; (III) Formal analysis: Noppon Taksaudom, Chawakorn Leampriboon, Apichat Tantraworasin, Amarit Phothikun, Thitipong Tepsuwan, Yutthaphan Wannasopha; (IV) Funding acquisition: Noppon Taksaudom; (V) Methodology: Noppon Taksaudom, Chawakorn Leampriboon, Thitipong Tepsuwan, Amarit Phothikun, Apichat Tantraworasin, Yutthaphan Wannasopha; (VI) Project administration: Noppon Taksaudom, Chawakorn Leampriboon, Thitipong Tepsuwan; (VII) Visualization: Noppon Taksaudom, Thitipong Tepsuwan, Chawakorn Leampriboon, Apichat Tantraworasin; (VIII) Writing - original draft: Noppon Taksaudom, Thitipong Tepsuwan, Chawakorn Leampriboon, Amarit Phothikun, Apichat Tantraworasin; (IX) Writing – review & editing: Thitipong Tepsuwan, Noppon Taksaudom, Amarit Phothikun, Apichat Tantraworasin.

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