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Comparison of Diagnostic Value of Clinical Examination and Routine Radiography in Diagnosis of Chest Injury in Stable Blunt Trauma Patients

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ABSTRACT

Introduction: The Stable blunt chest trauma is a common reason for visiting emergency rooms. Patient history and careful clinical examination can provide information similar to CXR at a faster rate and with no complication. This study aimed to compare the results of radiography and clinical examination.

Methodology: This prospective study conducted on 186 stable blunt trauma patients aged 16 and over. The acute injuries of the chest wall evaluated and compared in this study, included rib fracture, sternum fracture, flail chest, pneumothorax, hemothorax, and emphysema. The data were analysed using descriptive statistical tests.

Findings: The mean age of patients participating in this study was 39.63 ± 14.95 years, and 125 patients (67.2%) were male. The most common pathologic finding in the patients' CXR was rib fracture, observed in 45 patients (24.2%). A total of 54 patients had a positive finding and injury diagnosis in CXR, while the total number of positive cases in the clinical examination was 87. The analysis of the results showed that the overall sensitivity, specificity, positive predictive value, and negative predictive value of the clinical examination in the diagnosis of chest injuries in patients with blunt trauma were 94.1%, 72.7%, 58.6%, and 96.9%, respectively.

Conclusion: Although the results of this study suggested the appropriateness and high level of clinical examination sensitivity in the diagnosis of some chest injuries such as rib fracture and sternum fracture, its sensitivity is unacceptable in the diagnosis of some important injuries, such as pneumothorax and hemothorax.

Key words: Stable blunt trauma, Chest X-ray, Clinical examination

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INTRODUCTION

Trauma is currently one of the most common causes of death in people of the age range 1-44 years and the third most common cause of death at all ages [1]. Chest injury is the main reason for 20%-25% of deaths from trauma. Non-life-threatening or stable blunt trauma of the chest is a common cause for referral to emergency departments [2]. Motor vehicle accidents are the major cause of chest injury [3]. According to guidelines of the Advanced Trauma Life Support (ATLS), developed by the American College of Surgeons, chest, lateral neck, and pelvic AP radiography of patients with blunt trauma are essential regardless of the results of clinical examination [3]. In the absence of specific clinical indications, if X-ray not performed, the patient's care will not be interfered with, or the diagnosis of the injury will not be missed or delayed [4]. Posteroanterior chest radiography is a primary and traditional diagnostic test for screening and diagnosing chest injuries [5]. Routine CXR after blunt chest trauma causes unnecessary X-ray radiation. Precise history taking and physical examination in stable patients with blunt chest trauma reveal faster and same information as the CXR [6].

In this study we compare the results of radiographic findings and clinical examinations done by the residents of the emergency department. According to this study if the achieved results were favourable, unnecessary and harmful radiation of patients can be avoided by substituting radiography with clinical examination.

METHODOLOGY

This prospective study conducted on 186 patients aged 16 and over who visited the emergency department of the Shahid Hasheminejad Hospital (trauma center) in Mashhad. The inclusion criteria were blunt chest trauma in awake and alert patients with stable conditions and normal blood pressure, non-hypoxia, non-intubation, and requiring CXR (PA) according to current treatment protocols. The exclusion criteria were a reluctance to participate in the study, shock (systolic blood pressure<90 mmHg and heart rate<100 bpm), hemoptysis, penetrating trauma, GCS<15, pregnancy, inability to cooperate in clinical examination, poor quality X-ray, and the impossibility of re-imaging, and multiple trauma. Acute injuries to the chest which evaluated and compared in this study included rib fracture, sternum fracture, flail chest, pneumothorax, hemothorax, and emphysema. Since CXR is not a screening test for hemopericardium and heart contusion, patients with these injuries excluded from the study. This study conducted at Mashhad University of Medical Sciences with the Ethics Committee code of 920466. At the beginning of the study, the details of the project explained to the patient or his/her companion, and written consent obtained from the patient. Those who refused to participate in the study received the standard routine care.

Patients willing to participate in the project examined by the emergency medical team and residents. The checklist completed for name, surname, gender, file number, initial clinical diagnosis, and mechanism of injury (falling, motor vehicle accident, sport injuries, and assaults). The criteria used to confirm the diagnosis by the physician included chest pain, dyspnea, chest wall damage (scratch, bruise, ecchymosis, lacerate), chest wall tenderness, palpable vibrations, abnormal chest sound, and pain in lateral chest compression. After completing the examination, a PA chest X-ray takes from the patient. The reports of radiographic images were reviewed by a radiologist who was unaware of the study. The data analysed with SPSS-11 (SPSS Inc., Chicago, IL, USA) using descriptive statistical tests.

RESULTS

Acute injuries of the chest included rib fracture, sternum fracture, flail chest, pneumothorax, hemothorax, and emphysema evaluated and compared in this study.

The mean age of patients participating in this study was 39.63 ± 14.95 years. The youngest patient was a 17-year-old and the oldest aged 85 year. As expected, due to the prevalence of trauma in males, most of the patients in this study were male (n=125, 67.2%), while 61 patients (32.8%) were female (Table 1).

Mechanism of injury divided into four categories (fall from a height, direct trauma, fight, and motor vehicle accidents). The main cause of injury was direct trauma (n=61, 32.8%), followed by motor vehicle accidents (n=49, 26.3%), fall from height (n=43, 23.1%), and fight (n=33, 17.7%) (Table 2).

Table 1: Demographic data of patients participating in the study

Age (years)	39.63 ± 14.95	
Gender; Number (%)	**Male**	125 (67.2)
	Female	61 (32.8)

Table 2: Mechanisms of injury

Injury mechanism	Number	Percent
Fall from height	43	23.1
Direct trauma	61	32.8
Fight	33	17.7
Accident	46	26.3

The most common pathologic finding in the patients' chest radiography was rib fracture, seen in 45 patients (24.2%), followed by pneumothorax (n=15), thoracic subcutaneous emphysema (n=11), sternum fracture (n=6), hemothorax (n=5), and flail chest (n=2). A total of 54 patients (29%) had pathologic findings in radiography (Table 3).

Table 3: The radiographic-based diagnosis of patients participating in the study

Disease	Number of positive cases (%)	Number of negative cases (%)	Total number (%)
Rib fracture	45 (24.2)	141 (72.5)	186 (100)
Sternum fracture	6 (3.2)	180 (96.8)	186 (100)
Pneumothorax	15 (8.1)	171 (91.9)	186 (100)
Hemothorax	5 (2.7)	181 (97.3)	186 (100)
Emphysema	11 (5.9)	175 (94.1)	186 (100)
Flail chest	2 (1.1)	184 (98.9)	186 (100)
Total injuries	54 (29)	132 (71)	186 (100)

The most common finding in the patients' clinical examination was also rib fracture, seen in 65 patients (34.9%), followed by pneumothorax (n=18), thoracic subcutaneous emphysema (n=12), sternum fracture (n=6), hemothorax (n=4), and flail chest (n=2). A total of 87 patients (46.8%) had positive findings in clinical examination (Table 4).

Table 4: The clinical examination-based diagnosis of patients participating in the study

Disease	Number of positive cases (%)	Number of negative cases (%)	Total number (%)
Rib fracture	65 (34.9)	121 (65.1)	186 (100)
Sternum fracture	6 (3.2)	180 (96.8)	186 (100)
Pneumothorax	18 (9.7)	168 (90.3)	186 (100)

Hemothorax	4 (2.2)	182 (97.8)	186 (100)
Emphysema	12 (6.5)	174 (93.5)	186 (100)
Flail chest	2 (1.1)	184 (98.9)	186 (100)
Total injuries	87 (46.8)	99 (53.2)	186 (100)

A total of 54 patients had a positive finding in the radiography revealing chest injury, while the total number of positive cases in the clinical examination was 87. The analysis of the results showed that the overall sensitivity, specificity, positive predictive value, and negative predictive value of clinical examination in the diagnosis of chest trauma in patients with blunt trauma were 94.4%, 72.7%, 58.6%, and 96.9%, respectively. The sensitivity and specificity of this method were 93.3% and 82.9% for rib fracture, 54.5% and 96.5% for emphysema, 73.3% and 95.9% for pneumothorax, 40% and 98.8% for hemothorax, and 100% for sternum fracture and flail chest (Table 5 and Table 6).

Table 5: Comparison of the overall results of positive and negative cases of total injury in physical examination and radiography of the chest

Cases	Positive radiography	Negative radiography	Total
Positive clinical diagnosis	51	36	87
Negative clinical diagnosis	3	96	99
Total	54	132	-

Table 6: Evaluation of diagnostic effectiveness of clinical examination by diagnostic indicators

Indicator	Total diagnoses	Rib fracture	Emphysema	Pneumothorax	Hemothorax	Sternum fracture	Flail chest
Sensitivity	94.40%	93.30%	54.50%	73.30%	40%	100%	100%
Specificity	72.70%	82.90%	50%	95.90%	98.80%	100%	100%
Positive predictive value	58.60%	63.60%	50%	61.10%	50%	100%	100%
Negative predictive value	96.90%	97.50%	97.10%	97.60%	98.30%	100%	100%

DISCUSSION

Examinations necessary for patients with non-life-threatening blunt chest trauma with stable conditions are not defined precisely [2]. Upright chest radiography is usually the first diagnostic study to investigate the presence of chest injury in trauma [7]. Routine CXR in blunt chest trauma causes unnecessary X-ray radiation; while the history and a precise clinical examination of stable patients with blunt trauma can reveal the same and faster information as the chest X-ray [6]. In a study by Sears et al. comparing the efficiency and diagnostic value of clinical examination and radiography, sensitivity and specificity of examination were 92.7% and 55.6%, respectively, which are very close to the present study [8]. Myint et al. compared the diagnostic efficacy of clinical examination and radiography in intrathoracic lesions of patients with blunt chest wall trauma and found a sensitivity of 100%, a specificity of 32.9%, a positive predictive value of 16.4%, and a negative predictive value of 100% [3]. In the study of Rodriguez et al., major intrathoracic lesions were seen in 31 patients (6.3%). Tenderness and chest pain had the highest sensitivity of 90% and hypoxia, the highest specificity of 97%. The combination of tenderness and hypoxia revealed all major intrathoracic lesions and had 100% sensitivity, 50% specificity, 12% positive predictive value, and 100% negative predictive value. It has the potential to reduce the need for chest radiography to 46% [9]. Nejati et al. showed that chest pain and tachypnea could show important injuries of the chest wall with 100% sensitivity [10]. In the study of Bokhari et al., the negative predictive value of auscultation, pain, tenderness, and tachypnea was 99%-100%. They concluded that stable blunt trauma patient with a normal clinical examination not need routine chest radiography [6]. Rodriguez et al. indicated a sensitivity of 99.3%, a specificity of 14%, a negative predictive value of 99.4%, and a positive predictive value of 11.7% for clinical examination [11]. A study by Seamon et al. in the United States proved the effectiveness of clinical examination in confirming these findings and suggested not to perform unnecessary chest X-ray [12]. The present study and other similar studies reported that stable patients with blunt trauma and no valuable clinical finding do not need chest radiography. In the present study, the majority of injuries in patients were due to direct trauma. However, in the study of Nejati et al. falling from a height was the most common mechanism of injury (37.7%) [10]. Road accidents (n=226) were the main cause of injuries in the study of Mefire et al. [13], while the most common lesions were rib fracture (50.3%) and hemothorax (38.7%). In the present study, rib fracture was also the most common pathologic finding in chest radiography, which observed in 45 patients (24.2%), and most cases diagnosed based on clinical and radiographic examinations. At least one associated lesion seen in 73.45% of cases [13]. Sears et al. reported that rib fracture was also the most common diagnostic finding found in 5.1% of patients with blunt trauma [8]. In another study by Rodriguez et al., 31 (6.3%) of 492 patients have major chest injury that diagnosed by chest

X-ray. Rodriguez et al. reported rib fracture (more than two ribs) as the most common diagnosis seen in 20 patients with blunt chest trauma (4.1%) [9]. In the study of Myint et al., 11.7% of 77 patients with stable chest trauma had an abnormal finding in chest radiography, and again, rib fracture was the most common finding observed in all nine patients, 3 of whom had a pneumothorax, and one had pulmonary contusion [3]. In this study, pneumothorax, thoracic subcutaneous emphysema, sternum fracture, hemothorax, and flail chest reported as associated lesions [3]. Rodriguez et al., explained NEXUS chest algorithm in blunt trauma that based on physical examination and history taking [14].

CONCLUSION

The results of this study showed that although the clinical sensitivity of the clinical examination may be helpful in some cases, this method has low specificity, and paraclinical methods should be used to confirm the diagnosis.

LIMITATIONS

The small sample size was the first limitation of this study, which may arise from the selection of the patients (based on blunt trauma and stable condition), as well as the low incidence of isolated blunt chest trauma. Another major limitation arises when radiography as the gold standard diagnostic test of disease has a diagnostic error. To remove these limitations, a multi-centric study should be conducted simultaneously with large sample size.

SUGGESTIONS

Further studies with more patients can help confirm these findings.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this manuscript.

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