



## Evaluation of PERSH Criteria to Avoid Unnecessary Chest X-ray in Patients with Blunt Chest Trauma: A Qualitative Study

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Received: 10 April, 2019

Accepted: 29 December, 2019

### ARTICLE INFO

#### Article type:

Original Article

#### Keywords:

Emergency Department

Mortality

Multiple Traumas

### Abstract

**Background:** Chest X-rays (CXRs) are traditionally performed to determine intra-thoracic injuries in all blunt chest trauma patients in Shahid Bahonar hospital in Kerman. As there are some disadvantages upon CXR and radiation exposure, therefore, this study aimed to evaluate the role of CXR in the diagnosis of intra-thoracic injuries caused by any blunt chest trauma.

**Methods:** This prospective qualitative study was conducted on all patients over 16 years old with blunt chest trauma. Unstable patients with GCS<13/15, RTS<12, dyspnea, intratracheal intubation, pregnancy, intoxication, an accident time longer than 24 hours, patients referred from other centers, and patients who did not agree to participate were excluded. All patients underwent routine CXR and followed up by telephone call 48 hours after admission. Data were analyzed through SPSS version 16.

**Results:** Of 2850 patients, 1320 cases were encountered and screened using screening tools. Mean age of patients was  $31.6 \pm 15.6$  years. From all, 1022 (67.4%) patients were male. Motor vehicle accident [439 (28.9%)] and motorcycle crash [437 (28.8%)] were the most frequent causes of trauma. The mean accident-visit time was  $181.2 \pm 72.7$  min. There was no trauma-related pathogenic finding in CXRs. None of the patients needed any further emergency treatment.

**Conclusion:** Some parameters may be used to rule out intra-thoracic injuries, and accordingly, decrease CXR performance. Four areas including physical examination (PE), Revised Trauma Score (R), oxygen saturation (S), and history taking (H), were explained and presented as PERSH criteria. Therefore, there is no need to perform CXR as a standard process of care in stable multiple trauma patients who have negative PERSH criteria.

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**Citation:** Mayel M, Ghasemirad S. Evaluation of PERSH Criteria to Avoid Unnecessary Chest X-ray in Patients with Blunt Chest Trauma: A Qualitative Study. *Journal of Kerman University of Medical Sciences*, 2019; 26 (6):488-493.

### Introduction

Intra-thoracic injuries are the cause of 20 to 50% of mortality rate due to multiple traumas. Chest X-ray

(CXR) is the most commonly performed radiographic evaluation, known as a standard method for the diagnosis of intra-thoracic injuries (1). Advanced Trauma Life

Support (ATLS) suggests routine CXR for all patients with multiple traumas regardless of physical examination (2). American Surgical Association (ASA) has reduced emphasis on pelvic and lateral neck radiographs, and has suggested physical examination for the diagnosis of pelvic and neck injuries (3), however, CXR is still used as a screening tool for the diagnosis of intra-thoracic injuries (4).

Moreover, in most cases, CXR has no effect on the diagnostic approach, yet, it is done for the assessment of blunt chest trauma (5), leading to a large number of unnecessary CXRs (2,6). History and physical examination can provide more helpful data compared with CXR (7). For instance, clinical suspicion according to the history and mechanism of trauma is more reliable than CXR for early diagnosis of lung contusion (8), rib fracture (9), hemothorax, and pneumothorax (10), which are life-threatening conditions, and any diagnostic and management delay may affect outcomes significantly (11).

Nowadays, Emergency Department (ED) overcrowding is one of the most common medical care difficulties (12). Studies have reported that this situation would lead to higher mortality rates in the overcrowded EDs (11). Furthermore, unnecessary CXRs expose patients to potentially harmful ionizing radiation and interrupt trauma resuscitation process in the overcrowded EDs (12). It, also, leads to substantial radiologic charges and imposes more unnecessary costs on patients and health systems (14).

This study aimed to evaluate the role of CXR in the diagnosis of intra-thoracic injuries caused by any blunt chest trauma.

This study suggests a more accurate and comprehensive criteria abbreviated as PERSH in comparison with other criteria such as National Emergency X-Radiography Utilization Study (NEXUS).

### Materials and Methods

This prospective qualitative study was conducted on all patients with blunt chest trauma referred to the ED of Shahid Bahonar Hospital (a level 2 trauma referral center with admission rate of nearly 250 patients per day located in the Southeast of Iran) affiliated with Kerman University of Medical Sciences during a 12-month period (from January to December, 2014).

All patients over 16 years old with blunt chest trauma were registered in the study by simple sampling. Patients with unstable vital signs ( $SpO_2 < 95\%$ ,  $SBP < 90$  mmHg,  $PR > 100$  bpm,  $10 > RR > 29$ /min), decreased consciousness ( $GCS < 13/15$ ), chest pain, dyspnea, shortness of breath, hemoptysis, tracheal deviation, chest wall abrasions and ecchymosis, chest wall deformity, flail chest, chest wall crepitation and tenderness, decreased breath sounds, intra-tracheal intubation, pregnancy, intoxication, an accident time longer than 24 hours, patients referred from other centers, patients who did not agree for participating and those with Revised Trauma Score (RTS) less than 12 (15) were excluded.

The study protocol was approved by the Ethics Committee of Kerman University of Medical Sciences and Institutional Review Board (IRB), and all the

participants filled up informed written consent forms. Also, checklists including primary vital signs, age, sex, trauma mechanism, time elapsed from the time of injury, and phone number, were filled up. Abnormal findings of patient's history, physical examination, and other parameters regarding PERSH were recorded. Routinely, all patients underwent a standard CXR based on ATLS protocol and abnormal findings were recorded by an emergency medicine (EM) resident.

If there was any pathologic finding such as hemothorax, pneumothorax, subcutaneous air, rib fracture, lung contusion, and wide mediastinum, chest CT scan and further assessments were performed through consultation with a trauma surgeon. In this study, regarding the CXRs, there was no indication for chest CT scan.

All participants were followed up by telephone call 48 hours after the admission time and asked for any complication or medical problem due to recent trauma by a blinded trained researcher. For further confidence, all CXRs were reviewed and interpreted by a board-certified radiologist or a radiology senior resident.

Regarding major findings related to chest blunt trauma, there was no significant difference between emergency physician and radiologist report.

All data were analyzed using descriptive statistical tests and through SPSS version 16.

## Results

A total number of 2850 patients were encountered and screened using screening tools. From all, 1350 subjects were excluded based on the exclusion criteria

and consequently 1500 subjects were included in this study. Due to the disagreement of 180 patients with telephone follow-up, a total number of 1320 cases were analyzed. 1022 (67.4%) patients were male. Mean age of patients was  $31.6 \pm 15.6$  years (16 to 92 years). Motor vehicle accident [439 cases (28.9%)] and motorcycle crash [437 cases (28.8%)] were the most frequent mechanisms of trauma. The average elapsed time from accident to physician visit (Accident-visit time) was  $181.2 \pm 72.7$  min (Table 1).

**Table 1.** Demographic characteristics and mechanism of injury

Characteristics/Mechanisms	(mean±SD)
<b>Age (year)</b>	31.6±15.6
<b>Gender</b>	number (%)
<b>Male</b>	1022 (77.42)
<b>Female</b>	298 (22.58)
<b>Mechanism of injury</b>	number (%)
<b>Falls</b>	200 (15.15)
<b>Ejected from vehicle</b>	99 (7.5)
<b>Motor vehicle collisions</b>	439 (33.25)
<b>Motorcycle crush</b>	437 (33.10)
<b>Pedestrian struck by vehicle</b>	145 (10.98)
<b>Accident-visit time (min)</b>	(mean±SD)
	181.2±72.7

For all included patients, CXR was obtained. There was no trauma-related pathogenic findings in CXRs, and in no case, there was an indication for chest CT scan. All patients were followed up using telephone call for 48 hours, and none of the patients needed any further emergency treatment.

## Discussion

Due to the lack of any obvious criteria for the necessity of CXR performance and since imaging, in spite of taking time and imposing extra cost, is not resulted in a corresponding increase in making diagnoses, researchers have tried to explain specific guidelines in screening patients with blunt chest trauma (3,11,16). The present study showed that PERSH criteria can be used as a reliable screening tool for patients with blunt chest trauma and prediction of the necessity of CXR amongst these patients. CXR can be allocated to patients who have at least one of the following factors including abnormal physical examination, RTS less than 12, SpO<sub>2</sub> less than 95%, and an abnormal history.

All new diagnostic methods and modalities focus on three points including increasing the speed of evaluation and management, decreasing economic burden and costs on patients and health systems, and decreasing patients' X-ray exposure (17). Fortunately, it seems that this study has involved all these three points.

There are several studies that support reducing the use of CXR in the early assessment and management of patients with multiple traumas. In Sears et al. (2005) study, a senior trauma surgeon's judgment had 95.1% sensitivity for the need for chest imaging (7). Pinette et al. (2012) suggested that significant thoracic injuries can be clinically identified (18). Ungar et al. (2006) reported a decision rule with 86% sensitivity to rule out traumatic aortic injury (19). Paydar et al. (2012) suggested that CXR should be taken only according to physical examination of stable blunt chest trauma patients (4). Forouzanfar et al. (2014) reported that in clinically stable

patients, younger than 60 years, patients with no pain and chest wall tenderness, decreased breath sounds, and dyspnea, taking CXR could be ignored (5). Myint et al. (2012) showed that physicians in the Emergency Department overuse CXR, and there is a significant relationship between normal physical examination and normal CXR (6). The present study also confirms these findings and shows that history and physical examination are very helpful in reducing CXR performance, although the role of oxygen saturation and RTS is also highlighted.

In another study, Rodriguez et al. (2013) evaluated the accuracy of NEXUS chest criteria in blunt chest trauma patients. These criteria are age >60 years, rapid deceleration mechanism defined as fall >20 ft, motor vehicle crash at a speed limit of >40 mph, chest pain, intoxication, abnormal alertness and mental status, distracting painful injury, and tenderness of chest wall. They validated the NEXUS chest criteria as a decision making instrument which may safely reduce the need for chest imaging in blunt chest trauma patients older than 14 years (16). In the present study, PERSH criteria including physical examination (unstable vital signs, chest crepitation, chest wall tenderness, unilaterally decreased breath sounds, tracheal deviation, flail chest, chest wall abrasions, and ecchymosis), RTS less than 12, SpO<sub>2</sub> less than 95%, and history taking (chest pain, dyspnea, shortness of breath, and hemoptysis) have been considered which by evaluating more aspects of multiple trauma patients, could be a more reliable tool.

According to the findings of this study, the rate of multiple traumas in male patients was significantly higher than that in female patients. The most frequent

mechanisms of trauma in this study were motor vehicle accident (28.9%) and motorcycle crashes (28.8%), which is consistent with the results of other studies in Iran (2,9).

Accident-visit time, the time elapsed between accident time and physician visit, was also assessed; although, it was revealed that there is no relationship between accident-visit time and outcomes of patients.

In this study, the interpretation of all the CXRs was performed by an expert board-certified attending radiologist and all patients were primarily visited and evaluated by an EM resident. In contrast with similar studies, a 48-hour follow-up was performed. Also, an acceptable sample size in a level 2 trauma center, which serves as a referral center in the Southeast of Iran, was obtained.

There were some limitations such as not using chest CT scan as a gold standard because of high costs and insurance limitation.

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## Conclusion

According to the results, some parameters may be used to rule out intra-thoracic injuries, and accordingly, decrease the CXR performance. Generally, four areas were explained including physical examination (PE), Revised Trauma Score (R), O<sub>2</sub> saturation (S), and history (H), which finally presented as PERSH criteria. Therefore, in stable multiple trauma patients who have negative PERSH criteria, there is no need to perform CXR as a standard process of care.

## Acknowledgements

This study has been extracted from the thesis written by the Emergency Medicine resident, Sareh Ghasemirad, School of Medicine, Kerman University of Medical Sciences, Kerman, Iran. The authors would like to gratitude all the colleagues and radiology ward staff who helped us to perform this study.

## Conflict of Interests

The authors have declared no conflict of interests.

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