

Necessity of Emergency Chest X-ray in a Patient with Multiple Trauma with Injury Severity Score >15

Alireza Ala¹, Samad Shams-Vahdati², Golnaz Majidi¹, Respina Jalilian¹

¹Emergency Medicine Research Team, Tabriz University of Medical Sciences, Tabriz, Iran

²Emergency Medicine Research Team, Tabriz University of Medical Sciences, Road Traffic Injury Research Center, Tabriz, Iran

Abstract

Aim: It was aimed to evaluate necessity of performing chest X-ray (CXR) in patients with multiple traumas and injury severity score (ISS) >15 in this study.

Materials and Methods: In this cross-sectional study conducted on trauma patients, the clinical and radiographic findings of all the patients were collected and the relationships between these variables were analyzed based on advanced trauma life support guidelines.

Results: A total of 170 patients was included in the study. Of them, 114 (67.1%) were male. The mean age of males was 33.86±17.36 years and it was 37.75±18.33 years in females (p=0.181). Twenty six patients had symptoms; seven patients had dyspnea and 19 had chest pain. Clinical examination was abnormal in 28 patients. Emphysema was detected in one patient, ecchymosis in one patient and local tenderness in 26 patients. CXR was performed in all patients and it was normal in 161 patients (94.7%). It detected rib fracture in six patients (3.5%), pulmonary contusion in two patients (1.2%) and hemothorax in one patient (0.6%).

Conclusion: Investigation of the necessity of emergency CXR in patients with multiple trauma with ISS >15 showed that there was no need to perform CXR in stable patients lacking signs and symptoms and instead we suggest physical exam to detect any problem.

Keywords: Chest X-ray, multiple trauma patients, injury severity score, chest injury

Introduction

Management of patients with multiple trauma is a real challenge for every physician (1). Assessment of traumatic patients is composed of two phases according to advanced trauma life support (ATLS) instructions: 1- Initial quick assessment to detect life threatening injuries, 2- Complete detailed assessment to locate injured body parts (2,3). Finding symptoms in traumatic patients is a time-consuming process. Moreover, it is much harder to rule out asymptomatic injuries than finding positive symptoms (3). Due to difficulty in management of patients with trauma and importance of this topic, trauma is a major hazard in every society, which affects health, economic and social indicators (4).

Injuries due to trauma, abdominal and chest injuries in particular, have increased steadily following an increase in road accidents, along growing urbanization and industrialization related problems.

Thoracic trauma is the most important type of emergency traumas, which can cause complications. Accurate follow up of patients, repeated examinations and regular paraclinical tests are helpful in the prevention of serious complications in these patients. Regular and control thoracic radiographies are performed in many centers with interval of 6-8 hours to follow up complications in stable patients. There are different ideas about follow up procedure and interval between actions. Some believe that even 3 hours is adequate for monitoring in patients with asymptomatic penetrating trauma (4).



Corresponding Author: Respina Jalilian MD, TEmergency Medicine Research Team, Tabriz University of Medical Sciences, Tabriz, Iran

Phone: +98 93 72857020 **E-mail:** respina.jalilian@gmail.com **ORCID ID:** orcid.org/0000-0002-5334-251X

Cite this article as: Ala A, Shams-vahdati S, Majidi G, Jalilian R. Necessity of Emergency Chest X-ray in a Patient with Multiple Trauma with Injury Severity Score >15. Eurasian J Emerg Med. 2020;19(1): 20-4

©Copyright 2020 by the Emergency Medicine Physicians' Association of Turkey
Eurasian Journal of Emergency Medicine published by Galenos Publishing House.

Received: 01.07.2017

Accepted: 11.07.2017

Some traumatic patients need quick administrations and emergency surgeries while some of the cases can discharge from hospital without comprehensive investigation following initial assessments. A high percentage of these patients cannot be classified into the aforementioned two groups because their condition calls for more precise assessments. Proper use of diagnostic instruments in hospitals is a method to reduce costs imposed to patients and hospitals (3).

Blunt or penetrating chest trauma can cause death in 25% of cases and surgery is required in 10-15% of patients with chest trauma. Death due to chest trauma comprises half of all deaths due to trauma and usually occurs immediately after the chest injury (5).

Most patients with chest injury can be treated conservatively with close observation and tube thoracostomy. Blunt trauma, head injury and abdominal injury independently and adversely affect mortality after chest trauma. Investigation of causes and patterns in stab injuries assists to effective prevention (6,7).

Thoracic computed tomography (CT) is highly sensitive in detecting thoracic injuries of blunt chest trauma and is preferred to routine chest X-ray (CXR) to visualize lung contusions, pneumothorax, and hemothorax (8).

Different imaging studies exist to diagnose thoracic trauma injuries such as CXR, CT-scan and ultrasonography although these methods may not be efficient. Numerous studies revealed that CT-scan was more effective in diagnosis of injuries such as pneumothoraces, hemothoraces, and lung contusions (9,10). CT-scan is also more effective for these patients compared with CXR in terms of diagnostic error (11).

According to ATLS, it is necessary to obtain chest radiographic images in patients with multiple traumas and injury severity score (ISS) levels of higher than 15 or in patients at levels 3 or 4 in triages. Since most of the radiographic images in these patients are normal, the present study is based on the assessment of costs imposed on health care system and more importantly, of unnecessary X-rays imposed on patients' bodies. In addition, normal radiographic images obtained from these patients are assessed and compared with results of clinical examinations.

This study investigates normal chest radiography and unnecessary costs as well as relationship between results of chest radiography and clinical examination of patients with multiple traumas.

Materials and Methods

This is a prospective descriptive-analytic study that is performed in the emergency department of Tabriz University of Medical

Sciences in traumatic patients to determine necessity of imaging in patients with multiple traumas and ISS >15. Assessments are performed according to ATLS. ISS is an emergency assessment with CT and other modalities beside first presentation vital sign.

This study included 170 patients with multiple trauma referred to emergency department between March 2015 and March 2016 during the four intermediate days of each month. Ethical committee of Tabriz University of Medical Sciences approved this study before patients' enrollment.

CXR was performed in every patient according to ATLS and the person performing serial examinations was blind to the results. Residents of emergency medicine in emergency room performed serial examination and monitored vital signs of patients. The person performing chest radiography was blind to the results of serial examinations. Serial examinations were performed every half an hour to 3 hours in the primary survey. Results were recorded as well.

Exclusion criteria included the following:

1. Patients below 18 years and over 65 years
2. Patients with ISS <15
3. Patients with the emergency severity index (ESI) 1, 2 and 5 (Patients with ESI 3 and 4 were enrolled in the study).

Statistical Analysis

Data obtained from patients were analyzed using the SPSS ver. 15 software. We used t-test method or Mann-Whitney U test method for independent groups to compare quantitative data after determining data distribution and chi-square test method or Fisher's exact test to compare qualitative data. A p value less than 0.05 was considered statistically significant.

Moral Considerations

Since there was no intervention during examining process and only routine information about patients was obtained, this study caused no moral problem. All of the moral criteria concerning use of patients' files were observed and file contents would stay completely confidential and inaccessible.

Results

In this study, we evaluated 170 patients with multiple traumas. The results are as follows:

Among all patients, 114 (67.1%) were male and 56 (32.9%) were female. Mean age of patients was 35.15 ± 17.73 years ranging from 1 to 95 years. Mean age of male and female patients was

33.86±17.36 and 37.75±18.33 years, respectively (p=0.181). One hundred and fifty eight patients (92.9%) were in ESI III triage level and 12 (7.1%) were in ESI-IV triage level. Table 1 shows trauma causes by gender. There was no significant relationship between physical exam and triage level (p=0.189), between physical exam and trauma (p=0.64), between chief complaint and triage level (p=0.457), between chief complaint and gender (p=0.053) and also between gender and physical examination (p=0.306).

Twenty six patients had respiratory problems manifested as dyspnea in seven patients and chest pain in 19 patients. Physical examination of 28 patients detected positive clinical findings including skin emphysema in one patient, ecchymosis in another patient and local tenderness in 26 patients.

CXR was performed in all patients, 168 patients had one CXR (98.8%) and it was repeated in two patients (1.2%). CXR was normal in 161 patients (97.7%), while six patients had rib fracture (3.5%), one patient had hemothorax (0.6 %) and two patients had lung contusion (1.2%) all of whom had symptoms or positive findings in physical exam.

Table 2 shows CXR findings by trauma causes. There was no significant relationship between physical examination and CXR (p=0.647), between chief complaint and CXR (p=0.176) and also between CXR and trauma (p=0.844).

Discussion

Trauma is one of the most common causes of death in patients

Table 1. Trauma causes by gender

| | Gender | | Total |
|---------------------|--------|--------|-------|
| | Male | Female | |
| Car accident | 24 | 16 | 40 |
| Pedestrian accident | 9 | 15 | 24 |
| Falling | 15 | 11 | 26 |
| Rollover | 28 | 9 | 37 |
| Bike accident | 38 | 5 | 43 |

Table 2. Chest X-ray findings based on trauma causes

| | CXR | | | | Total |
|---------------------|--------|--------------|------------|----------------|-------|
| | Normal | Rib fracture | Hemothorax | Lung contusion | |
| Car accident | 38 | 2 | 0 | 0 | 40 |
| Pedestrian accident | 20 | 2 | 0 | 2 | 24 |
| Falling | 24 | 2 | 0 | 0 | 26 |
| Rollover | 37 | 0 | 0 | 0 | 37 |
| Bike accident | 42 | 0 | 1 | 0 | 43 |

CXR: Chest X-ray

aged 1-44 years and the third common cause of death for all ages. The main cause of thoracic injuries is car accidents (12,13).

In this study, we decided to eliminate radiation dose on the patients, reduce additional costs imposed to health care system and maximize the efficiency of clinical evaluation.

Diagnostic value of imaging in patients with chest trauma is proven. But this procedure is not useful in patients with blunt trauma as a method of screening because it is time consuming.

Rib fractures occur in 2/3 of thoracic injuries during accidents (14,15). Multiple fractures of the ribs are observed in 5% of the people, which may cause intra-thoracic injuries (16-18). The results of our study were consistent with the results of the above mentioned studies. Six patients had rib fractures (3.5%) in our study, which was the most common findings in CXR.

CXR is recommended as a primary test for all patients with thoracic blunt trauma (19-21). It is inexpensive, convenient and non-invasive (22). CXR is applicable in diagnosing fractures, hemothorax, pneumothorax, pulmonary injuries and aorta injuries, however it has less efficacy in small lesions (21). Initial evaluation is performed by portable CXR in patients with higher risks such as unstable hemodynamics, severe tenderness, hypoxia, seat belt sign on the abdomen and symptoms of fractures in several ribs. Posteroanterior CXR is beneficial in normal states (23-25). Serial imaging is utilized in those with probability of rib's fracture with no findings in their radiography. This is more important in the elderly (26-28). In some cases of penetrating trauma, initial CT scanning is replaced with serial CXR. Performing serial CXR and the interval between them are still a controversy (19). CT scan gives more information about thoracic lesions (29-32), but it is not appropriate for all patients. Thoracic CT scan is used in patients with positive findings in CXR or positive symptoms like thoracic pain or dyspnea (26-28).

Serial examination every 6 hours can be replaced with control X-ray that reduces number of radiographies from 5 to 2 in the first 24 hours after trauma. Results of this study was similar with some researches. In them, serial X-rays were not required and

in some cases with penetrating trauma, primarily CT scan was adequate (19). Seamon et al. (20) suggested that even 3 hours of follow-up was adequate in penetrating traumas without chest pain. In another study it was shown that there is no significant difference after 3 hours of X-ray and 6 hours in non-penetrating thoracic trauma (33).

Because of concerns about using unnecessary X-Rays in patients with blunt trauma and about excessive radiation dose on body, a study was performed. Although the role of CXR in detecting significant intra-thoracic injuries was very low, it was believed that it was standard part of trauma work up (34). Another study sought to evaluate performing CXR in patients with blunt trauma and found that these patients did not need CXR routinely if they were stable and if they had no symptoms (35). Forouzanfar et al. (36) concluded in a recent study in patients with multiple blunt trauma that the diagnostic yield of CXR was not high enough and that it could be ignored in stable patients who were conscious, under 60 years old, had no decrease in pulmonary sounds, no dyspnea, no thoracic skin abrasion, and no crepitation. According to some studies, physical examination had high sensitivity for the diagnosis of chest lesions in patients with GCS >14 (37-39).

We should also mention that in a research done in 2003, it was shown that clinical examination alone was not adequate for the accurate detection of chest lesions in 90% of cases, especially in patients with blunt trauma (40). In another study that was carried out in 2010 in Virginia, It was shown that 10% of patients had hidden lesions without any evidence in the examination (41). In a study published in 2003, it was determined that physical examination had 99% sensitivity and 44% specificity in the diagnosis of thoracic lesions and due to the low specificity, it was better to do X-ray alongside the clinical examination (42).

This data in support of our data showed that in patients with blunt trauma there was no need of performing CXR if they were stable and had no signs and symptoms. Instead, we can perform a complete physical examination.

Conclusion

We found that CXR was not used in diagnostic process of patients with thoracic blunt trauma who were stable and had no finding in physical exam and no symptoms. In this study, from a total of 170 patients with blunt multiple trauma, 161 patients (97.7%) had a normal CXR and only 9 patients (2.3%) had a positive finding in CXR. All these patients had symptoms like dyspnea or chest pain or positive finding in physical exam like skin emphysema, ecchymosis and local tenderness. According to ATLS it is necessary to obtain chest radiographic images in patients with multiple traumas and ISS higher than 15 or patients at

levels 3 or 4 in triages and CXR is performed as a routine process of trauma patients management. Actually, there is no need to impose this excessive radiation dose to patient and it is better to reduce costs in health care system. We suggest performing physical exam instead of CXR in patients with blunt chest trauma with ISS >15 without any discomfort in the chest.

Ethics

Ethics Committee Approval: Ethical committee of Tabriz University of Medical Sciences approved this study before patients' enrollment.

Informed Consent: Informed consent was taken.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Concept: A.A., S.S.V., G.M., R.J., Design: A.A., S.S.V., G.M., R.J., Data Collection or Processing: A.A., S.S.V., G.M., R.J., Analysis or Interpretation: A.A., S.S.V., G.M., R.J., Literature Search: A.A., S.S.V., G.M., R.J., Writing: A.A., S.S.V., G.M., R.J.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study

References

1. Gordon Buduhan, McRitchie. Missed Injuries in Patients with Multiple Trauma. *J Trauma*. 2000;49:600-5.
2. American College of Surgeons Committee on Trauma. Initial assessment and management. In: *Advanced Trauma Life Support Reference Manual*. Chicago: American College of Surgeons; 1994:17-37.
3. Enderson BL, Reath DB, Meadors J, Dallas W, DeBoo JM, Mauli KI. The tertiary trauma survey: a prospective study of missed injury. *J Trauma*. 1990;30:669-70.
4. Hemmati H, Kazemnezhad-Leili E, Mohtasham-Amiri Z, Darzi AA, Davoudi-Kiakalayeh A, Dehnadi-Moghaddam A, et al. Evaluation of chest and abdominal injuries in trauma patients hospitalized in the surgery ward of porsina teaching hospital, guilan, iran. *Arch Trauma Res*. 2013;1:161-5.
5. Mohammadzadeh M, Hosseinpour M, Mirzadeh AS, Jazayeri H, Ghannae Arani M. Chest Injury Evaluation and Management in Two Major Trauma Centers of Isfahan Province, IR Iran. *Arch Trauma Res*. 2012;1:54-7.
6. Zargar M, Khaji A, Karbakhsh Davari M. Thoracic injury: a review of 276 cases. *Chin J Traumatol*. 2007;10:259-62.
7. Farooq U, Raza W, Zia N, Hanif M, Khan MM. Classification and management of chest trauma. *J Coll Physicians Surg Pak*. 2006;16:101-3.
8. Trupka A, Waydhas C, Hallfeldt KK, Nast-Kolb D, Pfeifer KJ, Schweiberer L. Value of thoracic computed tomography in the first assessment of severely injured patients with blunt chest trauma: results of a prospective study. *J Trauma*. 1997;43:405-11.
9. Marts B, Durham R, Shapiro M, Mazuski JE, Zuckerman D, Sundaram M, et al. Computed tomography in the diagnosis of blunt thoracic injury. *Am J Surg*. 1994;168:688-92.
10. Karaaslan T, Meuli R, Androux R, Duvoisin B, Hessler C, Schnyder P. Traumatic chest lesions in patients with severe head trauma: a comparative study with

- computed tomography and conventional chest roentgenograms. *J Trauma*. 1995;39:1081-6.
11. Traub M, Stevenson M, McEvoy S, Briggs G, Lo SK, Leibman S, et al. The use of chest computed tomography versus chest X-ray in patients with major blunt trauma. *Injury*. 2007;38:43-7.
 12. Liman, ST, Kuzucu, A, Tastepe, AI, Ulasan GN, Topcu S. Chest injury due to blunt trauma. *Eur J Cardiothorac Surg*. 2003;23:374-8.
 13. Rodriguez RM, Hendey GW, Marek G, Dery RA, Bjoring A. A pilot study to derive clinical variables for selective chest radiography in blunt trauma patients. *Ann Emerg Med*. 2006;47:415-8.
 14. Kohn MA, Hammel JM, Bretz SW, Stangby A. Trauma team activation criteria as predictors of patient disposition from the emergency department. *Acad Emerg Med*. 2004;11:1-9.
 15. Nirula R, Talmor D, Brasel K. Predicting significant torso trauma. *J Trauma*. 2005;59:132-5.
 16. Newman RJ, Jones IS. A prospective study of 413 consecutive car occupants with chest injuries. *J Trauma*. 1984;24:129-35.
 17. Gaillard M, Herve C, Mandin, L, Raynaud P. Mortality prognostic factors in chest injury. *J Trauma*. 1990;30:93-6.
 18. Ho ML, Gutierrez FR. Chest radiography in thoracic polytrauma. *AJR Am J Roentgenol*. 2009;192:599-612.
 19. Magnotti LJ, Weinberg JA, Schroepel TJ, Savage SA, Fischer PE, Bee TK, et al. Initial chest CT obviates the need for repeat chest radiograph after penetrating thoracic trauma. *Am Surg*. 2007;73:569-72.
 20. Seamon MJ, Medina CR, Pieri PG, Fisher CA, Gaughan JP, Bradley KM, et al. Follow-up after asymptomatic penetrating thoracic injury: 3 hours is enough. *J Trauma*. 2008;65:549-53.
 21. Ekeh AP, Peterson W, Woods RJ, Walusimbi M, Nwuneli N, Saxe JM, et al. Is chest x-ray an adequate screening tool for the diagnosis of blunt thoracic aortic injury? *J Trauma*. 2008;65:1088-92.
 22. Kram HB, Appel PL, Wohlmuth DA, Shoemaker WC. Diagnosis of traumatic thoracic aortic rupture: a 10-year retrospective analysis. *Ann Thorac Surg*. 1989;47:282-6.
 23. Kirkpatrick AW, Sirois M, Laupland KB, Liu D, Rowan K, Ball CG, et al. Hand-held thoracic sonography for detecting post-traumatic pneumothoraces: the Extended Focused Assessment with Sonography for Trauma (EFAST). *J Trauma*. 2004;57:288-95.
 24. Blaivas M, Lyon M, Duggal S. A prospective comparison of supine chest radiography and bedside ultrasound for the diagnosis of traumatic pneumothorax. *Acad Emerg Med*. 2005;12:844-9.
 25. Mandavia DP, Joseph A. Bedside echocardiography in chest trauma. *Emerg Med Clin North Am*. 2004;22:601-19.
 26. Stawicki SP, Grossman MD, Hoey BA, Miller DL, Reed JF. Rib fractures in the elderly: a marker of injury severity. *J Am Geriatr Soc*. 2004;52:805-8.
 27. Bergeron E, Lavoie A, Clas D, Moore L, Ratté S, Tetreault S, et al. Elderly trauma patients with rib fractures are at greater risk of death and pneumonia. *J Trauma*. 2003;54:478-85.
 28. Holcomb JB, McMullin NR, Kozar RA, Lygas MH, Moore FA. Morbidity from rib fractures increases after age 45. *J Am Coll Surg*. 2003;196:549-55.
 29. Omert L, Yeane WW, Protetch J. Efficacy of thoracic computerized tomography in blunt chest trauma. *Am Surg*. 2001;67:660-4.
 30. Shanmugananthan K, Mirivis SE. Imaging diagnosis of nonaortic thoracic injury. *Radiol Clin North Am*. 1999;37:533-51.
 31. Brink M, Deunk J, Dekker HM, Kool DR, Edwards MJ, van Vugt AB, et al. Added value of routine chest MDCT after blunt trauma: evaluation of additional findings and impact on patient management. *AIR Am J Roentgenol*. 2008;190:1591-8.
 32. Dissanaiké S, Shalhub S, Jurkovich, GJ. The evaluation of pneumomediastinum in blunt trauma patients. *J Trauma*. 2008;65:1340-5.
 33. Kiev J, Kerstein MD. Role of three hour roentgenogram of the chest in penetrating and nonpenetrating injuries of the chest. *Surg Gynecol Obstet*. 1992;175:249-53.
 34. Calderon G, Perez D, Fortman J, Kea B, Rodriguez RM. Provider perceptions concerning use of chest x-ray studies in adult blunt trauma assessments. *J Emerg Med*. 2012;43:568-74.
 35. Myint KS, French S, Williams-Johnson J, Williams E, Johnson P, Reid MO, et al. Role of routine chest radiographs in the evaluation of patients with stable blunt chest trauma--a prospective analysis. *West Indian Med J*. 2012;61:64-72.
 36. Forouzanfar MM, Safari S, Niazazari M, Baratloo A, Hashemi B, Hatamabadi HR, et al. Clinical decision rule to prevent unnecessary chest X-ray in patients with blunt multiple traumas. *Emerg Med Australas*. 2014;26:561-6.
 37. Tintinalli JE, Kelem GD, Stapzynski Js. *Emergency medicine: a comprehensive study guide*. 6th ed. Mc Graw Hill: New York; 2004. p.1569-82.
 38. Duane TM, Cole FJ Jr, Weireter LJ Jr, Britt LD. Blunt trauma and the role of routine pelvic radiographs. *Am Surg*. 2001;67:849-52.
 39. Gonzalez RP, Fried PQ, Bukhalo M. The utility of clinical examination in screening for pelvic fractures in blunt trauma. *J Am Coll Surg*. 2002;194:121-5.
 40. Koury HI, Peschiera JL, Welling RE. Selective use of pelvic roentgenograms in blunt trauma patients. *J Trauma*. 1993;34:236-7.
 41. Siller-Matula JM, Spiel AO, Lang IM, Kreiner G, Christ G, Jilma B. Effects of pantoprazole and esomeprazole on platelet inhibition by clopidogrel. *Am Heart J*. 2009;157:148-5.
 42. Gillott A, Rhodes M, Lucke J. Utility of routine pelvic X-ray during blunt trauma resuscitation. *J Trauma*. 1988;28:1570-4.