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Original Article

Surgery Section

Comparison of Chest X-ray and Clinical Findings in Trauma Patients after Chest Tube Removal

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ABSTRACT

Introduction: Selective omission of Chest X-ray (CXR) after chest tube removal in asymptomatic patients has an important role in reduction of the consequences of unnecessary radiographies.

Aim: The aim of this study was to compare CXR and clinical findings in traumatic patients after chest tube removal.

Materials and Methods: This was a cross-sectional descriptive study on 130 trauma patients, who required a chest tube. CXR were obtained from all patients after four hours following chest tube removal and were studied by a radiologist. Clinical signs and symptoms were monitored and recorded and compared together. The correlation between CXR findings and clinical findings were analysed and compared with statistical tests.

Results: Among 116 patients with normal CXR, no patient needed an intervention and among 14 patients with abnormal CXR, 5 (35.7%) patients required an intervention, with the difference being statistically significant. Correlation percentage among CXR results and need for an intervention was 50% (Kappa=0.5, p<0.001), and among clinical manifestation and need for an intervention was 79% (Kappa=0.79, p<0.001).

Conclusion: It seems that taking a routine CXR in an asymptomatic patient after chest tube removal may not be necessary and can cause additional radiological exposure.

Keywords: Chest tubes, Haemothorax, Injuries, Pneumothorax, Radiography, Wounds

INTRODUCTION

Chest tube is one of the most valuable tools that can be placed after surgery for mediastinal and pleural cavity drainage. This tube is removed after the drainage slows down or stops [1,2]. Placing a chest tube is a common procedure in patients with trauma [3,4]. One of the major complications of removing chest tube is pneumothorax, that is why taking CXR has become a routine to study primary pathology, improvement and sufficient expansion of the lungs [1,5,6].

The purposes of routine CXR include help in diagnosis and treatment of patients with no clinical signs. Also, taking routine X-rays is helpful in documenting the disease's progression and response to treatment [7,8]. On the other hand, unnecessary X-ray that is taken routinely will expose patient to ionising radiation. Many studies show that the risk of many malignancies increases by an increase in the amount of radiation received and there is no safety threshold known for received radiation [8]. Avoidance of any unnecessary received radiation in people, especially young patients, seems necessary. In addition, many people in health services are exposed to significant amounts of radiation with any radiological imaging. Also, the increased workload and additional charges that these X-rays impose on patients and the health system cannot be ignored [7]. Today, with rising health care costs, paying extra attention to patient's assessment methods, the impact of these methods on diagnosis, the costs, and changes they can have on the disease process, has increased accordingly [9].

Some studies show that CXR is only helpful when there are clinical signs and it is only essential if patients are having respiratory or haemodynamic changes. Also, evidence indicates that the need for intervention in patients with abnormal X-ray is very low and studying patients' clinical conditions has significantly helped in planning for interventions [10,11]. According to mentioned issues, need to do CXR in traumatic and non symptomatic patients is challenging. In present study, we aimed to compare CXR findings and clinical findings in traumatic patients after chest tube removal.

MATERIALS AND METHODS

This was a cross-sectional descriptive study on trauma patients with early diagnosis of pneumothorax, haemothorax or haemopneumothorax, who had undergone chest tube placement and referred to the Poursina Medical and Educational Center in Rasht, during November 2015 to November 2016.

Patients Eligibility

Criteria for inclusion in present study were, being 14 to 65-year-old, full level of consciousness based on the Glascow Coma Score (GCS=15), necessary cooperation in clinical examination, the ability to speak and express symptoms, having spontaneous breathing without respiratory support, and no history of lung disease and thoracic surgery. Patients, who died from any cause during hospitalisation were excluded. In the event of changes in the patient's treatment plan to the thoracic surgery and/or diagnosis other than the above diagnoses in the process of treatment (such as rupture of the trachea and esophagus) and/or traumatic brain injury and other surgical procedures or admission to the Intensive Care Unit (ICU), the patients were excluded from the study, which left 130 patients remaining in the study.

Study Design

All patients eligible for inclusion, on average, had a chest tube for about three days. These patients were candidates for chest tube removal after resolution of the initial pathology and if this was approved by the CXR, the lung was completely expanded with no air leak, and a discharge of less than 150 cc per day. Chest tube removal was performed by a resident of surgery with a deep exhale and valsalva maneuver. All tubes were removed by one individual surgeon. A CXR was performed for all patients, four hours after the surgery and it was interpreted by a radiologist. During this time, patients in the surgical section were under observation of the nursing team and the surgeon. The specific forms of clinical signs and symptoms and the amount of arterial oxygen saturation

in these four hours were recorded by the surgical resident. These two groups of surgeons and radiologists did not know about each other's findings. Radiographs were taken immediately if there were clinical signs or patients made complaints in less than four hours.

Clinical and Radiographic Findings

Chest pain, shortness of breath, tachycardia and tachypnea (increased heart rate more than 120 and respiratory rate of more than 20 breaths per minute respectively and/or any rise compared to the time before extracting the tube), reduced arterial oxygen saturation and/or any rise compared to the time before removing the tube, Oxygen Pressure (pO_2) drop, which was measured by pulse oximetry, decreased breath sounds compared to breath sounds before removing the tube accompanied by hyper-resonance in the chest and haemodynamic instability, lack of expansion of the lungs during breathing movements and systolic blood pressure of less than 90 mmHg. Then, according to clinical and radiographic evidence in patients (pneumothorax exceeding more than 20%, full lung collapse, increase in the value of haemothorax compared to the value prior to pulling tubing chest), an appropriate intervention decision was made that included the following cases;

1. Redoing chest tube placement
2. Keeping patients under observation with no discharge and taking serial X-rays

If the patient had no clinical signs in these four hours, according to the result of their X-ray, they were either discharged, observed or underwent another intervention.

Statistics

Data were recorded and entered in the SPSS software version 22.0. Descriptive and inferential statistical indexes were used for analysing this information. The Fisher's exact-test was used to study the significance level. To determine the proper intervention, Indicators of Positive and Negative Predictive Value (PPV and NPV), the variables of clinical symptoms, and CXR findings were used.

RESULTS

All the trauma patients, who had chest tube placement, were examined according to the inclusion criteria of present study. Finally, 130 patients remained in the study. There were no patients drop outs and the total number of studied patients was 130.

Overall, 109 (83.8%) patients were male, and 21 (16.2%) were female. The average age of participants was 33.64±8.790. The youngest patient was 19-year-old and the oldest was 57-year-old. Furthermore, 118 (90%) patients had a blunt trauma and the other 12 (9.2%) patients had penetrating trauma. It was found that 98 (75%) patients were admitted with pneumothorax, 18 (13%) patients with haemothorax, and 14 (10%) people with haemopneumothorax.

From 130 patients, 125 (96.2%) had no clinical symptoms in the first four hours after removal of the chest tube. However, 5 (3.8%) of them had clinical symptoms. After CXRs were taken, it was shown that 116 (89%) had a normal CXR and 14 (10%) had abnormal CXR; 125 (96%) did not need an intervention and only 5 (3%) ended up needing an intervention.

According to the results, there was a significant statistical difference in clinical signs between patients with normal CXR and those with abnormal CXR (p<0.001). Out of 116 patients with normal X-ray, only 1 (0.9%) patient had clinical symptoms, while 4 (28.6%) patients was with abnormal CXR [Table/Fig-1]. According to [Table/Fig-1], in the field of diagnostic value of clinical findings compared to CXR, 28.6% sensitivity, 99.1% specificity, 80% PPV, 92% NPV was obtained.

Also, based on the results, there was a significant statistical difference in clinical signs between people, who needed an intervention and those, who did not (p<0.001). 4 (80%) patients who needed an intervention had clinical symptoms, while only 1 (0.8%) patients did not need the intervention had clinical symptoms [Table/Fig-2]. The sensitivity of clinical symptoms to the need for intervention was 80%, specificity 99.2%, PPV 80%, and NPV 92%. Percentage of correlation between clinical signs and need for intervention was 79% (kappa=0.79, p<0.001) [Table/Fig-2].

Clinical symptoms	The result of chest imaging (CXR), n (%)		Total, n (%)	p-value
	Normal	Abnormal		
Yes	1 (0.9)	4 (28.6)	5 (3.8)	0.001
No	115 (99.1)	10 (71.4)	125 (96.2)	
Total	116 (100)	14 (100)	130 (100)	

[Table/Fig-1]: Comparison of CXR results in terms of clinical symptoms.

Comparing CXR results, studies showed that out of 116 patients, who had normal X-ray, no one needed an intervention and among 14 other patients with abnormal X-ray, only 5 (35%) of them needed an intervention. This difference was statistically significant (p<0.001) [Table/Fig-2]. The CXR sensitivity to the need for intervention was 100%, specificity was 92.8%, PPV 35.7%, and NPV 100%. Percentage of correlation between CXR results and need for intervention was 50% (Kappa=0.5, p<0.001) [Table/Fig-2].

Variables		Need for intervention n (%)		Total	Kappa coefficient	p-value
		No	Yes			
Clinical symptoms	No	124 (99.2)	1 (20)	125 (96.2)	0.79	<0.001
	Yes	1 (0.8)	4 (80)	5 (3.8)		
Total		125 (100)	5 (100)	130 (100)		
Chest X-ray finding	Normal	116 (89.2)	0 (0)	116 (92.8)	0.5	<0.001
	Abnormal	14 (10.8)	5 (100)	9 (7.2)		
Total		130 (100)	5 (100)	125 (100)		

[Table/Fig-2]: Comparison of the need for intervention in terms of clinical symptoms and chest x-ray.

DISCUSSION

The majority of the patients in present study were young and middle aged males. Most of the injuries were non penetrating trauma. Most of the patients in present study had normal X-rays and normal clinical signs after chest tube removal, and most did not need any intervention.

According to the results, comparing the results of clinical findings with the results of the X-ray; although, sensitivity of clinical findings as a diagnostic test was reported as low and if the clinical findings are positive, the patient will have pathologic findings in the radiograph as well. Comparing the results of this study with other studies, there is a clear relationship in this regard.

In study of Cunningham JP et al., which studied 462 patients, the most common indications of chest tube insertion in their statistical population included empyema (176 cases) and pulmonary resection (146 cases). The study concluded that it is necessary to perform X-rays and emphasise on the necessity of re-intervention based on clinical symptoms, however, it is not recommended to take chest radiographs routinely after removing the tube [10]. According to Eisenberg RL and Khabbaz KR 37 out of 400 patients, who had undergone CXR after chest tube removal, had pneumothorax. In this study, lack of taking CXR in patients after removing the chest tube resulted in loss of diagnosis of six cases of mild pneumothorax. None of them required surgery or medical intervention or late discharge [12]. In the study of McCormick JT et al., the CXR results in people, who had been routinely graphed after chest tube removal caused four cases in the intervention

group to have no signs and CXR repeat in 27 cases. The study noted that these patients could have been better managed if they did not undergo CXRs [13]. In general, in the present study, selective omission of CXR in patients with trauma after chest tube removal led to the loss of the ability to detect pneumothorax only in one person, who did not show any findings in terms of clinical symptoms in four hours of observation.

CXR also detected 14 cases of pneumothorax, only five of them required interventions, four of which already had clinical symptoms. Therefore, based on the statistical analysis of the current study and concomitant with the results of other similar studies, selective chest graph omission and assigning it only to people, who have signs and symptoms in selective trauma patients will not have any effect on the outcome of the disease. However, routine CXR is not always considered as an overdiagnostic procedure after a therapeutic process and its omission from diagnostic and therapeutic algorithms should be done with great care after numerous controlled studies. As a result of the findings of present study and similar studies, it seems that there is a close proximity between clinical symptoms and findings leading to intervention with chest radiography. Evidence suggests that clinical examinations are a better way for initial evaluation of patients and determining the strategy to treat these complications.

LIMITATION

Impossibility of examining all patients after discharge in regular sessions could have led to underestimation of the presence of delayed pathologies in asymptomatic individuals. This suggests the necessity for conducting studies with a longer period of observation. Given that predictive value of a test depends on the nature of test, the sample, outbreak of tested phenomenon in statistical population, it is recommended that the future studies be conducted with a larger population including non traumatic patients.

CONCLUSION

The present study showed that omission of chest radiography after chest tube removal in patients with trauma and limiting it to symptomatic cases will cause no change in the treatment trend of the majority of patients. Based on these findings and similar studies, it seems that taking a routine CXR in asymptomatic patients is not economically affordable and can cause unnecessary diagnosis and consequently can lead to unnecessary interventions. It is suggested for more studies to be performed on other age groups and other patients after pulmonary surgery and other chronic pathologies with precise and strict entry and exit criteria. The necessity of taking CXR after removing the chest tube in these groups should be investigated in retrospective and prospective studies with a larger statistical population. The results of these studies in the future could be replaced by an executive protocol in hospital departments to replace personalised treatments.

REFERENCES

[1] Woodward CS, Dowling D, Taylor RP, Savin C. The routine use of chest radiographs after chest tube removal in children who have had cardiac surgery. Journal of Pediatric Health Care. 2013;27(3):189-94.
[2] Kuhajda I, Zarogoulidis K, Kougioumtzi I, Huang H, Li Q, Dryllis G, et al. Tube thoracostomy; chest tube implantation and follow up. Journal of Thoracic Disease. 2014;6(4):S470-S79.
[3] Goodman MD, Huber NL, Johannigman JA, Pritts TA. Omission of routine chest X-ray after chest tube removal is safe in selected trauma patients. The American Journal of Surgery. 2010;199(2):199-203.
[4] Tolsma M, Bentala M, Rosseel PM, Gerritse BM, Dijkstra HA, Mulder PG, et al. The value of routine chest radiographs after minimally invasive cardiac surgery: an observational cohort study. Journal of Cardiothoracic Surgery. 2014;9(1):174.
[5] Paydar S, Johari HG, Ghaffarpasand F, Shahidian D, Dehbozorgi A, Ziaeian B, et al. The role of routine chest radiography in initial evaluation of stable blunt trauma patients. The American Journal of Emergency Medicine. 2012;30(1):01-04.
[6] MacDuff A, Arnold A, Harvey J. Management of spontaneous pneumothorax: British Thoracic Society pleural disease guideline 2010. Thorax. 2010;65(2):ii18-ii31.
[7] Ganapathy A, Adhikari NK, Spiegelman J, Scales DC. Routine chest X-rays in intensive care units: a systematic review and meta-analysis. Critical Care. 2012;16(2):R68.
[8] Zanobetti M, Poggioni C, Pini R. Can chest ultrasonography replace standard chest radiography for evaluation of acute dyspnea in the ED? Chest. 2011;139(5):1140-47.
[9] Wesson HK, Boikhutso N, Bachani AM, Hofman KJ, Hyder AA. The cost of injury and trauma care in low-and middle-income countries: a review of economic evidence. Health Policy and Planning. 2013;29(6):795-808.
[10] Cunningham JP, Knott EM, Gasior AC, Juang D, Snyder CL, Peter SDS, et al. Is routine chest radiograph necessary after chest tube removal? Journal of Pediatric Surgery. 2014;49(10):1493-95.
[11] Sepehripour AH, Farid S, Shah R. Is routine chest radiography indicated following chest drain removal after cardiothoracic surgery? Interactive Cardiovascular and Thoracic Surgery. 2012;14(6):834-38.
[12] Eisenberg RL, Khabbaz KR. Are chest radiographs routinely indicated after chest tube removal following cardiac surgery? American Journal of Roentgenology. 2011;197(1):122-24.
[13] McCormick JT, O'mara MS, Papasavas PK, Caushaj PF. The use of routine chest X-ray films after chest tube removal in postoperative cardiac patients. The Annals of Thoracic Surgery. 2002;74(6):2161-64.

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