Pre and post-thoracostomy chest x-ray taking; do we must do?

Radiografía de tórax antes y después de la toracostomía; Qué debemos hacer?

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Abstract

The prevalence of collision accidents is high in Iran, a developing country. Currently, a plain chest radiograph is routine 6 to 8 hours after chest tube removal. In recent years, there have been doubts about the necessity of routine post-removal chest x-ray (CXR) in the absence of clinical symptoms. In children, this is especially imperative because they are more sensitive to radiation exposure. This study conducted to evaluate the role of the plain chest radiograph in trauma patients after thoracostomy tube removal. If post-removal plain radiography has a little diagnostic value, elimination is important both economically and from a health point of view.

Methods: This study takes the records of all patients with chest tubes after trauma and during 16 months period. Patients' records listed up to 12 hours after thoracostomy removal. Routine chest x-rays (CXR) also evaluated. Final clinical decision variables and relation to clinical findings or radiographs also recorded. These decisions defined as more observation, re-thoracostomy or discharge. Data analyzed using R software. Chi-square and Fisher's exact tests used for comparison between two clinical and radiographic diagnosis variables considering three clinical decision outcome variables. A P-value <0.05 was statistically significant.

Results: Of the 58 chest tubes with the indication for removal, only one patient needed further observation clinically after removal. The coincident chest x-ray (CXR) led to recurrent chest tube insertion. All thoracostomies had performed by a trained resident or surgeon. Considering variable clinical decisions, a comparison of the diagnostic value of chest x-ray (CXR) to clinical examination did not differ statistically. The null hypothesis says the independence of the two decision methods thoroughly rejected (chi-squared of 58 and a P = 0.018). Six-hour chest x-ray (CXR) was posteroanterior in 28 patients and anteroposterior in 30. These two techniques of chest x-ray (CXR) had no significant correlation with clinical decisions. Chest x-ray (CXR) imaging in the absence of clinical symptoms did not make any difference in clinical decision-making. The low incidence of complications may be due to the thoracostomy technique done by a surgeon or a trained resident.

Conclusion: The study should be done on a larger sample and prospectively. Neither pre-removal chest x-ray (CXR) nor post-removal chest x-ray (CXR) appears to be needed. An x-ray can be helpful in cases where there are clinical symptoms.

Keywords: chest tube; thoracostomy; chest x-ray(CXR); complications; decision-making; clinical; radiographic; diagnosis

Resumen

La prevalencia de accidentes de colisión es alta en Irán, un país en desarrollo. Actualmente, una radiografía simple de tórax es una rutina de 6 a 8 horas después de la extracción del tubo torácico. En los últimos años, ha habido dudas sobre la necesidad de una radiografía de tórax de rutina después de la extracción (CXR) en ausencia de síntomas clínicos. En los niños, esto es especialmente imperativo porque son más sensibles a la exposición a la radiación. Este estudio se realizó para evaluar el papel de la radiografía simple de tórax en pacientes con trauma después de la extracción del tubo de toracostomía. Si la radiografía simple posterior a la extracción tiene poco valor diagnóstico, la eliminación es importante tanto desde el punto de vista económico como desde el punto de vista de la salud.

Métodos: Este estudio toma los registros de todos los pacientes con tubos torácicos después de un trauma y durante un período de 16 meses. Los registros de los pacientes figuran hasta 12 horas después de la extracción de la toracostomía. También se evaluaron las radiografías de tórax de rutina (CXR). También se registraron las variables de decisión clínica final y la relación con los hallazgos clínicos o radiografías. Estas decisiones se definen como más observación, re-toracostomía o alta. Datos analizados con el software R. Chi-cuadrado y las pruebas exactas de Fisher utilizadas para la comparación entre dos variables de diagnóstico clínico y radiográfico y tres variables de resultado de decisión clínica. Un valor P <0.05 considerado estadísticamente significativo.

Resultados: De los 58 tubos torácicos con la indicación de extracción, solo un paciente necesitó observación adicional clínicamente después de la extracción. La radiografía de tórax coincidente (CXR) condujo a una inserción recurrente del tubo torácico. Todas las toracostomías fueron realizadas por un residente o cirujano capacitado. Teniendo en cuenta las decisiones clínicas variables, una comparación del valor diagnóstico de la radiografía de tórax (CXR) con el examen clínico no difirió estadísticamente. La hipótesis nula dice que la independencia de los dos métodos de decisión fue completamente rechazada (chi-cuadrado de 58 y una P = 0.018). La radiografía de tórax (CXR) de seis horas fue posteroanterior en 28 pacientes y anteroposterior en 30. Estas dos técnicas de radiografía de tórax (CXR) no tuvieron correlación significativa con las decisiones clínicas. Las imágenes de rayos X del tórax (CXR) en ausencia de síntomas clínicos no hicieron ninguna diferencia en la toma de decisiones clínicas. La baja incidencia de complicaciones puede deberse a la técnica de toracostomía realizada por un cirujano o un residente capacitado.

Conclusión: El estudio debe hacerse en una muestra más grande y prospectiva. Parece que no se necesita ni una radiografía de tórax previa a la extracción (CXR) ni una radiografía de tórax posterior a la extracción (CXR). Una radiografía puede ser útil en casos donde hay síntomas clínicos.

Palabras llave: tubo torácico; toracostomía; radiografía de tórax (CXR); complicaciones Toma de decisiones; clínico; radiográfico diagnóstico

Introduction

Trauma is the leading cause of death under the age of 40-years old. Chest injuries are the primary cause of death in 25%[1] and complementary cause in 75%[2]. Commonly, the only essential treatment is fluid resuscitation and occasionally tube thoracostomy[3,4]. Tube thoracostomy is the most common thoracic operation and performs as needed by various medical personals[5]. Thoracostomy indicated in trauma patients to drain air, blood, bile, pus, and other fluids[6].

Undoubtedly, Thoracostomy has several complications. The most common complications include empyema, hemothorax, and pneumothorax. Meanwhile, these complications can occur at the time of chest tube insertion, chest tube in-situ, or after chest tube removal. In one study overall complication rate was 19%. The complications divided into insertion complications (15.3%), in-situ complications (53.1%), and complications after removal (16.2%). The complications rate has not changed over time[7]. The diagnosis of complications is via clinical examination or CXR.

Nowdays, chest radiography after thoracostomy removal is a routine[8]. In the study of 216 patients with thoracostomy tube, pneumothorax occurred in 51 (24%) patients after removal and ten required re-insertion. Complications included empyema, hemothorax, and pneumothorax and happened in 36% of cases[9]. There are three ways to evaluate complications after thoracostomy withdrawal: first, clamping the chest tube for 6 hours period before removal; second, CXR after discontinuation; and third, close observation after extraction[10].

Several studies established that routine post-removal CXR may be not necessary[10–21]. Most of these studies have conducted in children or in groups with underlying diseases. The current study assessed the necessity of CXR after thoracostomy discontinuation among trauma patients. Considering the age range of trauma patients, who are mostly young with fewer underlying diseases than the extremes, the results of this study may be more trustworthy.

Methods

A retrospective cross-sectional study of trauma patients who underwent tube thoracostomy for any indication between March 2017 and July 2019 conducted. These patients identified by the computerized hospital archive of thoracostomy procedure codes. This rechecked by a hand search from manual records of operation procedures log book.

From 78 patients with thoracostomy in this era, 58 patients qualified for the study (20 patients with non-trauma causes for tube thoracostmy). At our center, CXR imaging is customary after thoracostomy removal. Meanwhile, a 6-hour of thoracostomy tube clamping time before chest tube removal is also routine. Exclusion criteria included incomplete records or death before thoracostomy tube extraction.

The notes reviewed for demographic variables, mechanism of injury, the ward where procedure performed, operator, indication, in-situ duration of chest tube, complications, length of hospitalization, and follow-up. Clinical evaluation notes just before and up to 12 hours after chest tube removal also recorded. The post-removal CXRs reviewed by three investigators as well as compared with previous expert radiologist reports. History and examination notes (including vital signs, pulmonary auscultation, excessive discharge from the site of thoracostomy, and the need for early dressing change after chest tube removal) listed carefully.

CXR finding indicative of complications (hemothorax and effusion, pneumothorax, lung whiteness, or a combination) recorded. The final decision variables include discharge, more than 12 hours observation or re-thoracostomy also verified and recorded. Data transferred to the R 3.6.1 software program considering patient's codes as rows. Right statistical tests applied for analysis. Chi-square and Fisher's exact tests used for comparison between two clinical and radiographic diagnosis variables and three clinical decision outcome variables. A P-value <0.05 considered statistically significant.

Results

In total 58 patients with a chest tube, 7 had bilateral thoracostomy (both left and right chest tubes). All thoracostomies had placed via open surgery. None of them had a percutaneous procedure or use of trocar. Ninety-two percent were male and 8% female with the mean age of 30 years old. The mean time spent between thoracostomy removal and discharge was 12 hours (6 to 72 hours). The chest tube mean intrapleural settlement duration was six days (see Table. 1). Hospital stay related to thoracostomy was seven days (4-43 days) on average. Blunt trauma was the most common cause of tube thoracostomy (72.4%). In 27.6% of patients, chest tube inserted for penetrating trauma. All patients had a plain CXR 6 hours after clamping of the thoracostomy tube and before thoracostomy removal.

Pneumothorax was the most common cause of thoracostomy (56.9%). Hemothorax alone reported in 10.3% of cases. Lung contusion as a wrong diagnosis, which later diagnosed on chest computed tomography (CT), was the indication in 8.6% of thoracostomies. The rest were combinations of these pathologies. None of them had a history of proven or registered lung disease. The majority (97.3%) of thoracostomies had accomplished by a trained resident or surgeon but in 1.7% by an emergency medicine specialist. All thoracostomies removed by a resident. In 85% of cases, thoracostomy had inserted in the emergency department (table. 2).

Table 1. Variables related to hospitalization time

	Range	Minimum	Maximum	median	IQR[a]
Time from DC* to discharge(hours)	66	6	72	12	3
Thoracostomy in place(days)	35	3	38	6	4
Admission time related to thoracostomy(days)	39	4	43	7	4.75

*: discontinuation of chest tube. a: interquartile range

Table 2. Distribution of the operative, remover, and the ward of placement.

		Frequency	Percent
Operator	Resident	55	94.8
	Attending	2	3.4
	Emergency medicine	1	1.7
Location of insertion	ER	47	81.0
	OR	9	15.5
	ICU	1	1.7
	Ward	1	1.7
Remover	Resident	58	100.0

Table 3. Diagnosis method for thoracostomy insertion and removal.			
Insertion indication	Clinic & eFAST*	25	43.1
	CXR	12	20.7
	CT scan	21	36.2
Removal indication	Only clinic	1	1.7
	Clinic and CXR	57	92.3

*: extended focused assessment sonography of trauma

Table 4. Frequency Distribution of accompanied Surgery.		
Operation	Frequency	Percent
No surgery	31	53.4
Orthopedic surgery	15	25.9
Neurosurgery	2	3.4
Urologic	1	1.7
Abdominal surgery	3	5.2
Thoracic surgery	4	6.9
Orthopedic and neurosurgery	2	3.4
Total	58	100.0

The frequency of the insertion indication method and to removing indication method shown in Table. 3. Thoracostomy was the lone operation in 53.4% of patients. The accompanied surgeries displayed in Table. 4. After thoracostomy removal, based on both clinical and CXR findings, 1.7% required further observation or re-thoracostomy. Chi-square test for independence between the two categories of clinical and radiographic decision variables showed a significant statistical difference (chi-square 58 and a p-value of 0.018). The comparison matrix in R software showed that plain radiograph and clinical evaluation had the same diagnostic value for decision making after thoracostomy discontinuation. The six-hours CXR was posteroanterior (PA) in 28 patients and anteroposterior(AP) in thirty. No significant correlation displayed between diagnosis and x-ray technique (p = 0.675).

Discussion

This study showed that routine CXR does not add to the diagnosis. The imaging technique (PA or AP technique) did not affect the clinical decision-making. Most of thoracostomies were after blunt trauma. The most common pathology was pneumothorax. Almost all of the thoracostomies inserted and extracted by surgeons or trained residents. In most cases, thoracostomy was the only surgical procedure. These patient series enclosed no chest tube complication.

The majority of patients were male without any history of underline lung disease. In some studies, trauma is more common in men than in women[22]. In the present study, 92% of patients were male. This proportion is slightly higher than that in literature, probably due to cultural issues and no job choice leading to injury in women.

The results showed that the majority of thoracostomies performed after blunt trauma (72.4%). These results justified by the high incidence of collision accidents in this area of the country. However, this pattern has reported in some other studies[7,23]. Thoracostomy was the only required procedure in most cases which, also evident in other studies[1,2].

Considering the low prevalence of complications in this study compared with reports in previous studies[7,24], different factors could be considered. One of the most important factors may be that all procedures for diagnosis, insertion, and removal of the thoracostomy had done by a trained resident or surgeon. The absence of percutaneous and trochar procedures could also be a reason for reduced complications[5].

There are several factors associated with increased complications. A study about the risk factors for thoracostomy tube complications concluded that the severity of the injury not associated with complications, but factors such as the presence of shock, ICU admission, and the need for mechanical ventilation associated with an increased incidence of complications. There was also a significant difference in the rate of complications between surgeons and other physicians performing thoracostomy, including emergency medicine specialists[25].

CXR imaging is routine after thoracostomy extraction[10,12,15,26]. In recent years, several studies have evaluated the necessity of chest radiography after thoracostomy extraction[10,12-15,26]. These studies determined that routine CXR is not essential and should be limited to states when there is a clinical sign of complications after thoracostomy removal[10,12-15,26]. In our study, routine x-rays after thoracostomy discontinuation do not change clinical decisions. We also showed that the clinical symptoms diligently correlated with the radiographic findings. In 1.7% of cases, the clinical diagnosis suggested more observation and finally, thoracostomy placed again after confirmation of pneumothorax by CXR.

In the study of 400 patients following Cardiac Surgery, 9.3% had new pneumothorax after thoracostomy tube removal. Pneumothorax was tiny or small in most cases (97.3%) without clinical significance. The incidence of small and medium pneumothorax was more in patients with clinical suspicion[27]. Patients without formal radiographs but with the least clinical suspicion, 1.7% had small pneumothorax. None of these pneumothoraxes resulted in medical or surgical intervention or delay in discharge[27]. In the current study, despite the routine x-rays, there was no change in final clinical decisions. The low rate of complications in this study could be due to adherence to the correct technique of insertion, proper care, and discontinuation technique. Ultimately, this could prevent the need for simple radiography that is important both economically and from a health point of view.

In these series, all patients had a plain CXR six hours after clamping of the thoracostomy tube and before thoracostomy removal. It seems that clinical signs were entirely consistent with pre-removal x-ray and no pre-removal x-ray required. It is possible to make decisions based on

clamping of the thoracostomy tube and with a careful recording of clinical symptoms[10]. In the study of Johnson et al. on 179 patients, 99% of patients had a CXR before thoracostomy extraction. In 5.6% of the circumstances, images changed decision making for patients[28]. In the study by McGrath et al. In children, exhibited that only 0.7% of 281 patients required intervention due to CXR[21].

Conclusions

CXR imaging in the absence of clinical symptoms did not make any difference in clinical decision making. The low incidence of complications may be due to the thoracostomy technique done by a trained resident or surgeon. The study should be done in a larger sample and prospectively. Neither pre-thoracostomy CXR nor post-thoracostomy CXR appears to be needed. An x-ray can be helpful in cases where there are clinical symptoms.

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