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Efficacy of Routine Chest X-ray after Chest Tube Removal in Patients Undergoing Cardiac Surgeries

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The purpose of this study is to determine the safety and efficacy of routine CXR after chest drain removal in patients undergoing cardiac surgeries. In a *Prospective*, randomized, clinical investigation, a total of 315 consecutive patients were randomly categorized into routinely and clinically indicated CXR groups, prospectively. Demographic information, type of cardiac surgeries and presence of any co morbidities were recorded. In non-routine CXR group, patients underwent radiographic evaluation if clinical signs or symptoms of complicated chest drain removal were detected. CXR findings and therapeutic interventions were also recorded for each patient. Two categories were obtained with 157 and 158 patients as routine and non-routine CXR group, respectively. Age, gender, type of cardiac surgeries and co-morbidities were comparable in both groups. Both groups did not differ significantly with respect to the frequency of signs or symptoms ($p = 0.38$), CXR findings ($p = 1.00$) and therapeutic interventions ($p = 1.00$). The difference between hospital stay duration in both groups and the frequency of readmissions were negligible. We detected no value of routine CXR after chest drain removal in postoperative cardiac patients and omission of this practice could be considered.

Key words: Chest X-ray, chest tube, cardiac surgery, pneumothorax, pleural effusion

INTRODUCTION

Growing concern over the expenditure of health care budgets has increased interest in cost-saving policies of medical practices in many countries. Considering resource allocation, health care providers have initiated to investigate many routine medical practices with regard to cost containment and outcomes. One of these routine practices that has raised questions about its utility and efficacy is obtaining chest radiographs after chest tube removal in patients undergoing cardiac surgeries (Amshel *et al.*, 1998; Pacanowski *et al.*, 2000).

Re-accumulation of pleural effusions and recurrence of pneumothorax are possible events after chest tube removal. Despite the routine protocol for chest tube insertion, the management of chest drain removal is still under debate. Routine radiographic evaluation after chest drain removal, increases radiation exposure, handling and cost but there is little data proving clinical benefit (van den Boom *et al.*, 2006).

There was a single retrospective study by McCormick *et al.* (2002) who stated that routine CXR films after chest tube removal in postoperative cardiac patients are not necessary. Accordingly they suggested that the routine CXR films after chest tube removal in postoperative cardiac surgery can be safely eliminated and this omission does not alter the course of the disease. Since the previous studies were retrospective and there was not enough support for this hypothesis, we decided to evaluate it in a prospective study. The purpose of the current study is to determine the safety and efficacy of routine CXR omission after chest tube removal in postoperative cardiac patients in a prospective evaluation.

MATERIALS AND METHODS

This study was approved by the ethics committee of Tehran University of Medical Sciences based on the ethical principals of human research and experimentation. At the beginning of study an informed consent was achieved from all participants. We evaluated 315 consecutive patients undergoing cardiac surgery in a prospective study from December 2004 to March 2004 in a university hospital as a tertiary referral center. These patients were followed until their hospital discharge. We recorded patients' demographic information, type of cardiac surgeries and presence of any co morbidities which could predispose patient to have complication after chest tube removal such as asthma and COPD. Any further emergency visits or hospital admission because of surgical complications were also registered. The patients

who died in recovery room or while still had chest tube were excluded from our study. According to the simple randomization, our patients were divided into two groups who had and did not have routine CXR films after chest tube removal. All chest tubes were removed by cardiac surgeons of our research team when its drainage was less than 100 mL 12 h in the absence of air leak. During this procedure, the patients were asked to take a deep breath and hold for a few seconds until the tube came out. Chest drains must be removed rapidly without significant traction force. Simultaneous pressure of an occlusive dressing was also carried out to prevent air from entering the pleural space. Average time of chest imaging was 3±1 hours after chest drain removal in the routine CXR group.

Our accepted clinical indications for CXR after tube removal were symptoms of dyspnea or tachypnea and any signs of abnormal arterial blood gasses, low O₂ saturation on pulse oximeter, abnormal findings in chest examination or hemodynamic instability. Postoperative routine or clinically indicated CXR, reported by a single radiologist who was blind to primary categorization of the patients. Clinical examinations were also performed by a single physician. Signs and symptoms were recorded for each patient. Chest X-ray findings were defined as any radiographic changes such as pneumothorax or pleural effusion after chest tube removal that were not detected during chest tube insertion. Any attempt to correct pathological changes in CXR or intrapleural abnormalities was accounted as therapeutic interventions.

Then, continues variable of age was described with mean (±SD) and compared using student t-test between two groups. Comparison of categorical variables was carried out utilizing the χ^2 test (or the Fisher exact test when one cell had an expected frequency of less than five). All statistical analyses were two-sided. A test result was considered statistically significant if the p-value was less than 0.05.

RESULTS

In the current study, a total of 315 patients consisted of 193 (61.3%) men and 122 (38.7%) women were evaluated prospectively (mean age: 58.9 years, range: 40-79 years.). After simple randomization, two groups of routine and non-routine chest X-ray protocol were obtained with 157 (mean age: 58.9 years.) and 158 (mean age: 58.8 years) patients, respectively. According to the Table 1, the groups were comparable regarding age (p = 0.37) and sex (p = 0.90). In addition, there were no statistically significant differences in the type of cardiac surgeries (p = 0.24) and co morbidities (p = 1.00) between the routine and non-routine CXR groups. The most

frequent type of operation was CABG-on pump (using cardiopulmonary bypass) in both groups. When patients were assessed to have any medical condition (co morbidity) that could make them experience the complications after chest tube removal, the majority of them had no co morbidities such as COPD or asthma (Table 1).

In the routine group of this study, 4.5% detected to have signs or symptoms of complicated chest drain removal during their admission. This result was quite similar to the analysis of the patients who were randomized into non-routine CXR group (p = 0.38; Table 2). Among patients undergoing radiographic evaluation because of our accepted clinical indications, 3.2 and 3.1% of routine and non-routine groups, demonstrated to have a new finding in their chest X-rays (p = 1.00). It was necessary to assess whether a radiographic finding could make a patient undergo a therapeutic intervention although the decision to perform such intervention may depend on many clinical factors more than chest X-ray findings. However, 1.9 and 2.5% of routine and non-routine groups were indicated to experience therapeutic procedures regarding their X-ray findings. Table 2 shows that the groups did not differ

significantly with respect to their therapeutic interventions (p = 1.00). When all patients were assessed for any additional radiographic evaluations more than their routine or clinically indicated Chest X-ray, no significant difference was demonstrated between two groups (p = 0.41; Table 2).

To investigate the patients' outcome in the present study, without any subsequent mortality or sever morbidity, the difference between hospital stay duration in both groups and the frequency of readmissions or extra emergency visits were negligible.

DISCUSSION

Lots of diagnostic evaluations or therapeutic procedures, once believed as beneficial interventions for patients care, have been discussed that they are not cost-effective and do not significantly change patient's outcome. For example, postoperative chest x-ray films which were once routinely used after cardiac surgeries have been denied in the absence of clinical indications by many authors (Graham *et al.*, 1998; Hornick *et al.*, 1995; Rao *et al.*, 1997; Silverstein *et al.*, 1993). McCormick *et al.* (2002) reviewed 1,021 consecutive

Table 1: Characteristics of patients at the beginning of study

Characteristics	Routine CXR group (%)	Non-routine CXR group (%)	Total patients	p-value
Gender				0.37
Male	100 (63.7%)	93 (58.9%)	193 (61.3%)	
Female	57 (36.3%)	65 (41.1%)	122 (38.7%)	
Age, (years)				0.90
Mean± SD	058.9±7.9	58.8±8.0	58.9±8.0	
Age range (years)	41-79	40-79	40-79	
Type of cardiac surgery				0.24
CABG-off Pump	8 (5.1%)	14 (8.9%)	22 (7%)	
CABG-on Pump	132 (84.1%)	127 (80.4%)	259 (82.2%)	
ASD	5 (3.2%)	2 (1.2%)	7 (2.2%)	
ASD+CABG	3 (1.9%)	1 (0.6%)	4 (1.3%)	
Valvular	9 (5.7%)	14 (8.9%)	23 (7.3%)	
Co morbidity*				1.00†
COPD	4 (2.5%)	5 (3.1%)	9 (2.9%)	
Asthma	2 (1.2%)	2 (1.3%)	4 (1.3%)	

*Most patients had no co morbidity, † Fisher's Exact Test

Table 2: Distribution of signs and symptoms, CXR findings and resulted interventions

Variable	Routine CXR group (%)	Non-routine CXR group (%)	Total patients	p-value
Signs and symptoms				0.38
Dyspnea	3 (1.9%)	9 (5.7%)	12 (3.8%)	
Tachypnea	0 (0%)	1 (0.6%)	1 (0.3%)	
Decreased pulmonary sounds	0 (0%)	4 (2.5%)	4 (1.3%)	
Low O2 saturation	2 (1.3%)	2 (1.2%)	4 (1.3%)	
Hemodynamic instability	2 (1.3%)	3 (1.8%)	5 (1.6%)	
CXR findings				1.00*
Pleural effusion	3 (1.9%)	4 (2.5%)	7 (2.2%)	
Pneumothorax	2 (1.3%)	1 (0.6%)	3 (0.9%)	
Therapeutic Intervention				1.00*
Pleural tap	1 (0.6%)	0 (0%)	1 (0.3%)	
Chest tube	2 (1.3%)	4 (2.5%)	6 (1.9%)	
Re-evaluation by CXR				0.41
Yes	5 (3.2%)	9 (5.7%)		
No	152 (96.8%)	149 (94.3%)		

*Fisher's, Exact test

patients undergoing median sternotomy due to cardiac pathologies retrospectively and determined a 1.5% incidence of therapeutic intervention after chest tube removal without any significant difference between two groups of routine and non-routine CXR.

Present study revealed that, abnormal radiographic findings are not statistically more frequent in subjects undergoing clinically indicated CXR. It was also detected that the rate of intervention and additional CXR films are identical in both groups which is similar to the findings of McCormick *et al.* (2002). This suggests that routine CXR not only burdens extra cost on asymptomatic patients, but also might lead to unnecessary interventions in patients without any pathology which is, moreover, statistically proved. Since we could not strictly follow our patients after their discharge, we only recorded readmissions and extra emergency visits which can be an underestimation of the real rate of postoperative problems. But as there were no other centers where a postoperative cardiac surgery patient can refer to in our area, we believe that this underestimation does not greatly alter our outcome. Furthermore, as there are many different insurance companies with different rates and coverages, we could not accurately calculate the cost of treatment and follow-up in these two groups.

Recently, a great deal of attention has been devoted to resource utilization of medical services. Present study revealed that no additional benefit could be realized by the strategy of routine CXR in contrast with clinically indicated CXR after chest tube removal. Definitely, personnel costs for radiology staff and amount of radiation exposure to patients and health-care workers will be decreased if we follow the protocol which supports obtaining clinically based CXRs.

Finally we suggest that routine CXR films after tube removal in postoperative cardiac patients is redundant and chest tube removal cannot be an adequate reason to order a CXR film in an asymptomatic patient.

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