Is routine chest X-ray following mediastinal drain removal after cardiac surgery useful?

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Abstract

Objective: Mediastinal and pleural drains are routinely employed following open-heart surgery to prevent accumulation of blood and fluids in the mediastinum or the pleural cavities. Chest radiographs are obtained after removal of these drains to search for a pneumothorax. We hypothesised that clinical signs and symptoms are sensitive indicators of the presence of significant pneumothorax and routine use of radiographs in these patients is unnecessary. Methods: A prospective study of 151 consecutive patients undergoing various cardiac surgical procedures over a 10-week period was undertaken. Chest X-rays were performed in all patients within 4 h of drain removal. Patients were clinically monitored for development of any respiratory difficulties and the X-rays were evaluated for presence of a pneumothorax or any other abnormality necessitating intervention. The cost of a portable chest X-ray was calculated by taking into consideration the radiographer’s time and the cost of an X-ray film. Results: There were 113 males and 38 females with a mean age of 67.5 years. Fourteen patients (9%) had obstructive airway disease. The left and right pleurae were opened in 62% and 11% of patients respectively and a chest drain was inserted in all of them intraoperatively. Three patients (2%) developed pneumothorax following drain removal. Two of these patients had clinical signs and symptoms, which would have warranted a chest X-ray. One patient had a moderate pneumothorax but was not clinically compromised. Two patients needed chest drain reinsertion that was subsequently removed after 3 and 4 days. The third patient was monitored clinically and the pneumothorax resolved spontaneously on subsequent chest X-ray. In the remaining 148 patients, postdrain removal chest X-ray did not provide any additional information to alter the management. The cost saving of omitting an additional chest X-ray was calculated to be about £10,000 per year. Conclusions: Incidence of pneumothorax following mediastinal drain removal is very low. Clinical signs and symptoms almost always identify those few patients requiring intervention and the decision to obtain an X-ray could be based on clinical judgement alone. In addition, this approach may result in cost savings without compromising patient safety.

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1. Introduction

Mediastinal and pleural drains are routinely employed following open-heart surgery to prevent accumulation of blood and fluids in the mediastinum or the pleural cavities. Chest radiographs are obtained after removal of these drains to exclude pneumothorax, pleural effusion or any other abnormality requiring intervention. Although this practice is routine, there is little evidence of any benefit from this approach. Several studies have questioned the utility of routine postoperative and postdrain removal chest X-rays. Rao et al. performed a prospective study of 340 patients undergoing cardiac surgery and found no benefit in performing postoperative chest radiographs unless clinically indicated [1]. We hypothesised that the routine use of radiographs in these patients is unnecessary and clinical signs and symptoms are a sensitive indicator of presence of any significant air collection that would merit intervention.

2. Materials and methods

A convenience sample of 151 consecutive patients undergoing various cardiac surgical procedures over a 10-week period was studied prospectively. Demographic data regarding age, sex, respiratory comorbidities, type of cardiac procedure, breach of one or both pleural cavities intraoperatively, position and number of drains, evidence of intraoperative or postoperative air leak from the drains, duration of chest drainage and probable development of postdrain removal pneumothorax were prospectively collected (Table 1). The drains were removed by the nursing staff as per unit protocol if there was less than 20 ml drainage in two consecutive hours and no visible air leak. Chest X-rays were performed in all patients within 4 h of drain removal.

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Patients were clinically monitored for development of any respiratory difficulties. The X-rays were evaluated for presence of a pneumothorax or any other abnormality necessitating intervention by the surgical registrar and corroborated with a formal radiologist’s report. The cost of a portable chest X-ray was calculated by taking into consideration the radiographer’s time and the cost of an X-ray film.

Statistics: Simple summary statistics were utilised. Data are expressed as mean ± standard deviation for continuous variables with a normal distribution. Categorical variables are expressed as an integer with their percentage values.

3. Results

A total of 151 patients were included in study. Of these, 113 (74.8%) were men and 38 (25.2%) were women with a mean age of 67.5 years. Fourteen patients (9%) had obstructive airway disease. The various cardiac surgical procedures carried out are shown in Table 1. The left and right pleurae were opened in 62% and 11% of patients respectively and all of them had a chest drain in the corresponding pleural cavity intraoperatively. One patient had an air leak in the early postoperative period, which stopped spontaneously within 24 h. In 91 patients the drains were taken out on postoperative day 1 and in 53 on day 2. Five patients had them removed on day 3 and two on day 4 following the operation. Three patients (2%) showed a pneumothorax of variable size on the chest radiograph following drain removal (Table 2). Two of these had physical signs and symptoms, which would have warranted a chest X-ray on clinical grounds. One patient had a moderate pneumothorax but was asymptomatic. A chest drain was inserted in two patients with a moderate sized pneumothorax and was subsequently removed after 3 and 4 days. In the third patient with a small pneumothorax, conservative management led to spontaneous resolution on subsequent chest X-rays. In the remaining 148 patients (98%), postdrain removal chest X-ray did not provide any additional information of clinical significance to alter the management. Given that 750 cardiac procedures are carried out per year in our institution, the cost saving of omitting a single chest X-ray was estimated to be about £10,000 per annum.

4. Discussion

With rising health care costs, there is an intensified interest in evidence-based medicine and cost effective practices bringing into focus many of the routine diagnostic tests with regard to their efficacy and usefulness.

Routine post chest drain removal radiograph in cardiac surgery is a standard practice in many cardiac centres. These are usually performed to rule out a pneumothorax or a collection in the chest cavity. The value of post chest drain removal X-rays in several retrospective studies has been questioned [2]. The incidence of findings requiring intervention is very low and in majority of cases, clinical evaluation helps in identifying these patients obviating the need for routine X-rays [3].

Hornick et al. [4] in their prospective study have shown that immediate postoperative chest X-ray following cardiac surgery unless clinically indicated, provided no additional information in managing these patients. Rao et al. [1], in their prospective study showed that omitting all routine postoperative chest X-rays following cardiac surgery unless clinically indicated, resulted in a decrease in the number of X-rays from 304 to 36 in their cohort of patients. They found an overall incidence of pneumothorax of 3% in postoperative period requiring intervention. However, it was not clear from their data whether the pneumothorax was postoperative, indicating intraoperative lung injury or postdrain removal due to inadvertent entry of air into pleural cavity. In another study, Pacharn et al. [5] retrospectively studied 374 paediatric cardiac surgical patients, and found a higher incidence (13.6%) of pneumothorax following drain removal but nearly all were clinically identifiable. Similarly, van den Boom and Battin [6] in their recent study of neonates following drain removal for pneumothorax concluded that close clinical observation is likely to detect clinically relevant recurrence of pneumothorax.

In this study, we prospectively looked at the occurrence of pneumothorax following drain removal and correlation of clinical findings with chest X-rays. Of the 151 patients, only three (1.5%) showed a pneumothorax on the X-ray following removal of chest drains and two of these were clinically

<table>
<thead>
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<th>Table 2</th>
<th>Outcome in the patients with pneumothorax</th>
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<td>Patient</td>
<td>Clinical state</td>
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<tr>
<td>A, known COPD</td>
<td>Short of breath</td>
</tr>
<tr>
<td>B</td>
<td>Short of breath</td>
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<td>C</td>
<td>Asymptomatic</td>
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SD, standard deviation; COPD, chronic obstructive pulmonary disease; CABG, coronary artery bypass graft; AVR, aortic valve replacement.
affected and would have warranted an X-ray in any case. Only one patient (<1%) with a moderate pneumothorax who underwent reinsertion of the chest drain was asymptomatic and would have been missed. Routine chest radiography did not alter the patient management in 98.5% of the patients studied.

These findings are similar to those found by McCormick et al. [2] who in a retrospective analysis of 1021 patients found a 1.5% incidence of therapeutic intervention and concluded that omitting postdrain removal X-rays was safe. Some of the data in this study was exposed to observer bias due to its retrospective nature.

Air leaking back into the pleural cavity during the removal of the drains is the usual cause of this complication. The air normally gets absorbed internally without any sequelae. Good technique in removing the drain tube by tying down the stay stitch immediately on exit of the drain and cooperation from the patient in holding the breath avoids the entry of air into the pleural cavity.

In an era of cost consciousness and reallocation of resources, adopting a policy of performing chest X-rays based on clinical indication results in financial savings. In addition, this will allow the stretched radiology services to perform more important X-rays on time.

In conclusion, the incidence of pneumothorax following mediastinal drain removal is very low. Clinical signs and symptoms almost always identify those few patients requiring intervention and the decision to obtain an X-ray could be based on clinical judgement alone. In addition, this approach may result in cost savings without compromising patient safety.

References