The Importance of Daily Routine Chest Radiography in Mechanically Ventilated Children

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ABSTRACT

Objective: To assess the usefulness of daily routine chest radiography in mechanically ventilated children.

Methods: This retrospective study was conducted in a pediatric intensive care unit at Queen Rania Al-Abdullah Hospital for children during the period between February 1 and April 30, 2010. The chest radiographs of 25 patients who had been mechanically ventilated during the study period were reviewed using the picture archiving and communication system.

Results: Of the 25 patients, 13 (52 %) were males and 12 (48 %) were females. The age ranged between 1 day and 14 years of life. Over a three month period 245 chest radiographs were done for 25 mechanically ventilated children. The main causes of admissions are shown in Table 1. 23 % of all radiographs showed cardiopulmonary abnormalities, 12 % showed malpositioned endotracheal tubes and 9 % malpositioned central venous catheter. 14% of chest radiographs had findings that altered management. The most common management changes were repositioning of central venous catheters and changes in drug therapy.

Conclusion: We conclude that the daily routine chest radiography in mechanically ventilated children had diagnostic and clinical usefulness.

Key words: pediatric, Intensive care, chest radiography, Intubation.

Introduction

The portable chest roentgenogram is one of the most frequent and effective diagnostic examinations used in the intensive care unit (1).

Obtaining daily routine chest-X Ray is a labor-intensive strategy, while diagnostic and therapeutic yields of daily routine chest-X Rays are low (2). Chest radiographs are routinely obtained in critically ill patients to monitor both clinical condition and to evaluate placement of invasive instruments such as central venous catheters and endotracheal tubes (3).

The consensus opinion of the American College of Radiology Expert Panel is that daily routine chest radiographs are indicated in patients with acute cardiopulmonary problems and in patients receiving mechanical ventilation (4).

Methods

This retrospective study was conducted in a pediatric intensive care unit at Queen Rania Al-Abdullah Hospital for children during the period between February 1 and April 30, 2010. The Queen Rania AL-Abdullah Hospital for Children is one of the affiliated hospitals of King-Hussein Medical Center in Amman, Jordan. The pediatric intensive care unit is an 18 bed mixed medical-surgical unit admitting children from birth to 14 years of age. Portable chest radiographs are routinely done every morning at 8 AM for mechanically ventilated children. Chest radiographs which are done when clinically indicated are called on demand chest X-Rays. The indication for on demand chest X-Rays includes placement of central venous catheters, endotracheal intubation and chest tube drain insertion. The chest radiographs are reviewed on daily morning rounds by pediatric intensive care consultant and fellows. These chest radiographs are accessible in the picture archiving and communication system (PACS) to the attending physicians.

Results

Of the 25 patients, 13 (52 %) were males and 12 (48 %) were females. Age ranged between 1 day and 14 years of life. Over a three month period 245 chest radiographs were done for 25 mechanically ventilated children. The main causes of admissions are shown in Table 1. 23 % of all radiographs showed cardiopulmonary abnormalities, 12 % showed malpositioned ET tubes and 9 % malpositioned CVC. 14% of chest radiographs had findings that altered management. The most common management changes were repositioning of CVC and changes of drug treatment.
Table 1: The Main diagnoses of the study group (n =25)

<table>
<thead>
<tr>
<th>Medical diagnosis (n=16)</th>
<th>Number (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronic lung disease</td>
<td>1</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>1</td>
</tr>
<tr>
<td>Acute respiratory distress syndrome</td>
<td>5</td>
</tr>
<tr>
<td>Acute bronchiolitis</td>
<td>1</td>
</tr>
<tr>
<td>Laryngomalacia</td>
<td>2</td>
</tr>
<tr>
<td>Inborn error of metabolism</td>
<td>2</td>
</tr>
<tr>
<td>Septic shock</td>
<td>1</td>
</tr>
<tr>
<td>Status epileptic</td>
<td>1</td>
</tr>
<tr>
<td>Congenital heart disease</td>
<td>2</td>
</tr>
<tr>
<td><strong>Surgical diagnosis (n=9)</strong></td>
<td></td>
</tr>
<tr>
<td>Intestinal obstruction</td>
<td>4</td>
</tr>
<tr>
<td>Tracheo-esophageal fistula</td>
<td>3</td>
</tr>
<tr>
<td>Trauma</td>
<td>1</td>
</tr>
<tr>
<td>Abdominal mass resection</td>
<td>1</td>
</tr>
</tbody>
</table>

Discussion
Whether chest radiographs in mechanically ventilated patients should be routinely obtained or only when an abnormality is anticipated remains debated (5).

While most medical studies evaluating daily chest X-Rays in patients in the ICU have been in adult populations, a few on children are available (3).

Our study showed that 14% of chest X-Rays had findings that changed management in the form of antibiotic coverage and repositioning of CVC. These results indicate clinical and diagnostic usefulness of daily routine chest X-Rays in mechanically ventilated pediatric patients.

Previous studies have evaluated the efficacy of daily routine chest X-Rays in mechanically ventilated children.

Sivit CJ et al prospectively evaluated the efficacy and clinical usefulness of bedside chest radiography in a pediatric intensive-care unit, where seven hundred and ninety-five radiographs were evaluated in 126 patients over a 10-week period in Children’s Hospital National Medical Center, Washington, D.C and their data indicated that bedside radiography in the pediatric intensive-care setting has a high efficacy and clinical utility (6).

Brainsky et al observed that 20% of routine chest X-Rays performed in a medical ICU had major important findings, and 8% prompted a change in management. The majority of changes related to diuretic use, antibiotic coverage, initiation of a diagnostic test, or decisions regarding ventilator weaning (7).

In a prospective study, Hall et al compared bedside clinical diagnosis with the diagnosis made from the routine chest X-Ray. A total of 538 chest radiographs were examined; of these, 354 (65.8%) did not disclose either new major or new minor findings but one hundred and sixty-three radiographs disclosed only new minor findings, 40.5% of which were anticipated by bedside assessment (8). However, in 13 (17.6%) of the 74 patients, new major findings were discovered only by chest radiography. These data demonstrate that, while a large percentage of radiographs will not disclose new findings, routine daily studies have a substantial impact on the management of intubated, mechanically ventilated patients in the ICU which support the use of daily chest radiographs in critically ill patients (8).

On the contrary to the findings of our study, many studies have questioned the usefulness of daily routine chest X-Rays on diagnostic and therapeutic level and its association with economic cost.

A study conducted by Karine A et al in Amsterdam-Netherland on 1780 daily routine chest-X-Rays in 559 hospital admissions, reported low value of daily routine chest-X-Rays (2).

Hejblume G et al compared routine and on-demand chest radiography in 21 intensive care units at 18 hospitals, in France. They strongly support adoption of an on-demand strategy in preference to a routine strategy to decrease use of
chest radiographs in mechanically ventilated patients without a reduction in patients’ quality of care or safety (9).

Bekemeyer et al found that 27% of both routine and non-routine chest-X-Rays revealed clinically unsuspected abnormalities, but that non-routine films were more likely to change investigative or therapeutic management (10).

Price et al found that 37% of chest-X-Rays could be avoided by establishing specific indications, thereby resulting in significant cost savings (11).

Chahine-Malus N et al evaluated the diagnostic and therapeutic efficacy of daily routine and clinically indicated chest-X-Rays in a prospective controlled blinded study in a nonacademic, mixed medical-surgical ICU. In addition, the effects of abandoning the daily routine chest X-Rays strategy on chest Ray volume, ICU length of stay, readmission rate, and mortality were evaluated during a 6-month period. The results confirm and corroborate previous data indicating that the diagnostic yield and therapeutic consequences of daily routine chest-X-Rays are very low (12).

In summary we conclude that daily routine chest radiographs in mechanically ventilated children had diagnostic and therapeutic usefulness but we need a study to compare between daily chest X-Rays and on demand chest X-Rays with more patients to be included and figures to be statistically analyzed to support our opinion.

References


