

Frequency of abnormal findings on routine chest radiography before cardiac surgery

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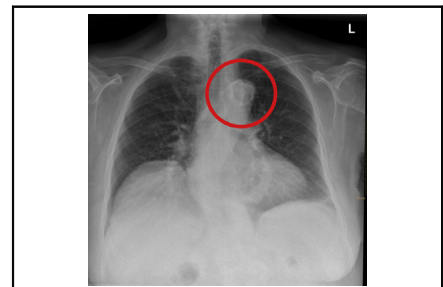
ABSTRACT

Objective: Preoperative chest radiograph screening is widely used before cardiac surgery. The objective of this study was to investigate the frequency of abnormal findings on a routine chest radiograph before cardiac surgery.

Methods: In this retrospective cohort study, 1136 patients were included. Patients were scheduled for cardiac surgery and underwent a preoperative chest radiograph. The primary outcome was the frequency of abnormalities on the chest radiograph. Secondary outcome was the effect of those abnormalities on surgery.

Results: One half of the patients (570/1136; 50%) had 1 or more abnormalities on the chest radiograph. Most frequent abnormalities were cardiomegaly, aortic elongation, signs of chronic obstructive pulmonary disease, vertebral fractures or height loss, possible pulmonary or mediastinal mass, pleural effusion, and atelectasis. In 2 patients (2/1136; 0.2%), the chest radiograph led to postponement of surgery, whereas in none of the patients the surgery was cancelled. In 1 patient (1/1136; 0.1%) the surgical approach was altered and in 15 patients (15/1136; 1.3%) further analysis was performed without having an impact on the planned surgical approach.

Conclusions: Although abnormalities are frequently found on preoperative chest radiographs before cardiac surgery, change in clinical management with regard to planned surgery or surgical approach occurs infrequently. (*J Thorac Cardiovasc Surg* 2018; ■:1-6)



Chest radiograph of an 81-year-old woman with extensive aortic calcifications.

Central Message

Abnormalities are frequently found on preoperative chest radiographs before cardiac surgery, but change in clinical management with regard to planned surgery or surgical approach occurs infrequently.

Perspective

A routine preoperative chest radiograph rarely has direct consequences for the planned surgery or surgical approach. Most abnormal findings are to be expected (eg, cardiomegaly) and therefore do not have a direct effect on the surgery. However, some findings can substantially alter the surgical approach in specific cases.

See Editorial Commentary page XXX.

More than 30 billion dollars is spent annually on preoperative testing in the United States.¹ A conventional chest radiograph is performed before both cardiac and noncardiac surgery in many hospitals as part of the routine workup. Although the cost of a chest radiograph is relatively low (estimated at \$31²) and the associated

radiation risks are small, there are doubts about the efficacy of routinely performing preoperative chest radiographs. For noncardiac surgery, several studies have demonstrated that a routine preoperative chest radiograph does not decrease morbidity or mortality.³ The frequency of abnormal findings on a routine preoperative chest radiograph before noncardiac surgery is 10%, but in only 0.1% does this cause a modification of clinical management.⁴ Therefore, it is recommended to only perform a preoperative chest

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Abbreviations and Acronyms

COPD	= chronic obstructive pulmonary disease
CT	= computed tomography
LUS	= lung ultrasound
UMCU	= University Medical Center Utrecht

radiograph if the results are expected to change perioperative management.⁵ Despite these recommendations, routine chest radiographs are still performed frequently before noncardiac surgery.⁶

In cardiac surgery, however, the frequency of abnormal findings on routine preoperative chest radiography is unknown. Cardiac surgery guidelines do not give recommendations whether a routine chest radiograph should be performed before cardiac surgery.⁷⁻¹⁰ Because cardiac surgery is associated with greater risks, routine chest radiography can possibly contribute to improved preoperative risk assessment.

To the best of our knowledge, there are no published studies that have investigated the frequency of abnormalities on routinely performed preoperative chest radiography in patients undergoing cardiac surgery. Therefore, the primary goal of this study was to investigate the frequency and types of abnormalities found on routinely performed chest radiographs in patients scheduled to undergo cardiac surgery. The secondary goal was to assess the effect of the preoperative chest radiograph on planned surgery.

METHODS

The STROBE (Strengthening The Reporting of OBServational studies in Epidemiology) guidelines for observational studies were used.¹¹ A retrospective cohort study was performed at the University Medical Center Utrecht (UMCU). The UMCU is a tertiary referral center and 1 of 16 hospitals in the Netherlands that performs cardiac surgery. The local institutional review board waived the need for informed consent (institutional review board approval: June 25, 2016; protocol number 15-359/C), because the study only involves retrospective analysis of recorded data.

Chest Radiography

A chest radiograph is part of the routine preoperative work-up at the UMCU. A chest radiograph in the lateral and posteroanterior direction was made with a digital flat-panel detector system with a tube potential of 125 kV (Philips Healthcare, Best, The Netherlands). The mAs value was optimized per patient by using automated exposure control. All radiographs were assessed and reported by a radiologist or radiology resident in the routine clinical care setting. No structured reporting was used. The reporting radiologist had access to previous imaging examinations as well as the electronic patient file.

Data Collection and Analysis

Patients from different hospitals are referred to the UMCU for cardiac surgery. After the patient is discussed in a multidisciplinary meeting and approved for surgery, the patient is invited to the hospital for preoperative screening. During this screening, the clinical history is obtained as well and a physical examination as well as preoperative tests, including a chest

radiograph, are performed. A random selection of all chest radiographs ordered by the Department of Cardiothoracic Surgery between May 2011 and August 2015 was automatically extracted from the Picture Archiving and Communication System. The text-based chest radiograph reports were assessed by 1 observer (A.H.) with 3 years of experience in radiology. The reports were made in routine clinical care by a radiologist and/or radiology resident at the time of acquisition. The chest radiograph images were not reassessed by the study observer. Postoperative chest radiographs were excluded. Patients who underwent screening for thoracic surgery or minimally invasive procedures (eg, video-assisted thoracoscopic surgery, lobectomy, mediastinoscopy, implantable cardioverter-defibrillator replacement, and procedures involving solely removal of sternal wires) were excluded.

Subsequently, the report was assessed to see whether any abnormalities were described. Abnormalities were divided in the following categories: pulmonary or mediastinal mass, consolidation, pleural effusion, cardiomegaly (cardiothoracic ratio $\geq 50\%$), aortic elongation, aortic calcifications, signs of cardiac decompensation, vertebral fractures or height loss, atelectasis, signs of chronic obstructive pulmonary disease (COPD), or a diaphragmatic herniation. In case of uncertainty, the observer discussed the described abnormality with a board-certified chest radiologist with more than 10 years of experience in radiology (P.J.).

Also, the date of the most recent chest radiograph before the routine preoperative chest radiograph and/or chest computed tomography (CT) was recorded. Both non-contrast-enhanced and contrast-enhanced cardiac and chest CT examinations were included as well as positron emission tomography-CT examinations. If a previous imaging examination was mentioned in the referral letter without the exact date of the examination and the examination was not available in the Picture Archiving and Communication System, the date of the referral letter was used.

The electronic patient file of the cardiothoracic surgery department was used to determine whether the chest radiograph results impacted the planned surgery. This was categorized as postponement of surgery, cancellation of surgery, change in surgical approach, or further diagnostic testing and analysis was needed. A direction relation between the abnormality described on the chest radiograph and the effect on surgery had to be mentioned.

For each patient, baseline patient characteristics, type of surgery, and postoperative complications were derived from the nationwide complication registry of the Dutch Association for Thoracic Surgery. This registry is based on the complication registry from the Society of Thoracic Surgeons and is mandatory for each patient undergoing cardiac surgery in The Netherlands. Completeness and accuracy of the nationwide complication registry are excellent (99% of the data are complete).¹²

Analysis was performed with SPSS, version 20.0.0 (IBM Corp, Armonk, NY). Data are presented as mean \pm SD unless otherwise stated. Frequencies are provided as count and percentage. Data are presented by the use of descriptive analysis.

RESULTS**Patient Selection and Baseline Characteristics**

The chest radiograph reports of a total of 1293 patients were screened. Overall, 157 patients were excluded because they underwent either thoracic surgery ($n = 119$) or minimally invasive surgery ($n = 38$; implantable cardioverter-defibrillator replacements and procedures involving solely the removal of sternal wires). Ultimately, 1136 patients were included. Baseline patient characteristics are provided in Table 1. Mean age was 65 ± 13 years and 30% was female. Details regarding the surgical procedure are provided in Table 2. Most surgeries were elective (772/1136; 70.2%) or within the same

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