

Thoracic and Cardiac Imaging / Imagerie cardiaque et imagerie thoracique

Chest Radiographs Are Valuable in Demonstrating Clinically Significant Pacemaker Complications That Require Reoperation

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Abstract

Purpose: To evaluate the utility of chest radiography in demonstrating clinically significant pacemaker complications that required reoperation.

Methods: In this retrospective case-controlled series, we identified 14 consecutive adults who required pacemaker reoperation and who had chest radiographs available for review (6 men, 8 women; mean age, 71 years [range, 43–95 years]). Ten patients had pacemakers implanted at our institution, and 4 were referred for reoperation. Forty-two controls, 3 for each patient, had postoperative chest radiographs and normal device function (25 men, 17 women; mean age 76 years [range, 37–96 years]). All postoperative chest radiographs, including 1-year follow-ups, were blindly reviewed by at least 2 of 4 radiologists for lead perforation and position of right atrial and right ventricular leads. Follow-up radiographs were assessed for lead perforation, lead displacement, and lead fracture. Data were analysed by using the Fisher exact test.

Results: Of the patients, 1.7% (10/581) required reoperation for pacemaker dysfunction (noncapture, oversensing, abnormal atrial and ventricular thresholds, failing impedance), extracardiac stimulation, and lead perforation and/or displacement. There were no lead fractures. Chest radiographs demonstrated pacemaker complications in 57% of patients (8/14) at a median of 2 days (<1–32 days) after implantation and in 5% of the controls (2/42) ($P < .0001$). None of the abnormalities were noted on the official reports. Among subgroups, chest radiographs were abnormal for the following indications: pacemaker dysfunction in 4 of 7 patients versus 0 of 21 controls ($P = .0017$), extracardiac stimulation in 1 of 3 patients vs 0 of 9 controls ($P = .25$), and lead perforation and/or displacement in 3 of 4 patients vs 2 of 12 controls ($P = .06$).

Conclusions: Chest radiographs are useful after pacemaker placement and demonstrate the majority of complications that require reoperation. Familiarity with the expected normal position of the leads, appearances of pacemaker complications, and comparison with prior radiographs is crucial in rendering a correct diagnosis that guides patient management.

Résumé

Objectif: Évaluer l'utilité de la radiographie pulmonaire pour révéler les complications liées à un stimulateur cardiaque qui sont cliniquement significatives et qui nécessitent une réintervention.

Méthodes: Dans cette étude rétrospective de type cas témoins, nous avons identifié une série de 14 patients adultes consécutifs qui ont nécessité une réintervention après l'implantation d'un stimulateur cardiaque et pour qui des radiographies pulmonaires étaient disponibles (6 hommes, 8 femmes; âge moyen de 71 ans [écart, 43 à 95 ans]). Dix patients avaient subi une intervention d'implantation de stimulateur dans notre établissement, tandis que quatre nous ont été adressés pour une réintervention. Les 42 sujets témoins (soit 3 pour chaque patient) avaient subi des radiographies postopératoires et avaient un stimulateur fonctionnant normalement (25 hommes, 17 femmes; âge moyen de 76 ans [écart, 37 à 96 ans]). Toutes les radiographies pulmonaires postopératoires, incluant celles des suivis à un an, ont été révisées à l'aveugle par au moins deux des quatre radiologistes pour dépister une perforation myocardique par une sonde et vérifier la position des sondes auriculaire et ventriculaire droites. Les radiographies de suivi ont été révisées pour détecter la présence de perforations par une sonde, de déplacements et de ruptures de sondes. Les données ont été analysées en utilisant le test exact de probabilité de Fisher.

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Résultats: Une réintervention s'est avérée nécessaire en raison d'un dysfonctionnement du stimulateur cardiaque (non-détection, surdétection, seuils auriculaires et ventriculaires anormaux, impédance insuffisante), d'une stimulation extracardiaque, d'une perforation myocardique et (ou) d'un déplacement de sonde chez 1,7 % des patients (10/581). Aucune rupture de sonde n'a été observée. Les radiographies pulmonaires ont permis de détecter des complications liées au stimulateur cardiaque chez 57 % des patients (8/14) dans un délai médian de deux jours après l'implantation (<1 jour à 32 jours), et chez 5 % des sujets témoins (2/42) ($P < 0,0001$). Aucune des anomalies n'était notée dans les rapports officiels. Quant aux sous-groupes, les radiographies pulmonaires étaient anormales dans les indications suivantes : dans les cas de dysfonctionnement du stimulateur, elles étaient anormales chez 4 patients sur 7, comparativement à 0 sujet témoin sur 21 ($P = 0,0017$); dans les cas de stimulation extracardiaque, elles étaient anormales pour 1 patient sur 3, comparativement à 0 sujet témoin sur 9 ($P = 0,25$); dans les cas de perforation myocardique et (ou) de déplacement de sonde, elles étaient anormales chez 3 patients sur 4, comparativement à 2 sujets témoins sur 12 ($P = 0,06$).

Conclusions: La radiographie pulmonaire est utile après l'implantation d'un stimulateur cardiaque, révélant la majorité des complications qui nécessitent une réintervention. Afin de poser un diagnostic exact qui permet de guider la prise en charge du patient, il est essentiel de bien connaître la position normale attendue des sondes ainsi que l'aspect des complications liées aux stimulateurs cardiaques, et d'établir des comparaisons avec les radiographies antérieures.

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Key Words: Pacemaker; Chest radiography; Complications

Pacemakers have proven to be effective in the treatment of cardiac arrhythmias, congestive heart failure, and vasodepressor syncope. Postprocedural frontal and lateral chest radiographs are often performed to determine the lead position and integrity after implantation and to identify complications [1]. Early complications after device implantation include lead malpositioning, myocardial perforation, and pneumothorax [1,2]. Suboptimal lead positioning may occur at the time of surgery or may result from lead dislodgement a few days after the procedure [1]. Unsatisfactory lead positioning is not uncommon after surgery and has been reported to occur in 5.5%–14% of patients [3,4]. Clinically manifest acute perforation of the right atrium or right ventricle is extremely rare, occurring in fewer than 1% of patients [3,5]. Pacemaker dysfunction, particularly loss of capture, presents as a delayed complication and is caused by mechanical factors, including lead displacement, myocardial perforation, and lead fracture [1,2]. Lead displacement has an incidence of up to 5%–10% [6,7] and tends to occur early, within weeks of implantation, because the fibrinous adherence that develops between the electrode, and endocardium protects against late displacement [2]. Lead fracture, which has received little attention in the literature, is reported in about 1% of patients and has very subtle imaging findings [3].

The value of routine chest radiography after device implantation remains uncertain and usually plays a secondary role to the clinical scenario, including the sensing and pacing parameters [4]. We conducted the present study to determine whether chest radiography is useful in demonstrating clinically significant device complications that required reoperation.

Materials and Methods

Patients

Our study population comprised 14 consecutive adults who required pacemaker reoperation at our academic

medical center between May 2005 and June 2008 and who had chest radiographs available for review after placement of the pacemaker and before reoperation. Ten of the pacemakers were implanted at our institution, and 4 were referred to our institution for reoperation. There were 6 men and 8 women, with a mean age of 71 years (range, 43–95 years). Device complications that required reoperation were divided into 3 categories: pacemaker dysfunction (noncapture, oversensing, abnormal atrial and ventricular thresholds, failing impedance), extracardiac stimulation, and lead perforation and/or displacement. Infection was excluded, because it is known to only rarely be detectable on chest radiography. To optimize the power of this case-control design, we retrospectively identified the 3 controls for each patient [8]. The controls were the 3 consecutive patients who had pacemaker implantation immediately subsequent to each patient and who did not require reoperation. Each control also completed 1 year of follow-up, had normal device function, and had serial chest radiographs available for review on a picture archiving and communication system (PACS). There were 42 controls: 25 men and 17 women, with a mean age of 76 years (range, 37–96 years).

Imaging Assessment of the Pacemaker

The standard protocol at many pacemaker centres consists of immediate assessment of pacemaker lead positioning by using fluoroscopy, followed by postimplantation posteroanterior and lateral or anteroposterior chest radiographs to exclude pneumothorax and confirm lead positioning. Postprocedure posteroanterior and lateral chest radiographs were performed for 6 patients and 31 controls, whereas anteroposterior chest radiographs were performed in 4 patients and 11 controls ($P = .45$).

At least 2 members of a panel composed of 3 board-certified, fellowship-trained cardiothoracic radiologists, and 1 radiology resident, blinded to all clinical information,

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