



Bedside Chest Radiographs and How Ambiguous Peripherally Inserted Central Catheter Tips Happen: A Case Report

Stuart Gordon, MSN, RN, CRNI, VA-BC, RN-BC

Legacy Emanuel, Portland, OR

Abstract

Verification of peripherally inserted central catheter (PICC) tip location with radiographic imaging is at times challenging. This case report details the experience of 1 patient and the difficulties encountered identifying the PICC tip using bedside chest radiographs. It examines, offers to explain the issues, and reviews the results of 209 chest radiographs post-PICC placement for consistency.

Keywords: PICC confirmation radiograph, radiograph gold standard, bedside chest radiograph

Introduction

The tip of a peripherally inserted central catheter (PICC) should ideally be in the distal one-third of the superior vena cava (SVC) or cavoatrial junction (CAJ), but correctly identifying placement using bedside chest radiographic imaging is often difficult. The following is a detailed examination of the errors introduced with bedside chest radiographs, followed by a case report. Inaccuracies seen with bedside chest radiographs may lead to unnecessary manipulation or replacement of a PICC; may increase costs to patients; may increase the risk of infection; and may result in the PICC tip terminating, unseen, in a location more distal than the CAJ. The purpose of this article is to bring into focus how bedside chest radiographs fail.

The use of bedside radiographic imaging to verify central line tip location and identify placement-related complications is considered by many to be the only acceptable assessment method postinsertion. However, those placing PICC lines have experienced first-hand the difficulties of seeing the tip or accurately judging the appropriate distance to withdraw the PICC when the tip is determined to be in the atria. Members of vascular access teams placing lines are more intimately familiar with the limitations and frustrations than the independent providers who only see the results of a team's

work. With the widespread introduction of electrocardiogram (ECG), ECG/Doppler, and ECG/magnetic PICC tip locators the limitations of radiographs have only been magnified.

Accurately identifying the location of a PICC tip with initial placement saves nursing time and patient cost. If, for example, the tip of a PICC is seen projecting below the CAJ institutional policy may require retraction of the line to bring it out of the atria. This requires nursing time to perform the adjustment, it delays use of the line, it requires disruption of the overlying dressing (an intervention that has been shown to increase the risk of a central line-associated bloodstream infection¹), and it will increase the overall cost to patients. Alternatively, if the tip of a PICC is seen at the confluence of the brachiocephalic veins many will remove and replace the PICC, again increasing cost, nursing time, and the risk of infection. This case study suggests initial bedside chest radiograph errors may lead to unnecessary adjustments of PICC lines.

Discussion

The impediments to accurately identifying the tip of a PICC with a bedside chest radiograph are patient position in relation to the source of radiographic images, whether the radiograph is taken during inspiration or expiration, cardiac motion blur, interreader variability, patient position, and patient body habitus. For the following examples and for the case study it may be helpful to think of radiographic results as shadows. A radiation source will emit high-energy photons that travel through or are blocked by, in this case, the bones, organs, and a central line in the chest on their way to the radiography plate.

Parallax error will occur when the radiographic source and the radiography plate are not in 90° alignment. The idea of

Correspondence concerning this article should be addressed to sgordon@lhs.org

<http://dx.doi.org/10.1016/j.java.2016.08.001>

Copyright © 2016 ASSOCIATION FOR VASCULAR ACCESS. Published by Elsevier Inc. All rights reserved.

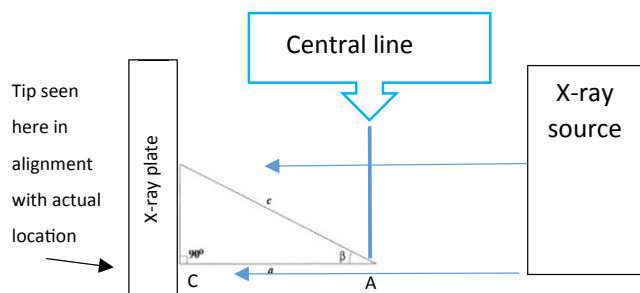


Figure 1. Fluoroscopic image after initial placement of the port.

parallax can be visualized by thinking of a right triangle, where the source of the radiograph is point A, the path of photons from the high energy (radiograph) source is side B, and the resulting image of the tip is point C (Figure 1). If the source of photons is not 90° to the plate the path of photons becomes side C and the image of the tip becomes point B instead of the actual tip at point C (Figure 2). Using the equation $a = p \frac{p-2b}{2(p-b)}$ (solving for side a of a right triangle) if the source of radiographs is 7° either side of 90° (ie, 83° or 97°) and the distance from point A to point C is 15 cm (average distance from the tip of the catheter to the radiography plate in a 70-75 kg patient) there will be a 2 cm (rounded up) error in identifying where the tip of the catheter appears. Although 2 cm may seem trivial, if the radiograph shows the PICC 2 cm into the atria due to parallax, the result may be an unnecessary retraction. Having the source of radiographs and the radiography plate in correct alignment (as they are set in a radiology department) would all but eliminate parallax; however, taking a patient to a radiology department is not always an option.

The ability to see the tip of a PICC is in part dependent on the size of the patient. Adequate penetration of x-rays through tissue is contingent on exposure to the source and larger patients are exposed for longer times. Longer exposure times increase the chance of having cardiac motion and blood turbulence whip the catheter, blurring the image in the same way long camera exposure times will blur pictures. This is often referred to as cardiac motion blur and as the fluoroscopic images in Figures 3 and 4 show, it is not limited to PICC catheters nor is it limited to bedside chest radiographs.

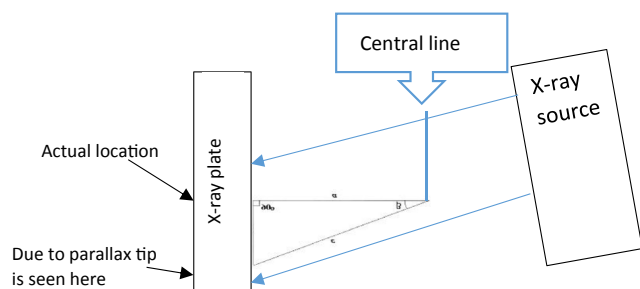


Figure 2. Fluoroscopic image before port revision secondary to palpitations.

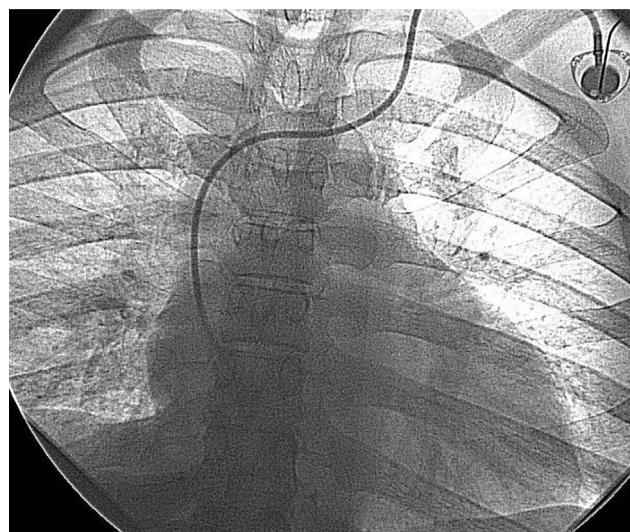


Figure 3. Fluoroscopic image of a port.

Figures 3 and 4 are of the same patient—Figure 3 after initial placement of the port and Figure 4 before port revision secondary to palpitations. Figure 5 shows a PICC, immediately postplacement, whereas Figure 6 is of the same patient 3 days later. This patient's electronic health record was reviewed to verify that the line had neither been manipulated nor had it migrated, it was cardiac motion that blurred the distal end of the PICC.

Several factors contribute to the differences in interpretation of tip location, the first being interreader variability. Different radiologists will use different landmarks when interpreting what they see, and being able to see the PICC tip is—as noted above—sometimes difficult. There is little consensus as to how well bedside chest radiographic images correlate to the CAJ when using common landmarks. Vesely states, “A catheter tip positioned 3 cm below the right tracheobronchial angle would always be in the SVC,”² and in a 2008 study Verhey found, “The average distance from the superior vena cava—right atrial appendage to the cavoatrial junction was 1.8 cm” on chest radiographs in adult patients.³ A similar conclusion was reached by Baskin et al,⁴ who found “the true cavoatrial junction is located more inferiorly than commonly believed and is not accurately estimated with commonly used imaging landmarks.” The population in that study was predominately pediatric patients lying in a supine position and the authors reviewed computerized tomography (CT) results. Another study using CT found tip placement 4 cm below the carina “will result in placement near the cavoatrial junction.”⁵ Perhaps the results of these articles is best summed up by Wirsing et al,⁶ who used transesophageal echocardiography to assess accuracy of bedside chest radiographs and determined, “Reading of a bedside chest x-ray alone is not very accurate to identify intra-atrial [central venous catheter] tip location.” They went on to say, “Although bedside [chest radiograph] can be a convenient screening tool for some problems, it cannot serve as a ‘gold standard’ for assessing a [central venous catheter] tip position with respect to the right atrium.”

Download English Version:

<https://daneshyari.com/en/article/5569256>

Download Persian Version:

<https://daneshyari.com/article/5569256>

[Daneshyari.com](https://daneshyari.com)