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5-1-2008

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Recommended Citation

Keckler, S. J., Spilde, T. L., Ho, B., Tsao, K., Ostlie, D. J., Holcomb, G. W., St Peter, S. D. Chest radiograph after central line placement under fluoroscopy: utility or futility? *Journal of pediatric surgery* 43, 854-856 (2008).

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Published in final edited form as:

J Pediatr Surg. 2008 May ; 43(5): 854–856. doi:10.1016/j.jpedsurg.2007.12.027.

Chest radiograph after central line placement under fluoroscopy: utility or futility?

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Abstract

Background—Postoperative portable chest films are routinely performed after fluoroscopic placement of central venous catheters to evaluate positioning and to rule out significant complications (eg, pneumothorax). Emerging evidence in the literature has called this practice into question suggesting that routine postoperative chest x-ray is unnecessary. Therefore, we investigated our recent experience to examine the utility of these films, to examine the development of symptoms relative to therapeutic intervention, and to report a cost-benefit analysis.

Methods—After obtaining institutional review board approval, all charts of patients undergoing central venous catheter placement from January 2004 to December 2005 at our institution were reviewed. Outcome measures included whether or not there was a complication and whether or not that complication required an intervention. Peripherally inserted central catheters were not included.

Results—In the study population, 237 catheters were placed in the operating room. There were two complications, both pneumothoraces (0.085%). One patient required tube thoracostomy, whereas the other was asymptomatic and the pneumothorax resolved spontaneously. Fourteen patients had no postoperative chest film without adverse consequences. Total cost for portable chest films was \$56,196.

Conclusions—For catheters placed under fluoroscopic guidance, postoperative chest films in asymptomatic patients add unnecessary cost. For this reason, we feel discontinuation of postoperative chest films in asymptomatic patients undergoing catheter placement with fluoroscopy is justifiable.

Keywords

Central venous catheter; Central line placement; Chest x-ray; Fluoroscopy

Central venous catheterization is a common procedure in children. When catheters are placed in the superior venous system, postoperative chest radiograph is typically performed to verify appropriate catheter placement and to rule out complications such as hemothorax, pneumothorax, or pleural effusion [1]. Previous studies in both the adult and pediatric literature have brought this practice into question when the procedure is performed using fluoroscopic guidance [1–8]. In the pediatric literature, these studies have not examined the

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Presented at the 39th Annual Meeting of the Canadian Association of Pediatric Surgeons, August 23–26, 2007, St John's Newfoundland, Canada.

cost-to-benefit ratio. We audited our recent experience with central line placement under fluoroscopy to verify the findings of the previous studies, determine the relationship of therapeutic interventions to symptoms, and to quantify the resources utilized by the practice of routine chest radiographs in the recovery room.

1. Methods

After institutional review board approval (05 12–153X), we conducted a retrospective review of all children who underwent central venous catheterization by the pediatric surgery service at Children's Mercy Hospital from January 2004 to December 2005. Central venous catheters placed by interventional radiology and peripherally inserted central catheters lines were excluded from our study. Demographic data included age and sex. Data collected included use of fluoroscopy, postoperative chest x-ray results, symptoms in the recovery room, and the occurrence of complications. Estimated cost is based on our current average institutional charge for a portable chest x-ray, which is \$252 per film. Descriptive statistics are listed as mean \pm SD.

2. Results

A total of 237 central lines were placed by the surgery service during the examined time period. Mean patient age was 4.9 ± 5.5 years (range, 0–18 years). The group was composed of 124 males and 113 females. There were 2 complications; both pneumothoraces (0.085%). One patient became symptomatic with shortness of breath and required tube thoracostomy, whereas the other was asymptomatic and the pneumothorax resolved spontaneously. Fourteen patients had no postoperative chest film and there were no adverse consequences. There were no chest films demonstrating catheter misplacement or abnormality requiring early revision. Based on the current average institutional charge for portable chest films, the total cost was \$56,196.

3. Discussion

Data currently accumulating in the adult literature have suggested a postoperative chest film may not be necessary if a central line is placed under fluoroscopic guidance [1,3–8]. A single retrospective review of a pediatric population has been published that, similar to our experience, documented a total complication rate of 1.6%, with a complication rate of 0.6% in the subgroup where fluoroscopy was used for placement of the catheters [2]. The authors concluded that routine chest x-ray after fluoroscopic placement should not be necessary. Thus, there is a mounting movement in the literature supporting the exclusion of routine chest x-rays after central line placement. This movement is based on solid logic: that the surgeon has the same view offered by the portable x-ray with the fluoroscopy in the operating room. The surgeon can see the curve of the line to ensure there is no kink and flush it on the table to prove it is patent. By simply looking at the apex of the lung and the costo-diaphragmatic angle after placement, the surgeon can effectively rule out significant pneumo- or hemothorax. Independent of the intraoperative radiography, we were specifically interested in the relationship of postoperative therapeutic interventions to the development of symptoms. The patient who could nullify the movement toward excluding routine chest x-rays is one who demonstrates no physiologic perturbation during their time in the recovery room then subsequently develops a pneumo- and/or hemothorax requiring intervention. Our total pool of patients with complications is extremely small with only 2 individuals, but these patients were illuminating for our interest. The one patient requiring a chest tube was clearly symptomatic with tachypnea and decreased oxygen saturation. This patient therefore could have easily been treated without a chest film and would have been, if the situation had become more acute. The other patient with a pneumothorax showed no

symptoms in recovery but went on to recover without intervention, implying the patient with no symptoms will likely not have a pathology requiring treatment. Stated another way, patients requiring intervention will almost certainly have abnormal clinical parameters, allowing for the selective use of chest films only in those patients who demonstrate an abnormal clinical parameter.

Therefore, in our series, the total cost of postoperative chest radiographs was slightly more than \$56,000 to result in a single chest tube placement, in which case the film was superfluous as the situation could have easily been handled with auscultation on the side of the line placement. If the practice of selective chest x-rays for symptomatic patients were universally applied, assuming a similar complication rate, the net benefit on resource use for the health care system would be immense. At an average cost of \$200 per chest film, assuming 100 central venous catheters per year per hospital, the savings would be approximately \$2.3 million per year for the roughly 116 hospitals providing dedicated pediatric care in North America. Safety will remain the primary concern for all caregivers, but our data lend further support to the notion that after a central line is placed in the operating room under fluoroscopy, a chest x-ray can be reserved for the symptomatic patient.

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