

IS IT ALWAYS NEEDED TO DO A CHEST X-RAY POST-CENTRAL LINE PLACEMENT?

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ABSTRACT

Objective: To find out the ability of physicians to predict in advance complications associated with the insertion of central venous line and to decide whether a chest X-ray is needed after placement.

Methods: Patients receiving subclavian central venous access in King Hussein Medical Center - intensive care unit were studied. Patient demographics, patient history, procedural details of the placement, and the type of catheter used were collected. The physician then predicted which patients had a reasonable potential to undergo radiography, which was then compared with the original prediction.

Results: Ninety patients who had central venous line insertion were included in the study. Eighty of the 90 central lines thought by the physicians to have been placed without event caused no significant complications; one individual in this group had a minor pneumothorax. Two of 10 patients predicted to have complications were noted to have a pneumothorax that required chest tubes.

Conclusion: Post central line insertion chest radiographs may potentially be ignored in certain cases after line insertion when experienced clinicians use proper technique, good clinical judgment, and discrimination.

Key words: Chest X-ray, Central venous line, Intensive care unit.

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Introduction

The technique of percutaneous central venous catheterization was described first by Aubaniac ⁽¹⁾ in 1952. Aubaniac described his experience with the use of subclavian fluids in military casualties. The use of central venous access expanded when an article about the use of pressure monitoring was published in 1962 ⁽²⁾. Further uses of central venous accesses became more common with the advent of total parenteral nutrition in 1968. According to the food and drug Administration, approximately 5 to 6 million catheters are placed in patients in the United States on an annual basis ⁽³⁾.

The placement of these catheters has been associated with various complications including pneumothorax, hemothorax, hydrothorax, chylothorax, arrhythmias, cardiac tamponade, hematoma formation, air embolism, infection, injury to the great vessels, thrombosis, injury to the brachial plexus, injury to the phrenic nerve, and death ⁽⁴⁻⁹⁾. The rate of complications from placement of these lines ranges from 0.4 to 20% ⁽¹⁰⁻²⁰⁾. Significant

malpositioning of the catheter occurs in approximately 2% of the patients when either a subclavian or internal jugular vein approach is used ⁽¹³⁾. Several studies have correlated these stated complications as being inversely proportional in their occurrence rate with the level of experience of the person placing the line ⁽¹⁴⁻¹⁸⁾.

In our intensive care unit (ICU), as in many other departments in KHMC, the standard of care has been to obtain a post procedural chest radiograph to evaluate for any placement complications. Chest radiographs after line placement may cause delay in the usage of the line. This study was undertaken to determine whether experienced physicians could reasonably predict patients who might have complications from the central line.

Methods

Ninety patients from the ICU received central access between June-December 2003 for different medical therapies. A history of prior line placement, previous pneumothorax, or any previous chest surgery was

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recorded and these are grouped as high risk to have pneumothorax.

Five Fr and 7 Fr triple-lumen catheters were placed in the patient at the bedside with the patient awake and with lidocaine for anesthesia. The location of the catheter entry site was always under the right or left clavicle for a subclavian access. Two board-certified intensivists who had extensive experience with line placement performed the procedure, each of them was then asked to decide and document whether or not a postprocedural radiograph of the chest was needed on the basis of the perceived difficulty in the placement of the central venous access. Sites of entry, and the type of catheter used were recorded in all patients. A portable supine chest radiograph was obtained after the placement of all central lines and subsequently reviewed by a radiologist to confirm the presence or absence of any complications and to check for malpositioning of the line. The radiologists reviewing the films were board-certified and were blinded as to concern for complications by the anesthesiologists. Malpositioning of the central line was considered to be any placement in the right ventricle, the jugular veins, or a doubling back of the catheter tip into the arm. Categorical variables were compared with Fisher's exact test and continuous variables were compared with Student's t-test. All reported P values are two-sided. Statistical significance was defined at the 0.05 levels.

Results

During the study period from Jun-Dec. 2003, attempts were made to place 90 central venous access devices. Placement of the central venous catheter was on the left in 50 patients (56%) and on the right in 40 patients (44%). The mean number of attempts to place catheters was identical for each side (mean, 2.2 attempts).

There were 3 patients (3%) who had attempts performed on both subclavian veins at the same sitting, with successful placement accomplished, and 1 patient (1%) in whom the attempt to place a line failed. This patient had a pneumothorax.

Post procedural radiographs were obtained for all the 90 patients to diagnose potential complications associated central venous access.

The staff radiologists at the institution reviewed all radiographs where the line was placed. Of the 90 patients, 80 were predicted to have no complications by the physician placing the line. The other 10 individuals were considered to be patients in whom venous access placement was difficult and therefore were thought to need a post procedural radiograph. Factors that might have complicated placement, and other demographic information about the study population are listed in Table I; the high-risk group was more likely to have had a prior chest surgery.

There were no statistically significant differences between the groups for any of the other factors.

Table I. Demographic data, previous related history and site of line with risk group in the study groups.

	High Risk	Low Risk
No. of Patients	10	80
Male / Female	7/3	50/30
Previous related history *	10	-----
Right / Left subclavian	2/8	38/42

*Previous related history (chest surgery, previous line insertion, pneumothorax).

Three pneumothoraces were identified in the study population. One of these complications was identified in the group of patients deemed not to have required a radiograph. This patient had a small pneumothorax, and did not require chest tube placement for treatment. The other two patients who had complications were in the group thought to be at risk for complications; both required treatment and the placement of a chest tube. There were two malpositioned catheters in the right ventricle, one in each study group. These were subsequently repositioned. None of the lines were noted in conjunction with these malpositioning.

No other potential complications that have been associated with central venous line placement were found. Therefore, two patients with complications for the entire study required treatment in the high-risk group (2 of 10) was significantly greater ($p = 0.03$) than the proportion of treatment in the low-risk group (1 of 80) (Table II).

Table II. Occurrence of complication in relation to risk group.

	High Risk	Low Risk
No. of Patients	10	80
Cases predicted in need of chest X-ray	10	--
Pneumothorax	2	1
Malposition	1	1

We reviewed the side of line placement, and number of attempts for patients who had a pneumothorax and compared the information with that of patients who did not have a pneumothorax. No significant risk factors that might explain why this subgroup had such a complication, were found.

Discussion

The physicians in this study correctly told in advance complications that required follow up in both instances. Total complications for the study group as a whole included a 3% rate for pneumothorax and approximately 2% for malpositioning of the line. The complications that required treatment occurred in 2% of the study population, and again both patients had been predicted to be at an increased risk at the time of placement of the central line.

Several articles in the literature have concluded that a routine chest radiograph after the replacement of a central line over a guide wire is not necessary when good clinical judgment and discrimination is used^(8,14). Farrell *et al*⁽¹⁹⁾ found that routine chest radiographs rarely contributed to the diagnosis of any procedural complications and were of little value after internal jugular access in hemodialysis patients. Gray *et al*⁽²⁰⁾ evaluated the necessity for post procedural chest radiographs after catheterization of the central veins or the insertion of pulmonary artery catheters. Their ability to predict the absence of complications after insertion of central venous catheters through the subclavian or internal jugular veins was excellent at 151 of 152. Gray *et al*⁽²⁰⁾ also showed, however, that in line placement by house staff, the unexpected complications rate increased to 12%.

Several series in recent years have shown that ultrasound guidance may limit complications from central line placement^(21,22). Slama *et al*⁽²¹⁾ revealed in 37 patients cannulate with ultrasound guidance that no complications occurred. Likewise, Fry *et al*⁽²²⁾ showed that in 52 consecutive patients with ultrasound-guided line placement, only one patient developed a pneumothorax.

In this study, the complication rate for pneumothorax was 3%. In those thought not to be at risk for complications, the pneumothorax rate was 1.2% (1 of 80). In this one case, however, the complication was minor and did not require treatment or the placement of a chest tube. There were two cases of minor malpositioned of catheters, in which the lines were placed in the right ventricle, and these were subsequently repositioned; none of these complications were of significance because none of them required treatment or resulted in a serious adverse event. In the group thought to be at higher risk for complications, the complication rate was 20% (n = 2). The 2 patients here that suffered from a pneumothorax, both required treatment with a chest tube. When comparing the two arms of the study (those who were thought to be at low risk versus those at high risk for complications), the difference in complications requiring treatment was statistically significant (0 versus 20%, p = 0.03).

The authors raise the question of whether a chest radiograph should be routinely obtained after line placement in all patients or whether some radiographs are unnecessary. Even in large volume, it might be justifiable if the even rare occurrence of a life – threatening complication could be detected. It might equally be argued that most life-threatening complications, such as a tension pneumothorax, might be recognizable before the chest radiograph has been read. Delays from the time of the post procedural film being taken, processed, and read may result in valuable time being lost.

This study had some limitations in that the lines were placed in a controlled environment. There were no rapid placements of central lines in trauma or emergent

situations in the ICU. Also, the study was limited in that both physicians placing lines were very experienced, and the results may not apply to placement of lines by unexperienced practitioners.

Conclusion

Routine chest X-ray post-central venous line placement may not be necessary when experienced clinicians use the proper technique, clinical judgment, and reasonable discrimination between low risk and high-risk patients when placing central venous access devices.

References

1. **Aubaniac RL.** Intravenous subclavian injection. *Presse Med* (French) 1952; 60: 1456-1458.
2. **Wilson IN, Grow JB, Demong CV, et al.** Central venous pressure in optimal blood volume maintenance. *Arch Surg* 1962; 85: 563-578.
3. **Dudrick SJ, Wilmore DW, Vars HM, et al.** Long-term total parenteral nutrition with growth, development, and positive nitrogen balance. *Surgery* 1968; 64: 134-142.
4. **Collier PE, blocker SH, Graff DM, et al.** Cardiac tamponade from central venous catheters. *Am J Surg* 1998; 176: 212-214.
5. **Moskal TL, Ray CE Jr.** Left Mediastinal central line malposition: A case report. *Angiology* 1999; 50: 349-353.
6. **Murray BH, Cohle SD, Davison P.** Pericardial tamponade, and death from Hickman catheter perforation. *Am Surg* 1996; 62: 994-997.
7. **Lo WK, Chong JL.** Neck haematoma and airway obstruction in a pre-eclamptic patient: A complication of internal jugular vein cannulation. *Anaesth Intensive Care* 1997; 25: 423-425.
8. **Lowell JA, Bothe A Jr.** Venous access: Preoperative, operative, and postoperative dilemmas. *Surg Clin North Am* 1991; 71: 1231-1246.
9. **Ryan JA Jr, Abel RM, Abbott WM, et al.** Catheter complications in total parenteral nutrition: A prospective study of 200 consecutive patients. *N Engl J Med* 1974; 290: 757-761.
10. **Amshel CE, Palesty JA, Durick SJ.** Is chest X-rays mandatory following central venous recatheterization over a wire? *Am Surg* 1998; 64: 499-502.
11. **Scott WL.** Central venous catheters: An overview of food and drug administration activities. *Surg Oncol Clinic N Am* 1995; 4: 377-393.
12. **Lefrant JY, Cuvillon P, Benezet JF, et al.** Pulsed Doppler ultrasonography guidance for catheterization of the subclavian vein: A randomized study. *Anesthesiology* 1998; 88: 1195-1201.
13. **Kaufman JL, Rodriguez JL, McFadden JA, et al.** Clinical experience with the multiple lumen central venous catheter. *J Parenter Nutr* 1986; 10: 487- 489.
14. **Palesty JA, Amshel CE, Dudrick SJ.** Routine chest radiographs following central venous recatheterization over a wire are not justified. *Am J Surg* 1998; 176: 618-621.
15. **Herbst CA Jr.** Indications, management, and complications of percutaneous subclavian catheters: An audit. *Arch Surg* 1978; 113: 1421-1425.

16. **Bernard RW, Stahl WM.** Subclavian vein catheterizations: A prospective study Part I: Non-infectious complications. *Ann Surg* 1971; 173: 184-190.
17. **Riblet JL, Shillinglaw W, Goldberg AJ, et al.** Utility of the routine chest X-ray after "over-wire" venous catheter changes. *Am Surg* 1996; 62: 1064-1065.
18. **Cullinane DC, Parkus DE, Reddy VS, et al.** The futility of chest roentgenograms following routine central venous line changes. *Am J Surg* 1998; 176: 283-285.
19. **Farrell J, Walshe J, Gellens M, et al.** Complications associated with insertion of jugular venous catheters for hemodialysis: The value of post procedural radiograph. *Am J Kidney Dis* 1997; 30: 690-692.
20. **Gray P, Sullivan G, Ostryzniuk P, et al.** Value of post procedural chest radiographs in the adult intensive care unit. *Crit Care Med* 1992; 20: 1513-1518.
21. **Slama M, Novara A, Safavian A, et al.** Improvement of internal jugular vein cannulation using an ultrasound-guided technique. *Intensive care Med* 1997; 23: 916-919.
22. **Fry WR, Clagett GC, O'Rourke PT.** Ultrasound-guided central venous access. *Arch Surg* 1999; 134: 738-741.