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Cost and morbidity analysis of chest port insertion in adults: Outpatient clinic *versus* operating room placement

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HIGHLIGHTS

- Chest ports can be safely placed under local anesthesia in the office setting.
- Fluoroscopy and ultrasound guidance are not necessary in the majority of cases.
- Port placement in the outpatient clinic is cost-effective.

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ABSTRACT

Background: Totally implantable venous access devices (TIVADs) represent a convenient way for the administration of medications or nutrients. Traditionally, chest ports have been positioned by surgeons in the operating room, however there has been a transition over the years to port insertion by interventional radiologists in the radiology suite. The optimal method for chest port placement is still under debate.

Materials and methods: Data on all adult patients undergoing isolated chest port placement at our institution in a 12-year period were retrospectively reviewed. The aim of this cohort study was to compare cost and morbidity for chest port insertion in two different settings: outpatient clinic and operating room.

Results: Between 2003 and 2015 a total of 527 chest ports were placed in adult patients. Of them, 262 procedures were performed in the operating room and 265 procedures were undertaken in the outpatient clinic. Patient characteristics were similar and there was no significant difference in early (<30 days, $p = 0.54$) and late complications (30–120 days, $p = 0.53$). The average charge for placement of a chest port was 1270 Euros in the operating room *versus* 620 Euros in the outpatient clinic.

Conclusion: Our results suggest that chest ports can be safely placed in most patients under local anesthesia in the office setting without fluoroscopy or ultrasound guidance. Future randomized controlled studies may evaluate if surgeons or interventional radiologists should routinely perform these procedures in a dedicated office setting and reserve more sophisticated facilities only for patients at high risk of technical failure.

1. Introduction

Totally implantable venous access devices (TIVADs) represent a convenient way to take blood samples and administer medications, such as chemotherapy in cancer patients. Chest port placement has been traditionally performed by surgeons in the operating room. Over the years, there has been a transition to TIVAD placement by interventional radiologists in the radiology suite that has been reported with a lower complication rate [1], however studies on cost-effectiveness are still controversial [2,3].

Progress in medical oncology has expanded the indications for TIVADs placement, and it has been reported a 313% increase of long-term central venous access procedures from 1992 to 2011 [4].

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Moreover, while the inpatient hospital setting remains the primary place of service for all temporary central venous catheters, it has been observed a relative shift from the inpatient to the outpatient hospital services for all long-term central venous access devices [4]. To the best of our knowledge, only one report has evaluated results of port placement in the outpatient clinic [5]. At present, a greater need for efficient use of resources has increased the ability of healthcare providers to offer high quality of care at a much lower cost [6].

The aim of this study was to compare cost and morbidity for chest port insertion by a single surgical unit in two different settings: outpatient clinic and operating room.

2. Materials and methods

An institutional board approved this retrospective cohort study and informed consent was obtained from patients prior to each procedure. Data on all adult patients undergoing isolated chest port placement for the administration of chemotherapy at our institution between 2003 and 2015 were retrospectively reviewed. The medical records included information on name, age, diagnosis, type of anesthesia, type of catheter, post-procedure chest radiograph, early and late complications. All procedures were performed either in the operating room (group 1) or the outpatient clinic (group 2) by a senior surgeon or an experienced resident under direct supervision of a senior surgeon. The technique for port insertion was the same in both groups of patients. Types of central venous catheters used included Titanium Implantable Port (Bard Access Systems, Salt Lake City, USA) and Districath (Districlass Médical SA, Saint-Etienne, France). Access site was the right or left subclavian vein and all procedure were performed by percutaneous guidewire technique exclusively under local anesthesia (1% lidocaine). Patients in the operating room received monitored anesthesia care (MAC) administered by a nurse or an anesthesiologist. Patients in the outpatient clinic were monitored during the procedure with a pulse oximeter device. No fluoroscopy or ultrasound guidance was used both in the outpatient clinic and operating room. After port placement, a plain chest radiograph was obtained in the radiology unit and oral antibiotics were given to all patients.

Post-procedural complications were documented and divided in early (catheter tip malposition, arrhythmia, pneumothorax) that occurred within 30 days of port placement and late (infections, venous thrombosis, catheter occlusion) which were documented between 30 and 120 days after catheter insertion. In all cases of catheter tip malposition, repositioning was performed under fluoroscopy in the radiology unit by an interventional radiologist. Pneumothoraces were treated by observation alone or chest tube placement depending on size and symptoms.

Cost of port placement was derived from our hospital's Financial Department. Charges for the procedure included the device and other equipment costs, radiographic services, and other related charges. Costs of any subsequent procedure for treatment of complications were also considered in this study.

For each group, a sample size of at least 250 patients was included in the study, which was obtained using a power of 80% to determine a difference of 15%. Chi-square or *t*-test was used for the statistical analysis as appropriate and a probability value of less than 0.05 was considered significant. Quantitative variables were expressed as mean and range, while qualitative variables were reported as number and percentage.

3. Results

Between 2003 and 2015 a total of 527 chest ports were placed in adult patients at our institution. Of them, 262 procedures were performed in the operating room between 2003 and 2012 (group 1) and 265 procedures were undertaken in the outpatient clinic between 2007 and 2015 (group 2). Male/female ratio was 136/126 and 144/121 in group 1 and 2, respectively ($p = 0.57$). Mean age was 60.9 years (range 20–84) in group 1 and 59.6 years (range 19–90) in group 2 ($p = 0.38$). Indication for catheter insertion was need for intravenous chemotherapy to treat a solid or hematological malignancy in 100% of cases, and patient characteristics were similar in both groups (Table 1). Average procedure time was 40 min for both groups of patients.

Post-procedural complications are presented in Table 2. Early complications occurred in 1.53% (4/262) of the operating room cases and in 2.26% (6/265) of the outpatient clinic cases. Tip malposition was observed in 7 cases (2 in group 1 and 5 in group 2), which required repositioning in the radiology unit under fluoroscopic guidance. Pneumothorax occurred in 3 cases: one patient (group 1) was treated conservatively, one patient (group 1) required hospitalization and chest tube insertion, and another patient (group 2) was managed in the outpatient clinic with chest tube placement. Late complications were recorded in 2.67% (7/262) and 1.89% (5/265) of group 1 and 2 patients, respectively. Infections occurred in 4 of the operating room patients and in 3 of the outpatient clinic cases. Venous thrombosis was observed only in one patient of group 1 who was successfully treated with low-molecular-weight heparin. Catheter occlusion occurred in 2 cases of each group, these patients required removal and repositioning that was performed in the outpatient clinic in all cases. The differences between early and late complications were not statistically significant ($p = 0.54$ and $p = 0.53$ for early and late complications, respectively).

The average charge for placement of a chest port was 1270 Euros in the operating room *versus* 620 Euros in the outpatient clinic (Table 3). Costs associated with treatment of early and late complications were similar between groups and differences were not statistically significant ($p = 0.60$ and $p = 0.17$ for early and late complications, respectively).

4. Discussion

Many patients require a long-term central venous access device for the administration of chemotherapeutic medications, nutrition, blood transfusions, or blood samples withdrawal. Most frequent indication is cancer, however TIVAD may be necessary for treatment of chronic infections, short bowel syndrome, and some hematological disorders. The technique for TIVAD placement has changed very little since it was first described in 1982 [7]. Venous access is usually obtained through percutaneous vein puncture and insertion of a guidewire (Seldinger). Recently, Biffi et al. [8] have evaluated which vein or technique is the best for TIVAD placement in a randomized three-arm trial. A total of 401 cancer patients were assessable: 132 with percutaneous land-mark access to the internal jugular, 136 with a ultrasound-guided access to the subclavian, and

Table 1
Patient Characteristics.

Demographics	Operating Room (%)	Outpatient Clinic (%)	*p*
Patients	262	265	
Male	136 (52)	144 (54)	0.57
Female	126 (48)	121 (46)	
Mean age (years)	60.9	59.6	0.38
Indications for port placement			
Chemotherapy	262 (100)	265 (100)	
Solid tumor	228 (87)	242 (91)	0.11
Hematological tumor	34 (13)	23 (9)	