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### A Study of Pneumothorax Rates for Physician Assistants Inserting Central Venous Catheters at a Large Urban Hospital

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#### Abstract

Physician Assistants (PAs) are frequently delegated the task of performing invasive procedures. While there is a nearly 40 year record of PAs performing procedures of various types, limited published information is available that verifies the safety of delegating these medical responsibilities. As the scope of practice expands for the PA profession, research data will be necessary to document the safety and effectiveness of PAs performing invasive procedures. This prospective study followed 9 PAs inserting central venous catheter (CVC) lines in pulmonary critical care and cardiothoracic surgery settings in a large urban hospital from June 1, 2002 through December 1, 2002. Each PA required general supervision for the procedures. The most common complication of CVC placement is pneumothorax. None of these occurred during the study period in 233 CVC lines inserted by PAs. Additionally, during the study period, this group of PAs inserted 75 Swan-Ganz catheters, performed 25 thoracenteses, 30 endotracheal intubations, and 10 chest tube placements. Complications were noted and recorded via the on site researcher. The only complication noted during the study period was a single pneumothorax while performing a thoracentesis. This research study demonstrates that with the proper training and supervision from a physician, PAs can perform invasive medical procedures with a complication rate comparable to that of physicians in a similar setting.

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#### Introduction

Physician Assistants (PAs) have been performing various medical procedures under the supervision of physicians for nearly four decades. Information from the 2004 American Academy of Physician Assistants national census<sup>1</sup> revealed that 41.8% of respondent PAs reported performing invasive procedures during the course of their practice. However, relatively little has been written about the skill and safety with which these procedures are performed by PAs. This study was undertaken to assess the complication rate for PAs inserting central venous catheter (CVC) lines. It also collected information on the performance of selected invasive thoracic procedures performed by the same group of PAs.

In part because of recent changes in resident work rules, PAs are increasingly finding employment in inpatient

settings. With this inpatient employment comes an expanded scope of practice, frequently including the performance of various invasive medical procedures. With proper training and supervision, there is no reason to believe that complication rates for these procedures would be any greater than those experienced by physicians in similar settings. This study will attempt to determine whether complication rates for CVC insertion by PAs are within accepted or expected ranges for the same procedure performed by physicians.

#### Review of the Literature

##### **Central Venous Catheter Lines**

The insertion of CVC lines, as with other invasive medical procedures, is associated with the potential for complications. These potential complications include those evident at the time of the procedure, such as "arterial punctures, hemothoraxes, superior vena cava

syndrome, and bleeding".<sup>2</sup> In addition, there may be late complications that become evident hours or days after the procedure, such as "malposition, thrombosis, septic thrombosis, and infection".<sup>3</sup> By far, the most common complication of CVC insertion is pneumothorax.<sup>4</sup>

The pneumothorax rate for various types of providers during CVC insertion varied among studies, but the rate ranged from 0.5 to 1.8%. The goal of a study conducted by Wey, Akamine, & Fernandes was to determine the route of CVC placement that resulted in the best placement of the catheter tip.<sup>5</sup> However, they also tracked complication rates, reporting that 563 CVC lines were inserted with a pneumothorax rate of 1.4%.<sup>5</sup>

Another study was conducted to determine the "efficacy of a central venous access service".<sup>6</sup> In this case 853 CVC lines were inserted with a pneumothorax rate of 0.5%.<sup>6</sup> A third study retrospectively reviewed 9,637 patients with CVC lines inserted on an outpatient basis with a pneumothorax rate of 1.0%.<sup>7</sup> Finally, a prospective study evaluating the insertion of 322 CVC lines placed in critically ill children demonstrated a pneumothorax rate of 1.8%.<sup>8</sup>

A simple average of the pneumothorax rates found in these studies is 1.175%. This will serve as the anticipated rate of pneumothorax as a complication of CVC insertion for the purpose of comparison to that found in this study.

The study above conducted by Walters, Kahn, and Jescovitch<sup>6</sup> included Physician Assistants among the providers inserting central lines on the "central venous access service". This study is remarkable as it was the "first report of PAs being used in the establishment of a structured service for central venous access."<sup>6</sup> In addition, this group had the distinction of having the lowest pneumothorax rate of the studies reported, at 0.5%.<sup>6</sup>

#### **Other Procedures**

The body of literature addressing the performance of invasive procedures by PAs is quite small. It does suggest, however, that properly trained and supervised PAs are performing a wide range of invasive procedures.

In an evaluation of complication rates associated with physician assistant placement of implantable peripheral port systems in cancer patients, Rubenstein, Fender, Rolston, Elting, Prasco, Palmer, Road, Pollock, Frisbee-Hume, and Laurence, reported no pneumothoraces, a thrombosis rate of 6.4%, and an infection rate of 0.2 per 1000 catheter days.<sup>9</sup> The researchers in this study reported that these rates were consistent with the complication experience of physicians.<sup>9</sup>

In a study titled, "Intracranial pressure monitor placement by mid-level practitioners," 215 ICP (intracranial pressure) monitors were placed in hospitalized patients.<sup>10</sup> Neurosurgeons placed 105 of the ICPs, mid-level practitioners (physician assistants and nurse

practitioners) placed 97 monitors, and general surgery residents placed 13 monitors. No major complications attributable to ICP monitor placement occurred. Nineteen minor complications were noted during the study period. The minor complications included dislodgment or malfunction of the device: 11 by neurosurgeons, 7 by mid-level practitioners, and 1 by the surgical resident.<sup>10</sup> All individuals, including the physician assistants and nurse practitioners, placed the monitors successfully. No significant differences were demonstrated between groups regarding age, GCS score, or the length of time the monitors remained in place.<sup>10</sup> This study demonstrated that properly trained and supervised mid-level practitioners can safely and effectively place ICP monitors without direct supervision and without any increase in complications.

Additionally, the literature contains studies of the effectiveness and safety of physician assistants in the performance of procedures in gastroenterology. In a prospective study entitled "Physician assistants in gastroenterology: should they perform endoscopy?" one physician assistant was followed in a gastroenterology practice over a three year period.<sup>11</sup> According to the researchers, "the physician assistant performed 178 panendoscopies, 505 colonoscopies, 827 flexible sigmoidoscopies and 617 polypectomies, with only one reported complication: a lower GI bleed five days post polypectomy that spontaneously resolved with observation."<sup>11</sup>

In an additional study of 3196 colonoscopies performed by physicians and PAs, the rate of major complications definitely related to the colonoscopy was 0.3% for those performed by physicians and 0.19% for procedures performed by PAs.<sup>12</sup>

PAs have also performed diagnostic cardiac catheterizations for a number of years. A study reported in the *American Journal of Cardiology* in 1987 compared the complication rates of PAs and cardiology fellows. In 150 procedures carried out by each group, the complication rate was the same. Minor complications occurred in 1.3% of cases in each group.<sup>13</sup> In an unpublished study reported by the American Academy of Physician Assistants on their web site, Duke University researchers in 2001 compared 929 diagnostic catheterizations performed by PAs to 4251 performed by cardiology fellows. The incidence of major complications was 0.54% for PAs and 0.58% for cardiology fellows.<sup>14</sup>

For procedures of many types, properly trained and supervised PAs are performing invasive medical procedures with apparent skill and safety. However, additional studies are needed to explore the various types of procedures being performed and to reinforce the findings of these earlier studies.

#### **Methods**

The activities of nine PAs working in cardiothoracic

surgery and pulmonary critical care in a large urban teaching hospital were followed from June 1, 2002 to December 1, 2002. Six of the PAs worked in cardiothoracic surgery and 3 were pulmonary critical care PAs. The PAs in this setting functioned under general supervision and with a fair amount of autonomy. PA billing records were scanned for CPT code 36489 to identify when a CVC line had been placed. Once it was identified that a PA had performed a CVC line, the lead PA on the respective service was consulted to review the case and determine if any post CVC pneumothorax had occurred. All CVC insertions were followed by a chest x-ray to document placement and to determine if a pneumothorax had occurred.

During the data collection period, lead PAs on each of the services were contacted frequently via telephone or e-mail to ensure that accurate data was maintained. In addition to the rate of pneumothoraces during CVC insertion, information was collected relating to complications occurring during endotracheal intubations, Swan-Ganz catheter insertions, chest tube insertion, and thoracenteses. These data were not the focus of the study, but will be reported in the results section.

#### Limitations

The main limitation of this study was the relatively small number of PAs followed at a single institution. In addition, patient selection may result in some bias in favor of the PAs performing these procedures. It is likely that more of the emergent or complicated cases are treated by the physicians on a given service. PAs are likely to perform more of the elective procedures.

#### Results

During the six month period of this study, the nine PAs performed 233 central venous catheter insertions; 175 of the lines were inserted by the three PAs assigned to the pulmonary critical care group and 58 were inserted by the six cardiothoracic surgery PAs. There were no reported pneumothoraces during the study period.

Additional information was collected during the study period about other invasive procedures performed by the same group of PAs. These PAs also inserted 75 Swan-Ganz catheters, performed 25 thoracenteses, 30 endotracheal intubations, and inserted 10 chest tubes. One pneumothorax occurred during a diagnostic thoracentesis that required chest tube placement. No

other complications for the procedures were reported. The pulmonary critical care group of PAs were employed for an average of 4.67 years. The cardiothoracic surgery PAs had an average experience of 15.33 years. The range of experience for both groups was 3 to 24 years.

#### Discussion and Recommendations

This study indicates that properly trained and supervised physician assistants are able to insert central venous catheters on hospitalized patients with skill and safety. The PAs in this study had a pneumothorax rate well below the average rate of 1.175% noted among physicians. In fact, there were no incidents of the most common complication of this procedure, pneumothorax, during the study period.

In addition, during the 6 month study period these cardiothoracic and pulmonary critical care PAs inserted 75 Swan-Ganz catheters, performed 25 thoracenteses, 30 endotracheal intubations, and inserted 10 chest tubes. The only complication reported during these additional procedures was a single pneumothorax during a diagnostic thoracentesis.

The complication rate of these procedures performed by physician assistants compared very favorably to that of physicians performing the same procedures. The possibility of a selection bias may exist, with physician assistants performing more of the elective cases or procedures on patients who are less complicated. Future studies should answer this question by determining how procedures are assigned to a physician or PA.

Additional studies of this type should be performed to document the safety and skill of PAs in performing a wide range of procedures. PAs have provided competent and compassionate care for nearly four decades. In an age of evidence-based practice, such documentation would support physicians and institutions that employ physician assistants on their health care teams. In addition, this information may be used to inform medical boards and state legislators about appropriate practice parameters for PAs. PAs, individually and collectively, should help to ensure that supervising physicians, state medical boards, and state legislators have ample evidence of the capabilities of PAs to inform their important decisions.

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