Short Report

Efficiency of PA Catheters in the ICU of a tertiary care hospital

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Abstract

Existing randomized controlled trials on Pulmonary Artery Catheter (PAC)-guided strategies reveal a modest risk reduction that does reach statistical significance. An observational, prospective, controlled study was carried out in the ICU of a tertiary care hospital. Incidence, indications, complication rate and outcome of Pulmonary Artery (PA) catheter over a period of 3 months was looked at, comparing cases to matched controls. Despite being a limited study, it is obvious that the cost effectiveness and outcome of patients with the PA catheter seems ambiguous. In a developing country where resources are limited, thought must be given to the risk and benefit ratio of placing this invasive monitor and use of the information provided properly justified.

Introduction

Pulmonary artery catheterization (or popularly known as Swan Ganz catheter) is a diagnostic tool being used for more than 30 years in critically ill patients.[1] The reliance on this tool is rampant in most ICUs although the outcomes remain unchanged. Often clinicians feel a 'psychological' assurance that they are doing 'all they can to save the patient' by placing this invasive monitor. In properly trained and experienced hands, it provides information on right and left ventricular filling pressures, thermodilution cardiac output, and perhaps, right ventricular ejection fraction or mixed venous oxygen saturation. All these parameters are used to distinguish types of shock and guide fluid management. However "shock" per se is not an 'absolute' indication for placement of a PA catheter.[2]

Commonly, the catheter increases hospital costs while exposing the patient to potential infectious, arrhythmogenic, mechanical, and therapeutic misadventures. Recognized complications include ventricular tachycardia or fibrillation, asystole, atrial arrhythmias, right ventricular or pulmonary artery perforation, thrombosis, catheter knotting, embolism, endocarditis and other nosocomial infections[3,4], and a host of additional problems related specifically to central venous cannulation (i.e., pneumothorax, haemothorax, chylothorax and carotid or subclavian artery puncture).[4]

Readings obtained from the PA catheter may be unreliable. The accuracy of intermittent thermodilution cardiac output determinations is reported to range from +3% to +30%. Tuman[5,6] has warned practitioners of the "many artifacts negating the relationship among pulmonary artery occlusion pressure (PAOP or wedge), [left ventricular end-diastolic pressure] LVEDP, and [left ventricular end-diastolic volume] LVEDV". Even when the PAOP can be determined accurately, the diagnostic value is limited as PAOP is an unreliable indicator of myocardial ischemia, with a positive predictive value of only 15%.[5,7]

A study was therefore carried out over a period of 3 months, with the objective, to observe the frequency of PA catheter use in our ICU, indications of PA catheter insertion, complications of PA catheters and cost analysis and outcome, i.e. length of stay and mortality.

Patients, Methods and Results

This was an observational, prospective, controlled study of three months duration, conducted in an ICU of a tertiary care university hospital serving an urban population of a third world country with limited resources. Every patient admitted to the ICU who had a PA catheter inserted for any indication was included prospectively, i.e. enrolled at the time of catheter insertion, using a simple data form. An equal number of patients matched to age and diagnosis but without a PA catheter were used as controls. Paediatric patients were excluded. A sample size calculation was not possible as no figures on PA catheter use in the ICU were available. Data collection was done by the first author and an ICU resident. A data collection form was used for the purpose.

Fourteen patients and 14 matched controls were enrolled in the study over a period of 3 months. Tables 1 and 2 give the age, sex, diagnosis, length of stay in days and the outcome, expiry or discharge from the ICU, of both patient groups who had a PA catheter placed (A) and controls, i.e. those who did not but were of the same description (B).

The incidence of PA catheter use was 20% in February and April and 17.5% in March, giving an average of 19% of all ICU admissions. Data was analyzed by using Epi -Info and a significance set at $p < 0.01$. There were 11 deaths in the PA catheter group (A) and 9 in group B ($p< 0.677$). The length of stay was 9.35 ± 2 days for group A and 6.86 ± 2 days for group B ($p < 0.003$). There was no significant difference in the ages

Table 1. Data for Cases (A): Patients who had PA catheters placed. (February-April 2005).

S.No.	Age (yrs) / Sex	Diagnosis	Outcome (expired=E; shifted=S)	Length of Stay (days)
1.	74 M	Pneumonia	E	3
2.	65 M	Sepsis	E	11
3.	81 M	Acute coronary syndrome (ACS)	S	4
4.	35 M	Pulmonary TB	E	20
5.	33 M	Non Hodgkins lymphoma (NHL)	E	3
6.	30 M	Gunshot /sepsis	E	9
7.	52 M	NHL	E	2
8.	76 F	Pneumonia	E	13
9.	73 M	Small bowel obstruction (SBO)	E	3
10.	25 M	Abdominal sepsis	E	11
11.	57 F	Acute pancreatitis	S	13
12.	75 M	Intestinal obstruction	E	16
13.	84 M	Acute pancreatitis	E	12
14.	50 M	Liver abscess	S	11

Data showing age, sex, diagnosis at admission, outcome (whether patient expired or was discharged from the ICU), and length of stay for patients (cases) who had PA catheters placed (group A).

Table 2. Data for controls (B): Age& diagnosis of matched patients without PA catheters (February-April 2005).

S.No.	Age (yrs) / Sex	Diagnosis	Outcome (expired=E; shifted=S)	Length of Stay (days)
1.	70 M	Pneumonia	E	1
2.	65 M	Pneumonia	E	2
3.	61 M	ACS	S	10
4.	65 M	Pneumonia	E	6
5.	28 M	NHL	E	9
6.	35 M	Sepsis	S	26
7.	33 M	NHL	E	3
8.	69 F	Pneumonia	E	11
9.	75M	SBO	E	16
10.	25 F	Sepsis	E	2
11.	68 M	Acute Pancreatitis	S	3
12.	72 M	Sepsis	S	3
13.	80 M	Acute Pancreatitis	S	2
14.	50 M	Liver abscess	S	2

Statistical analysis of both groups on Epi- Info® using Fisher Exact test and Student's T-test (with a significance value of $p < 0.01$ and a SD of 2 days and 2 yrs). Only LOS (length of stay) was significant.

of the patients of the two groups. The mean age of patients in group A was 57.8 ± 2 years and 59 ± 2 years for those in group B. Pneumonia and sepsis (with 3 patients each) were two of the leading causes for ICU admission, other admitting diagnoses being pulmonary tuberculosis, small bowel obstruction, acute pancreatitis, cancer and liver abscess. 'Fluid management' and 'haemodynamic monitoring' were two leading indications for PA catheter insertion (with 8 and 4 patients respectively), while others included acute renal failure and inotropic support (with only 1 patient in each group). There were complications present in 30% of the patients of group A, including line sepsis, balloon rupture and coiling. Group B , not having a line in situ, did not have line related complications. Some complications occurred in the same patient. Cost analysis showed a total of Pakistani Rs.16,532 per patient for PA catheter insertion and monitoring. The break up of the cost incurred during placement were as follows: The Swan Ganz catheter Rs.5557, the cardiac output kit Rs.3309. with various other kits used for insertion by physicians and equipment making up the remainder of the total cost. This did not include the transducer or monitor placed at each patient's bedside. Each set of readings cost Rs.100 and this was usually done for a minimum of 2 days. The frequency of various parameters measured 3 times per day (per shift), as well as when needed, included central venous pressures (CVP), wedge (pulmonary artery occlusion pressures), pulmonary artery (PA) pressures, cardiac output (CO), systemic vascular resistance (SVR), done in all patients (100%). Mixed venous gas measurement (SvO2) was performed in only 29% of the patients, as was the pulmonary vascular resistance (PVR). VÒ or oxygen consumption was not calculated in any of the patients.

Conclusion

PA catheters are used widely in the intensive care setting. In a developing country the cost may not be justified. Their use does not affect the outcome. The physicians often do not record the correct information required to identify the factors influencing the outcome. There may be indiscriminate use. Despite this being a limited study, due to the inability to calculate a proper sample size at the beginning, we can clearly see that the cost effectiveness and outcome of patients with the PA catheter seems ambiguous. In a developing country where resources are limited, thought must be given to the risk and benefit ratio of placing this invasive monitor and use of the information obtained properly justified.

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