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Early Use of the Pulmonary Artery Catheter and Outcomes in Patients with Combined Shock and Evidence of Right Heart Failure and/or Tricuspid Regurgitation

Study Purpose and Rationale:

Hemodynamic measurements obtained from pulmonary artery (PA) catheterization may provide information to aid in the management of critically ill patients in shock. It has been argued that rapid assessment and guided therapy with a PA catheter may improve patient outcomes though studies thus far have not shown any demonstrable benefit. A randomized controlled trial of high-risk patients 60 years of age or older who were scheduled for urgent or elective major surgery followed by a stay in an intensive care unit randomized to the use of PA catheter or not did not show any benefit and actually showed a higher rate of adverse events in the PA catheter group.[1]A multicenter randomized controlled study of 676 patients in shock, ARDS, or both, randomized to receive a PA catheter or not did not show a difference in mortality or morbidity, nor did it show any increase in adverse events with the PA catheter group.[2] A meta-analysis of 13 randomized controlled trials examining the use of PA catheters in patients who were undergoing surgery, in the intensive care unit, admitted with advanced heart failure, or diagnosed with ARDS and/or sepsis, showed no benefit.[3] No study has examined

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[1] Sandham JD, Hull RD, Brant RF, Knox L, Pineo GF, Doig CJ, Laporta DP, Viner S, Passerini L, Devitt H, Kirby A, Jacka M; Canadian Critical Care Clinical Trials Group. A randomized, controlled trial of the use of pulmonary-artery catheters in high-risk surgical patients. N Engl J Med. 2003 Jan 2;348(1):5-14.

[2] Richard C, Warszawski J, Anguel N, Deye N, Combes A, Barnoud D, Boulain T, Lefort Y, Fartoukh M, Baud F, Boyer A, Brochard L, Teboul JL; French Pulmonary Artery Catheter Study Group. Early use of the pulmonary artery catheter and outcomes in patients with shock and acute respiratory distress syndrome: a randomized controlled trial. JAMA. 2003 Nov 26;290(20):2713-20.

[3] Shah MR, Hasselblad V, Stevenson LW, Binanay C, O'Connor CM, Sopko G, Califf RM. Impact of the pulmonary artery catheter in critically ill patients: meta-analysis of randomized clinical trials. JAMA. 2005 Oct 5;294(13):1664-70.

the use of a PA catheter in patients with combined shock and known or suspected right heart failure or severe tricuspid regurgitation. In this scenario, a central venous pressure obtained from a central line will not be an adequate estimation of the left-sided filling pressures and thus the use of a PA catheter in this selected patient population may help with diagnosis and management, possibly translating into a benefit in mortality and morbidity.

Study Design and Statistical Procedures:

This study will examine 2 groups. Patients will be randomized to either standard care plus the use of a PA catheter or to standard care alone. Randomization will be carried out using computer-generated block randomization for each ICU. A Chi-square test will be used to detect a difference in the 28-day inpatient mortality of the two groups, the primary endpoint. Given an estimated 28-day inpatient mortality rate of 40%, a sample size of 764 patients will be obtained to provide the study with a power of 80% for an expected decrease in mortality of 10% with a p-value of 0.05. Secondary endpoints include length of ICU stay, length of hospital stay, time requiring vasopressors, time requiring inotropes, and time on the ventilator.

Study Procedures:

Patients who are randomized to standard care without the use of a PA catheter will be managed with standard care alone. Patients who are randomized to standard care plus the use of a PA catheter will have a PA catheter placed in the ICU immediately. The types of measurements, frequency of measurements, and treatment strategies based on PA catheter measurements will be left up to the discretion of the attending physician. The PA catheter will remain in the patient until the patient is no longer in shock or a complication ensues, requiring the removal of the PA catheter. Subjects in the PA catheter group will not likely experience any additional pain, discomfort or inconvenience.

Study Devices:

The PA catheters to be used are widely and commercially available. The use of PA catheters is known to be safe. There isa small rate of adverse events, which include accidental arterial puncture, pneumothorax, ventricular arrhythmias, right bundle-branch block (usually transient), pulmonary artery rupture, infection, and pulmonary infarction. Only attending physicians trained in the use of the PA catheter will be allowed to insert them.

Inclusion Criteria:

1) 18 years of age or older

2) Shock perceived by attending physican to be combined (i.e. cardiogenic + vasodilatory, hypovolemic + vasodilatory, cardiogenic + hypovolemic)

3) Must have evidence of either moderate right heart failure (RV hypokinesis) from TTE done during current hospitalization or within past 1 year or evidence of moderate tricuspid regurgitation documented from TTE done during current hospitalization or from current CVP tracing

Exclusion Criteria:

1) Contraindications to PA catheter insertion → tricuspid or pulmonary valve mechanical prosthesis, right heart mass (thrombus and/or tumor), tricuspid or pulmonary valve endocarditis

2) Contraindications to central venous catheters placed in internal jugular or subclavian veins

3) Myocardial infarction complicated by cardiogenic shock requiring revascularization

4) Patient in combined shock for greater than 24 hours prior to enrollment in trial.

Recruitment of Subects:

Patients admitted to the ICU's of participating medical centers will be approached as potential subjects.

Location of the Study:

This study will be a trial spanning 25 ICU's in 25 medical centers across the country.

Potential Risks:

Potential risks are minimal but arise because of the risks associated with insertion and maintenance of a PA catheter, which include accidental arterial puncture, pneumothorax, ventricular arrhythmias, right bundle-branch block (usually transient), pulmonary artery rupture, infection, pulmonary infarction.

Potential Benefits:

Potential benefits include rapid diagnosis and improved management of shock, resulting in improved clinical outcomes and higher likelihood of survival.

Compensation to Subjects:

There will be no compensation provided.

Costs to Subjects:

Subjects will not incur additional costs.

Reference:

1)Richard C, Warszawski J, Anguel N, Deye N, Combes A, Barnoud D, Boulain T, Lefort Y, Fartoukh M, Baud F, Boyer A, Brochard L, Teboul JL; French Pulmonary Artery Catheter Study Group. Early use of the pulmonary artery catheter and outcomes in patients with shock and acute respiratory distress syndrome: a randomized controlled trial. JAMA. 2003 Nov 26;290(20):2713-20.

2)Binanay C, Califf RM, Hasselblad V, O'Connor CM, Shah MR, Sopko G, Stevenson LW, Francis GS, Leier CV, Miller LW; ESCAPE Investigators and ESCAPE Study Coordinators. Evaluation study of congestive heart failure and pulmonary artery catheterization effectiveness: the ESCAPE trial. JAMA. 2005 Oct 5;294(13):1625-33.

3) Sandham JD, Hull RD, Brant RF, Knox L, Pineo GF, Doig CJ, Laporta DP, Viner S, Passerini L, Devitt H, Kirby A, Jacka M; Canadian Critical Care Clinical Trials Group. A randomized, controlled trial of the use of pulmonary-artery catheters in high-risk surgical patients. N Engl J Med. 2003 Jan 2;348(1):5-14.

4) Shah MR, Hasselblad V, Stevenson LW, Binanay C, O'Connor CM, Sopko G, Califf RM. Impact of the pulmonary artery catheter in critically ill patients: meta-analysis of randomized clinical trials. JAMA. 2005 Oct 5;294(13):1664-70.