

## COMPARATIVE STUDY OF PULMONARY ARTERY CATHETER VERSUS CENTRAL VENOUS CATHETER IN PATIENTS UNDERGOING BEATING HEART CORONARY ARTERY BYPASS SURGERY

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### ABSTRACT:

**Background:** Central venous and pulmonary artery catheter are integral part of hemodynamic monitoring during off pump coronary artery bypass grafting surgery.

**Methods:** In this prospective randomized trial, sixty patients were divided equally into two groups, to receive either central venous or pulmonary artery catheter after induction of anesthesia with high dose of opioid and Inj pancuronium. Patients between 35-65 years with ejection fraction 40-60% undergoing elective off pump coronary artery bypass surgery were included while those with left ventricular dysfunction were excluded. All patients were operated by same team of surgeons. Systolic blood pressure (SBP) and/or mean arterial pressure (MAP) was kept above 90 and 60 mm Hg respectively throughout perioperative period by fluid volume expansion and inotropic support. Nitroglycerine was used for blood pressure control and coronary vasodilation. Both groups were compared with respect to intervention requiring inotropes and its duration, ICU stay and any complications occurred.

**Results:** Significant number of patients in CVP group were started on inotropes than PAC group (66.6% vs 40%,  $P=0.038$ ). Among these, 75% in Gr.A needed it for less than 24 hours compared to 65% in Gr. B. Both groups needed similar trials of fluid challenge [40% vs 53.33%;  $P=0.30$ ] and showed similar duration of intensive care unit stay (more than 48 hrs) [66.67% vs 53.3%;  $p=0.29$ , chi square test]. More number of patients developed complications in CVP group [6.6 vs 16.6%;  $P=0.22$ ]. One patient in each group had mortality.

**Conclusion:** PA catheter guided management does not provide additional benefit over CVP guided management alone during OPCAB surgery in patients with preserved LV function.

**Keywords:** Cardiac surgery, CABG, catheter, internal jugular, pulmonary artery.

### INTRODUCTION

The introduction of extensive hemodynamic monitoring started the successful era of coronary artery bypass grafting surgery. With advanced knowledge in medical monitoring, ever increasing values has been placed on establishment of a central venous catheterization and pulmonary artery cannulation for hemodynamic monitoring.<sup>1</sup> Data obtained from it helps in early detection and management of hemodynamic perturbances.<sup>2</sup> However, PAC is associated with its own complications<sup>3</sup> like arrhythmias, variations in waveforms interpretation etc. That is why in the past decade, PAC monitoring has become less common with the newer advanced methods of cardiac output monitoring, although its use varies markedly between institutions and clinical settings.<sup>2</sup> But it is still considered as standard method for

hemodynamic monitoring during coronary artery bypass graft (CABG) or cardiac valvular surgery.<sup>4,5</sup>

On the other hand, CVC gives an idea about fluid status but does not provide extensive hemodynamic information as PA.<sup>6</sup> However, occasional reports have suggested that CABG can be performed in selected patients with only central venous pressure (CVP) monitoring with equivalent outcomes as pulmonary catheter<sup>7</sup>. Furthermore, there is little information on the impact of CVP rather than PA catheter use on CABG outcomes including length of stay and hospital costs. Although the direct cost of a PA catheter may not greatly exceed that of a CVP catheter, the additional costs related to the increased intensity of monitoring, the need to intervene therapeutically in cases of borderline hemodynamic function and the potential to increase intensive care unit (ICU) length of stay may be considerable.<sup>8</sup> So

we tested a hypothesis that PAC is superior to CVC in terms of management of patients undergoing coronary artery bypass grafting and assessed its impact on the postoperative intensive care unit stay and major complications.

## MATERIALS AND METHODS

In this single centered prospective randomized study, 60 patients undergoing elective OPCAB were randomly divided into two groups (n=30) by folded chit method. Institutional ethics committee approval was taken and written informed consent from patients was obtained. Group A and group B received PAC and CVC respectively. Patients between 35-65 years with ejection fraction between 40-60% were included while those with left ventricular dysfunction requiring intra-aortic balloon pump, significant renal and hepatic dysfunction and preoperative coagulation abnormality were excluded from the study. All patients were operated by the same team of surgeons and the senior anesthesiologist placed all the central venous catheters. CVC or PAC and radial arterial line was inserted under local anesthesia prior to induction under aseptic precautions. All patients were premedicated and induced with intravenous (IV) Inj midazolam 0.1 mg/kg IV plus Inj fentanyl 10 microgram/kg. Inj pancuronium 0.1 mg/kg was used for muscle relaxation and thereafter patients were maintained on oxygen+air+isoflurane with intermittent doses of pancuronium. CVP and PCWP were maintained between 10-12 mm of Hg and

12-15 mm Hg respectively in both groups throughout perioperative period. Similarly background infusion of Inj nitroglycerine was continued for coronary vasodilation and to control perioperative hypertension. Hypotension was corrected first by giving fluid challenge with 250-300 ml crystalloids and if failed, inotropes were started to keep systolic blood pressure (SBP) and/or mean arterial pressure (MAP) above 90 mm Hg and 60 mm Hg respectively.

Both groups were compared with regard to need for inotropes and fluid challenge to maintain stable hemodynamics, post-operative intensive care unit stay and any complications like significant arrhythmias, pulmonary edema, renal failure, cardiac arrest.

## STATISTICAL ANALYSIS

All data are presented as mean  $\pm$  SD and analyzed using SPSS 16 software. Ordinal data presented as a percentage were compared using Chi square/ Fisher's exact test as appropriate. P value <0.05 (two tailed) was considered significant.

## RESULTS

We found no significant difference between two groups regarding demographic data including age, sex, weight and duration of surgery. Baseline hemodynamic parameters were also similar in both groups. (Table 1)

**Table 1: Patients Demographic Data and Baseline Hemodynamics**

Parameter	Gr A (PAC)	Gr B (CVC)	P value
Age (years)	52 $\pm$ 4.11	52.73 $\pm$ 4.21	0.93
Weight (kg)	64.16 $\pm$ 7.27	65.23 $\pm$ 7.77	0.94
Sex (M/F)	25/5	23/7	0.48
Duration of Surgery (hrs)	4.50 (4.07-4.69)	4.50 (4.39-5.00)	0.16
Systolic blood pressure (SBP)	114.4 $\pm$ 19.43	125.33 $\pm$ 43	0.056
Diastolic blood pressure (DBP)	74.67 $\pm$ 13.30	75.60 $\pm$ 16.94	0.813
Mean blood pressure (MAP)	88.00 $\pm$ 14.65	91.90 $\pm$ 18.96	0.376
Central Venous Pressure (CVP)	8.87 $\pm$ 0.90	8.73 $\pm$ 1.14	0.617

Inotropic support was started in 20 patients (66.6%) in gr B as compared to 12 (40%) in gr A (p=0.038). This suggests that

requirement of inotropes was significant in CVP group than PAC group. Also, there was no difference in both groups regarding

requirement of fluid challenge [40% vs 53.33%; P=0.30](Table 2). Among patients managed with inotropes, 75% in Gr.A required inotropes for less than 24 hours compared to 65% in Gr. B; the difference being non-significant. However, intensive care unit stay (more than 48 hrs) was found to be similar in both groups [66.67% vs

53.3%; p=0.29, chi square test]. (Table 3) Overall rate of complications like metabolic acidosis, ventricular tachycardia (VT) and acute renal failure was similar in both groups. (Table 3) We observed mortality of two patients (1 from each group) during the study.

**Table 2: Interventions in both groups**

Intervention	Study group		P value
	Gr. A Frequency (%)	Gr. B Frequency (%)	
Fluid bolus only	12 (40%)	16 (63.3%)	0.30 (Chi square test)
Fluid bolus + Inj. Dopamine	10	15	<b>0.038</b> (Chi square test)
Fluid bolus + Inj. Dopamine + Inj. Adrenaline	2	5	
Total no. of patients with Inotropic support	12 (40%)	20 (66.67%)	

**Table 3: Complications in both groups**

Major complications	Study groups		P value
	PAC	CVP	
Ventricular tachycardia (VT)	1	2	0.22 Fisher's test
Metabolic acidosis	1	2	
Acute renal failure	0	1	
Total	2 (6.67%)	5(16.67%)	0.22 Fisher's test
ICU stay > 48 hrs	20(66.6%)	16(53.3%)	0.29 Chi square test

## DISCUSSION

OPCAB surgery often leads to hemodynamic instability due to altered positioning of heart, interruption of coronary flow and placement of epicardial stabilizer. Therefore, vigilant hemodynamic monitoring is of utmost important during OPCAB surgery. For this purpose, central venous catheter (CVC) and pulmonary artery catheter (PAC) are routinely used. Pulmonary artery pressure (PAP) and pulmonary capillary wedge pressure (PCWP) are obtained as additional information which helps to optimize patients and decide specific interventions during OPCAB. These parameters cannot be obtained in patients with central venous catheter and the management was only based on CVP guided approach in our study.

We found that the only statistically significant difference between two groups was an increased use of inotropic agents at

the conclusion of the surgery in patients managed with CVP alone. This is in contrast to the findings by Resano FG et al <sup>9</sup> and it can be explained on the fact that we did not measure cardiac output with PAC and relied solely on PAP and PCWP guided interventions; while measurement of cardiac output, prompted the frequent use of inotropic agents to maintain a CI > 2 L/min/m<sup>2</sup> in their study. They also concluded that when confounding variables are controlled, use of a PAC was found to be a significant predictor of use of inotropic support at the end of the surgery.

Robert D. Stewart et al <sup>7</sup> studied central venous catheter use in low risk CABG and they also found that the requirement of vasopressors was more in patients who were in PAC group than in CVP group. They also observed that total length of intensive unit care stay was longer in patients in PAC group but it was not statistically significant. We also found

similar trend of longer ICU stay (>48 hrs) in patients receiving PA catheter but it failed to reach statistical significance (P=0.29). But, they found more complications in PAC group than CVP group in contrast to our findings of similar trend of complications. This difference can be attributed to our small sample size and perhaps more expertise in OPCAB at our institute.

Resano FG et al<sup>9</sup> in their retrospective study, found no difference in mortality/morbidity of patients who were managed with either a PAC or CVP catheter. Safety of OPCAB surgery have definitely contributed into such low mortality rate.<sup>10,11</sup>

### LIMITATIONS

There are some limitations of this study; the first being selection of patients with good left ventricular function. These patients can better tolerate hemodynamic alterations during OPCAB than patients with

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depressed LV function and hence PA catheter might prove beneficial in this category. Second, we solely relied on PAP and PCWP guided management without recording cardiac output which could have led us in decreased inotropic requirement along with our low threshold of starting inotropes. We also think that the larger sample size from different population strata is needed for further analysis.

### CONCLUSION

PA catheter guided management does not provide additional benefit over CVP guided management alone during OPCAB surgery in patients with preserved LV function.

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