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Prospective Study of Trends in Peripheral Venous Pressures among Neurosurgical Patients during Intra Operative Period in a Tertiary Care Centre

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Abstract
Background: *Measurement of Central Venous Pressure (CVP) serves as an important hemodynamic monitor in major surgical procedures associated with blood loss and extensive fluid administration. In order to combat the risks associated with this highly invasive method, the peripheral venous pressure measurement as a trend monitor like central venous pressure measurement was introduced. Since the procedural complications and technical complications are less with peripheral venous pressure measurement it is emerging as a hemodynamic monitor in major neurosurgical procedures. Requirement of USS and highly qualified personnel not necessary for PVP measurement unlike central Venous Cannula insertion.*
Materials and Method: *In this study 25 patients posted for major neurosurgical procedures, peripheral venous catheter was connected to a pressure transducer which was linked to multichannel monitor and the peripheral venous pressure trends are recorded every 15 minutes. AS CVP measurement is stipulated as standard hemodynamic measurement as per text books for neurosurgical procedures in parallel to PVP, CVP was also measured.*
Results: *peripheral venous pressure recording serially done showed the trends in hemodynamics in various stages of surgery. Initial period of surgery showed lower, values trend due to induction and subsequent use of the mannital and diuretics. After correction of decreased trends in PVP gradual increase was showed in peripheral venous pressure. Peripheral venous pressure remained as higher value compared to the central venous pressure.*
Conclusion: *Peripheral venous pressure can be used as a monitor for hemodynamic trends in major neurosurgical procedures and as a guide for intra operative fluid therapy. CVP can also be predicted from PVP. But PVP can't be used for aspiration of air embolism from heart clambers unlike central venous catheter.*
Keywords: *CVP- Central Venous Pressure, PVP- Peripheral venous pressure, USS_ Ultra sound scan.*

Introduction

It is a prospective study aimed at recording the peripheral venous pressure trends during neuro surgery. Peripheral venous pressure varies edge to edge with the trends in the central venous pressure. Therefore, the peripheral venous pressure is nearly the mirror 'image' of the central venous pressure.

Primum noncere is a Latin phrase which is applicable to this study. It means, first do no harm. Here, in this study, trends in Peripheral venous pressure is associated with less risk, is cost effective and is an easier technique compared to Central Venous Pressure measurement. Therefore the Central Venous Pressure measurement can be substituted with PVP measurement based on the epicurean philosophy.

Neurosurgical patients who underwent craniotomy earlier for tumors, aneurysms or spinal meningiomas were subject to wide variations in the blood volume and vascular resistance. The ratio between the variables yield a pressure that is usually measured at supracristal part of superior venacava, referred to as Central Venous Pressure. We have investigated an alternative to Central Venous Pressure by measuring the peripheral venous pressure. Peripheral venous pressure trends paralleled Central Venous Pressure trends[(1)].

A portion of the hemodynamic risk is due to surgery and they may not be due to changes in cardiac function, relative blood volume, vascular tone, effect of anesthetics and mechanical ventilation.

Central Venous Pressure appears to have mere utility as trend monitor than for titration to absolute end point.

Invasive Central Venous Pressure monitoring has become the cornerstone of hemodynamic monitoring in neurosurgical patients. It is associated with inherent risks and technical difficulties. Measurement of Peripheral venous pressure is less invasive, cost effective and can predict the Central Venous Pressure trends.

Neurosurgical patients usually are followed up in ICUS during the immediate postoperative period. In critically ill patients, the Peripheral venous pressure monitoring can be done as a substitute to Central Venous Pressure. Peripheral venous pressure can be inserted by the nursing staff, thereby avoiding the insertion of invasive central venous lines by the anesthesiologist or ICU physicians. Thus it reduces the workload of the ICU physician.

Veins are the capacitance vessels containing 71% of the total blood volume. So veins serve as a reservoir of blood that drains in to the right heart via the great vessels inferior and superior venacavae. Veins being highly compliant are readily able to accommodate changes in the blood volume. Hence they are called capacitance vessels.

Central Venous Pressure monitoring is unreliable for estimating left ventricular filling pressure in patient with cardiopulmonary disease.

Estimation of peripheral venous pressure uses a simple method by using an IV cannula and pressure transducer taking care to avoid kinking of catheter.

Vein play a vital role in cardiovascular homeostasis. They do more than conducting blood to heart.

Falkow[(2)], around 1960's studied the features of veins and noticed the huge disparity existing in the literature concerning the quantity of information on the arterial compared to the venous side of the circulation.

There have been several attempts to consider static intravenous pressure as an indication central Venous pressure[(3,4,5,6,7)] Venous pressure[(8)] estimated from peripheral venous catheters (PVP) closely estimates the central venous pressure in surgically and critically ill patients. Simultaneous monitoring of Peripheral venous pressure, Central Venous Pressure and MZBP (Mean Arterial blood pressure) during resection of phacochromocytoma in a 63 year old women found good correlation between the three pressure variables indicating that alterations of PVP reflect over all changes in vascular tone[(9)].

Material and Methods

Study Setting

The Study was conducted in the Super speciality block Operation Theatre of Government Medical College, Thiruvananthapuram, during the period July 2013 to November 2014.

Design of the study

This was a prospective observational study.

Sample size

Based on the results observed in the existing literature and the correlation co-efficient between central venous pressure and peripheral venous pressure, (peripheral venous pressure is an

alternative to central venous pressure in neurosurgical patients) and with 99% confidence and 90% power the sample size ranges from 7 to 21. In this study, I had included 25 patients since there were ample cases and there was adequate infrastructure.

The study was conducted in 25 adults patients undergoing major neurosurgical procedure lasting for more than five hours so that 15 recording each of CVP and PVP could be recorded at 15 minute interval after induction of anesthesia.

Patients were included in the study after taking consent from them. The study was proceeded after getting approval from the institution ethical committee review board.

Sample size was calculated using the formula.

$$N = \left(\frac{(Z\alpha + Z\beta)x^2}{C(r)} + 3\right)$$

Where C(r) = ½ log x $\left(\frac{1+r}{1-r}\right)$

r = correlation co-efficient

$Z\alpha$ = 1.96

$Z\beta$ – 0.8416

For α 0.05 for β 0.20

Study Population

Inpatients posted for major neurosurgical procedure were selected for the study.

Inclusion criteria

1. Patients aged between 20-60 years
2. Patient in whom surgery was done is supine position without extreme positioning
3. ASA PS grade I – and ASA PS grade II patients without cardiac disease.

Exclusion Criteria

1) Frail patients, patients with septicemia
2) Patients who are febrile, with AV fistulae and peripheral vascular disease.
3) Age < 20 years or > 60 years.
4) Patients in whom there is contraindication for central line insertion due to bleeding and coagulation discords.
5) ASA III and IV class patients.
6) Patients in whom extreme positioning is needed.
7) Patients having poor peripheral venous access site.

Technique

After a thorough pre anaesthetic check up involving history, physical examination including systemic examination, airway examination and laboratory investigations, patients were accepted for anaesthesia. Written informed consent and the consent for study were obtained from each patient. 25 patients were selected consecutively from the neurosurgical patients who would need a neurosurgical procedure lasting for more than 5 hours.

Pre-operative day anaesthetic visit was done. All the procedures, risks, benefits were explained and the patients were relieved of anxiety. Instructions regarding nil per orally 8 hours prior to surgery, informed consent, arrangement of blood, oral premedication Tab Pantoprazole40 mg and Tab Domperidone 10 mg were given same drug were repeated at 6 am the next day.

On the day of surgery all patients received inj glycopyrolate 0.005mg/kg wt, inj morphine 0.05 – 0.1 mg/kg wt, after putting I/V cannulae 18 G in right upper limb and left lower limb under local anesthesia. Pre – induction monitors like ECG, NIBP, Pulse oximeters were attached. Pre oxygenation was done at 6 liters per minute for 3-5 minutes. Anesthesia was induced with inj thiopentone sodium 3-5 mg/kg body weight I/V or inj propofol 2-3 mg/kg body weight I/V plus inj xyloaine (preservative free) 1.5 mg/kg body weight I/V. Patient was mask ventilated followed by inj succinyl choline 1 to 2 mg/kg body weight I/V. Direct larynogoscopy and endotracheal intubation was done using endotracheal tube size 7.5 mm ID in females and 8.5 mm ID in males connected to Bain's circuit with oxygen inflow. ETT fixed using dynaplast after confirming ETT position. Anaesthesia was maintained using N2O+O2+isoflurane +inj Vecuronium infusion+ propofol infusion and patient was connected to circle system. Under sterile precautions, the right subclavian venous cannulation was planned. The area above clavicle and below clavicle upto mammary region was draped. Patient was positioned supine with head down and head turned to left. The right subclavian vein was cannulated

using 18G central venous cannula. The three way with venous extension line was placed in line with the central venous catheter, and thereby connected to the transducer which was zeroed at the level of right atrium. CVP can be read in the multichannel monitor.

Peripheral venous catheter attached to upper limb was connected to transducer and to the multichannel monitor. Intermittent flushing with heparin/saline was done, in both peripheral and central venous catheters. Zeroing of the peripheral venous catheter was also done. The intra-arterial cannulation was done under sterile precaution. The CVP and PVP were recorded immediately after their placement(recorded as at zero minutes) CVP and PVP were simultaneously measured at 15 minutes interval a total of 15 recordings each. Post induction monitors for CVP, PVP, Urine output, intra-arterial BP, Non invasive BP and temperature were also attached.

At the end of the surgery, patient was reversed with inj neostigmine 2.5 mg and inj glycopyrolate 0.4 mg I/V and extubated awake after return of muscle power, respiration or postoperatively ventilated depending on hemodynamic stability and duration of surgery. At the end of the study, data was collected and analysed.

Observations and Statistical analysis

To test the statistical significance of difference in mean value of CVP and PVP at each time point student's t test was applied. Pearson's product moment correlation co-efficient was computed between central venous pressure at each time enterval and their statistical significance was tested.

The present study was conducted in 25 adult patient undergoing major neurosurgical procedure lasting more than 4-5 hours. The CVP and PVP are recorded simultaneously at 15 minute intervals for a total of 15 minute recordings each during the intra operative period.

Table: 1 Percentage distribution of the sample according to age

Age	Count	Percent
<=30	5	20.0
31 – 40	5	20.0
41 – 50	11	44.0
51 – 60	4	16.0
Mean ± SD	42.4 ± 10.3	

The patients in the study had a mean age of 42.4 ± 10.3 years.

Table: 2 Percentage distribution of the sample according to sex

Sex	Count	Percent
Male	9	36.0
Female	16	64.0

64 % of the patients were females and 36 % were males.

Table: 3 Percentage distribution of the sample according to ASAPS Class

ASAPS Class	Count	Percent
I	14	56.0
II	11	44.0

ASA PS class of the patients predominated by ASAPSI 56 % and ASA PS II 44 %.

Table: 4 Descriptive statistics of height

Mean	164.2
SD	7.0
Median	164
Minimum	152
Maximum	176

Mean height of the Patient was 164.2 cms with a standard deviation of 7.

Table: 5. Descriptive statistics of weight

Mean	63.2
SD	7.1
Median	64
Minimum	52
Maximum	76

Mean weight of the patients were 63.2 kg with a standard deviation of 7.1

Table: 6 Mean score of CVP & PVP at different interval of time

	CVP	PVP
	Mean ± SD	Mean ± SD
0M	10.6 ± 2.7	13.4 ± 2.7
15M	10.7 ± 2.1	12.8 ± 2.3
30M	10.7 ± 2.2	12.9 ± 2.1
45M	11.2 ± 2.7	13.2 ± 2.4
60M	10.7 ± 2.5	13 ± 2.4
75M	10.9 ± 2.2	13 ± 2.1
90M	11 ± 2.2	13.2 ± 2.3
105M	11.2 ± 2.4	13.3 ± 2.5
120M	10.9 ± 2.2	13 ± 2.2
135M	11 ± 2	13.3 ± 1.8
150M	11.2 ± 2.6	13.4 ± 2.6
165M	11.8 ± 2.5	14.1 ± 2.3
180M	11.9 ± 2.7	13.8 ± 2.1
195M	11.3 ± 2.2	13.4 ± 2.2
210M	11 ± 2.2	13.9 ± 2.1

While comparing the mean intra operative CVP and PVP it was found that PVP always had a significantly high value.

First recorded of CVP showed a mean value of 10.6±2.7 and PVP correspondingly showed a value of 13.4 ±2.7.

At 120 minutes, mean CVP was 10.9 ± 2.2 and corresponding mean PVP value was 13 ± 2.2.

Table: 7 Correlation between CVP and PVP

	R	P
0M	0.851**	0.000
15M	0.773**	0.000
30M	0.845**	0.000
45M	0.859**	0.000
60M	0.802**	0.000
75M	0.611**	0.001
90M	0.799**	0.000
105M	0.825**	0.000
120M	0.767**	0.000
135M	0.792**	0.000
150M	0.901**	0.000
165M	0.826**	0.000
180M	0.719**	0.000
195M	0.797**	0.000
210M	0.82**	0.000

This graph shows that the correlation co-efficient was 0.851, 0.773 and 0.845 respectively at 0, 15 and 30 minutes. The r value was 0.719, 0.797 and 0.82 respectively at 180, 195 minutes and 210 minutes.

Since the P value is always <0.001 the correlation between PVP and CVP is evident.

Figure 1 Percentage distribution of the sample according to surgery

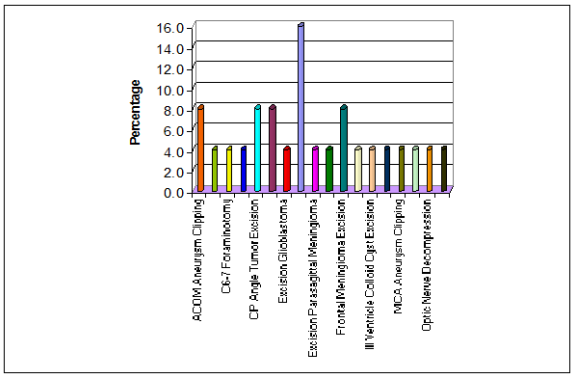


Figure 2 Mean score of CVP & PVP at different interval of time

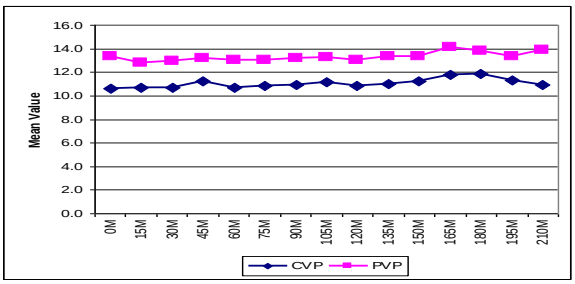


Figure 3 Scatter diagram for CVP & PVP for 180 Min

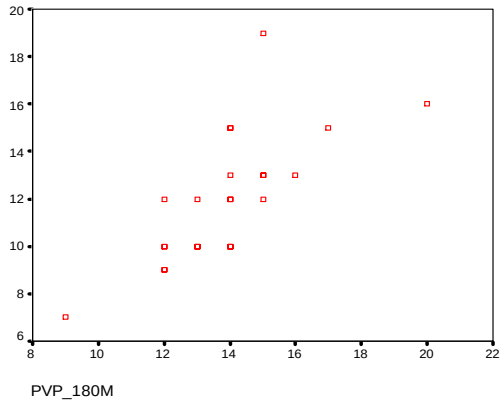


Figure 4 Scatter diagram for CVP & PVP for 195 Min

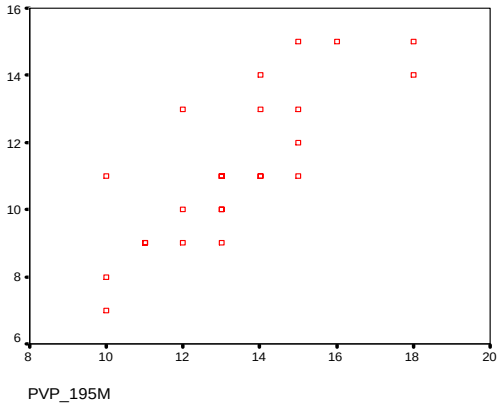
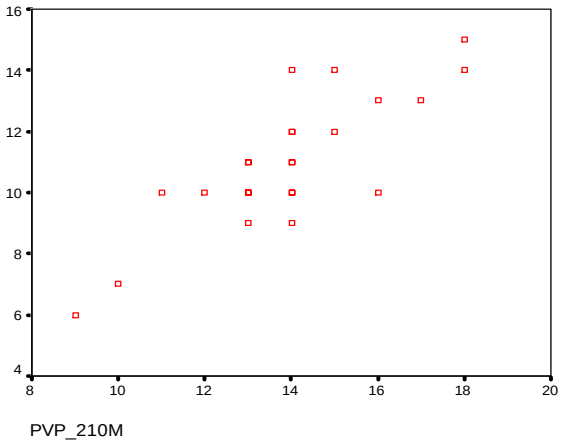


Figure 5 Scatter diagram for CVP & PVP for 210 Min



Scatter diagrams shows
That When CVP decreases PVP also correspondingly a lower value

Discussion

Neurosurgical[9] patients undergoing either craniotomy or complex spine surgery are subject to wide fluctuations in blood volume and vascular tone. An alternative to Central Venous Pressure by measuring PVP correlates highly with changes in absolute blood volume. Peripheral venous pressure trends parallel Central Venous Pressure trends and their relationship is independent of the patient position. Peripheral venous pressure Central Venous Pressure correlation was best in cases with significant blood loss of more than one litre.

The above study shows that Peripheral venous pressure trends provided equivalent physiological measurements to the Central Venous Pressure trends in this category of patients especially during period of haemodynamic instability. Peripheral venous pressure approximates mean systemic pressure (Systemic arrest pressure) which is a direct measure of patient volume status, not depending on cardiac or respiratory activity.

Central Venous Pressure [10] and PVP correlation was studied by sherif. Let al. In this study, 30 burns patients were selected from burns ICU. Central venous pressure waves were obtained using TF Double lumen central venous line placed on the left or right internal jugular vein or subclavian vein. Tip of the central venous catheter is positioned at the junction of SVC with the right atrium. Position of Central Venous catheter is confirmed by chest x-ray. The peripheral venous pressure monitoring and measurement of PVP was done from a peripheral intravenous site over the dorsum of hand, forearms or antecubital region using 18,20, 22G I/V cannula. Central Venous Pressure was measured by the Philips and space lab monitor equipped with invasive blood pressure monitoring device or transducers. Difference between Central Venous Pressure and PVP was evaluated using the paired 't' test. In the study, demonstration of relative agreement between Central Venous Pressure and Peripheral venous pressure 10 hour period suggests that Peripheral venous pressure monitoring be used as cost effective simple and a less invasive substitution for Central Venous Pressure. [11,12,13,14]

Comparing Central Venous Pressure from central and peripheral areas have shown consistent correlation, but these studies are done in surgical patients.

In the study of trends in Peripheral venous pressure in neurosurgical patients, Central Venous Pressure is also recorded side by side since the surgical procedures last longer time.

In the present study, it is shown that the PVP always had a higher trending in values compared to the Central Venous Pressure values.

In the initial part of the study, Peripheral venous pressure remained at lower values or lower trending due to the use of mannitol and diuretics prior to craniotomy later the dehydration was corrected using fluids and PVP then showed a higher trend. With the lower trending values of PVP, adequate administration of fluids, or blood may be done as the case may be as per the PVP trending. In this study the Peripheral venous pressure trending correlated with the Central Venous Pressure values. Peripheral venous pressure showed higher trending values compared to the central venous pressure values. In most patients, correlation co-efficient varied between 0.719 and 0.901 showing high degree of correlation between Central Venous Pressure and PVP, with a sample size of 25 neurosurgical

patients. Hence it indicates the true nature of the higher trending values of Peripheral venous pressure compared to Central Venous Pressure. Since Central Venous Pressure insertion is associated with various complication where man power and specialists are scarces trends in Peripheral venous pressure values throughout the surgery, is useful.

PVP monitoring may be useful for adequate guidance in the administration of fluids and blood. The cost of PVP monitoring which is mainly due to the pressure transducers employed can be avoided by the use of water manometer with three way system during intra operative period, especially in general hospital.

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