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Correlation Between Central Venous Pressure and Peripheral Venous Pressure in Abdominal Surgeries.

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Introduction

Fluid administration in the perioperative period is an integral part of day-to-day anesthesiology practice. Adequate intravascular volume replacement is a crucial issue that can seriously affect the outcome of the surgery. Precise assessment of volume status is a prerequisite for adequate volume replacement which may achieve optimal organ perfusion and oxygen supply. Fluid management is a crucial issue for patients undergoing major surgeries, in which large blood loss, transfusions, and fluid shifts are major concerns.

CVP is widely used to guide fluid therapy in Major surgeries. This represents the pressure in the right atrium immediately before the start of ventricular systole. CVP is often used to estimate right ventricular preload which serves as a surrogate for intravascular volume and can help to guide fluid management [1]. On the other hand, peripheral venous pressure measures the diastolic filling pressure of right heart, CVP monitoring via peripheral intravenous catheter in the arm has been described to be very safe and convenient with the easy accessibility and suggested as a comparable alternative to CVP measure ment [2]. PVP reflects an upstream venous variable that is coupled to CVP by a continuous column of blood [2]. However, complications associated with central venous cannulation, such as accidental arterial puncture, arrhythmias, hematoma, pneumothorax, nerve injury, arteriovenous fistula, air embolism, catheter or wire shearing, catheter occlusion / displacement and infection can outweigh its benefits. Thus, central venous pressure (CVP) measurement is important in assessing right ventricular function and systemic fluid status and is a reflection of cardiac function and the venous return to the heart. Studies have demonstrated that venous pressures measured from peripheral venous catheters closely correlate with the CVP and/or CVP trends in both surgical and critically ill patients in different situations like hemodynamic instability, in the presence of inotro pes, and postoperatively during spontaneous respiration.

Peripheral venous pressure reflects an upstream venous variable which is coupled to the CVP by a continuous column of blood, analogous to the fluid continuity that exists between a pulmonary artery occlusion catheter and the left atrium [3]. Measuring peripheral venous pressure is a simpler and safer monitoring technique [4]. The venous return concept originally described by gyton et al,

is based on the existence of a pressure gradient between the periphery and the right atrium. The gradient is the difference between mean systemic pressure and CVP. This gradient determines venous return. The concept of venous return implies that PVP must be greater than CVP to allow the blood to circulate towards the heart. However, the magnitude of the relationship between CVP and PVP is unknown and could depend on the site chosen for PVP measurement, on the resistance to venous return, and on cardiac systolic and diastolic function [5].

As majority of patients undergoing surgery have a peripheral iv catheter in place, monitoring PVP may contribute to reduction in cost , complications and time to the onset of operation . However it has not yet been determined whether PVP convincingly reflects changes in CVP in cases of increased intrathoracic pressure [6]. Hence we did study to know whether PVP can be comparable and reliable to CVP.

Aims & Objectives

1. To compare the CVP measurements with PVP in major abdominal surgeries.
2. To assess the reliability of PVP as a predictor of CVP.

Methods For Cannulation

It can be cannulated using either a landmark technique or ultrasound guidance. Ultrasound guidance is nowadays strongly recommended for central line placement.

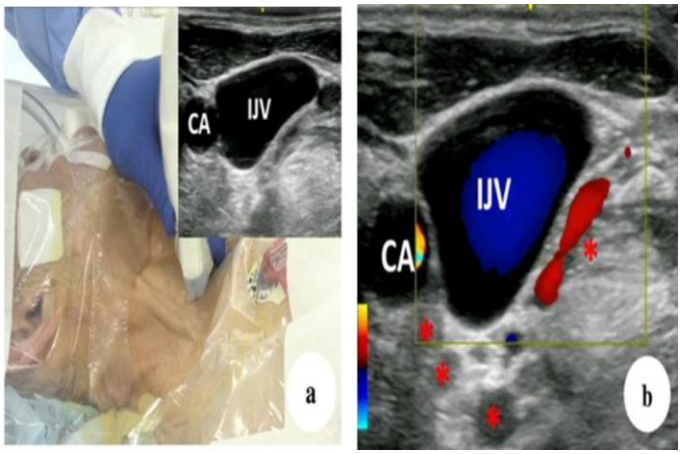
Approaches for insertion: anterior, medial and posterior based on the location of insertion relative to the SCM muscle.

Here we have used USG guided method for cannulation.

Ultrasound guided central venous cannulation:

1. Pt positioned in head low position with head extended and turned towards the contralateral side of insertion.
2. Under ASP locate and visualize the IJV using USG
3. Conform patency of the vein using compression ultrasound
4. Use real time us guidance for puncturing the vein.
5. Use short axis out of plane or long axis in plane approach for puncturing.
6. Conform the needle tip is placed centrally in the vein
7. Insert the guide wire properly and confirm its correct position.
8. Dilate the vein using a dilator over the guide wire.
9. The dilator is removed while maintaining the guide wire and introduce the double lumen catheter over the guide wire.
10. The wire is removed, ports are aspirated and flushed and the catheter is secured to the skin.
11. Get done CXR to confirm the position and exclude complications such as pneumothorax and the tip of the catheter should be at the junction of SVC and right atrium.

Figure 1: Usg Guided Approach for Ijv Cannulation



Factors Affecting The Measurement Of cvp

- Zeroing
- Levelling
- Transmural pressure

Where to make the measurement(best measured at the base of the C wave)

Normal CVP ranges from 2-5 mmhg/ 5-10 cm h2O

Figure 9

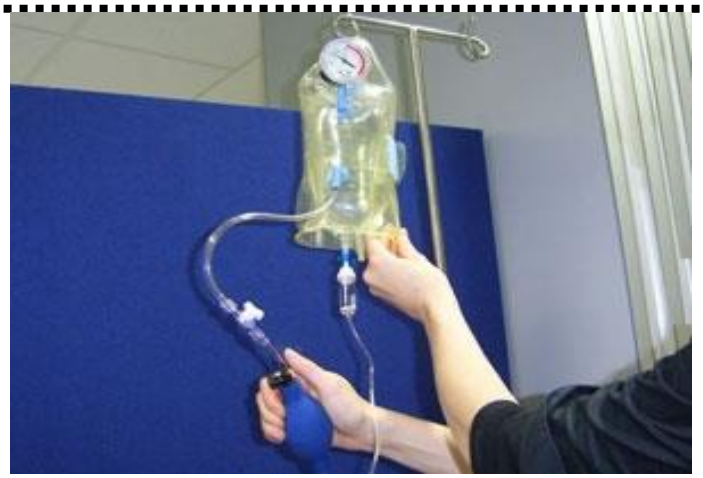


Figure 2: Measuring central venous pressure using a trans ducer

Explain the procedure to the patient to gain informed consent. The CVC will be attached to intravenous fluid within a pressure bag. Ensure that the pressure bag is inflated up to 300mmHg.

Place the patient flat in a supine position if possible. Alter natively, measurements can be taken with the patient in a semi-recumbent position.

The position should remain the same for each measure ment taken to ensure an accurate comparable result

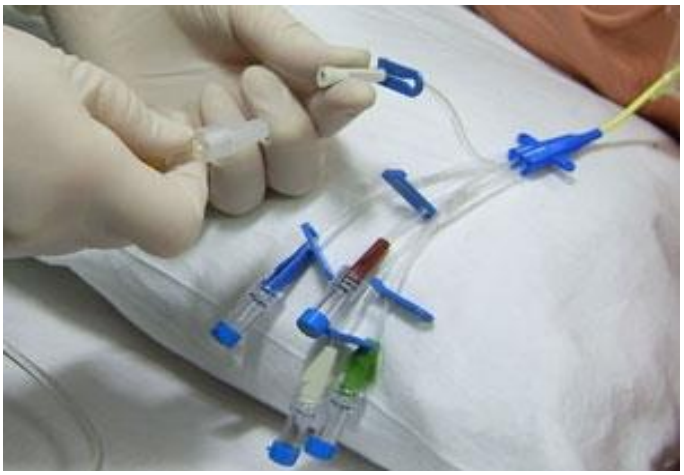


Figure 3: Catheter differs between manufacturers; how ever, the white or proximal lumen is suitable for measuring CVP

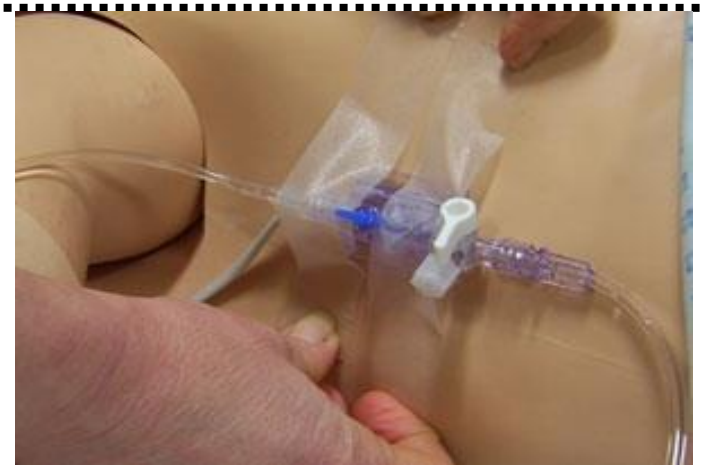


Figure 4: Tape the transducer to the phlebostatic axis or as near to the right atrium as possible

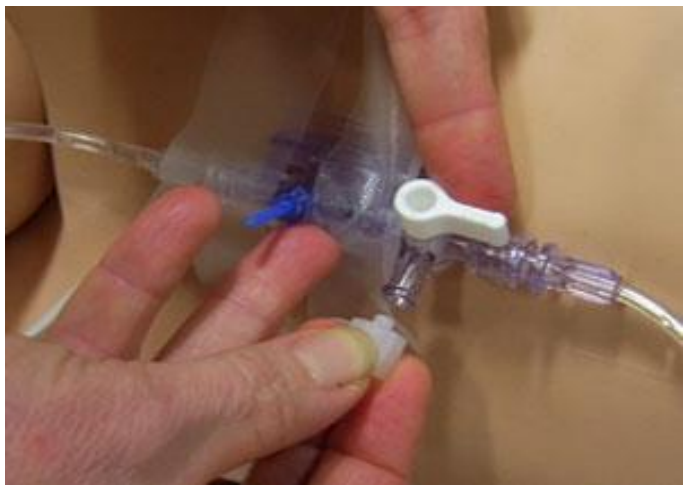


Figure 5: Turn the tap off to the patient and open to the air by removing the cap from the three-way port opening the system to the atmosphere

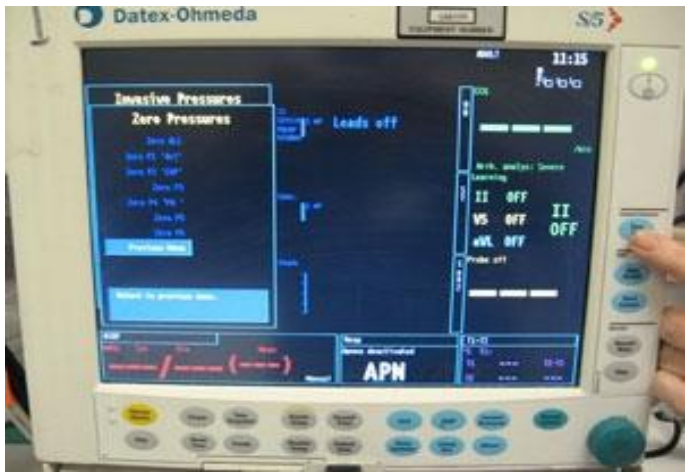


Figure 6: Press the zero button on the monitor and wait while calibration occurs

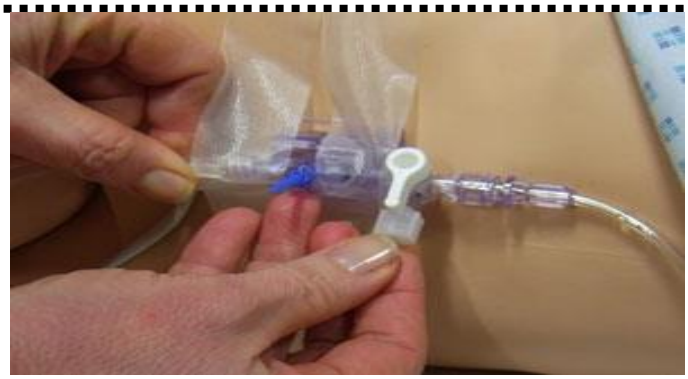


Figure 7: When 'zeroed' is displayed on the monitor, replace the cap on the three-way tap and turn the tap on to the Patient

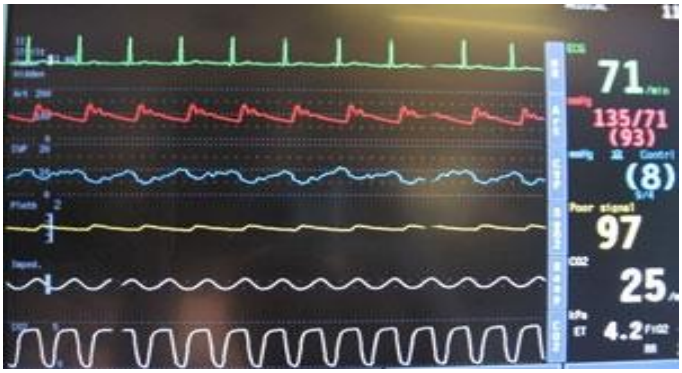


Figure 8: Observe the CVP trace on the monitor. The waveform undulates as the right atrium contracts and relaxes, emptying and filling with blood. (Light blue in this image)

Peripheral venous pressure measurement

PVP is measured as same as that of cvp using a pressure transducer system simultaneously.

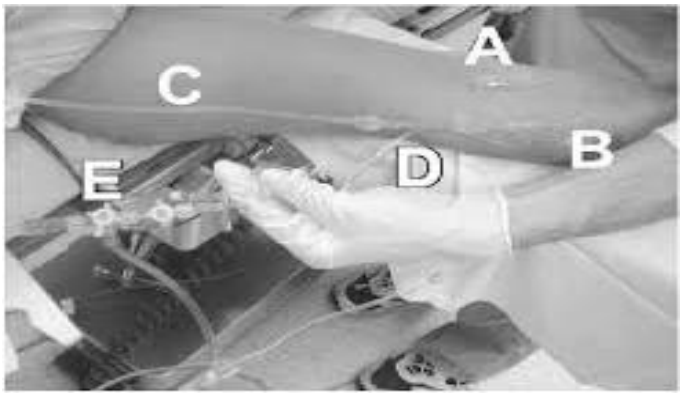


Figure 9:

Peripheral venous pressure monitoring system. (A) In a 18G iv catheter in the antecubital vein is connected to a y connector (B) .This connector is attached to both the pressure transducer system (C) and the low compliance iv tubing (D). Finally in E a three - way stopcock is used to isolate the pressure monitoring system.

Materials and Methods

After getting approval from institutional ethical com mittee (institute of kidney disease and research centre), patients over 18 years of age, 60 in number scheduled for major abdominal surgeries were selected for this prospective observational study. Written and informed consent for participation was obtained from each patient. Pre-operative assessment and investigation was done in all patients day prior to surgery.

Inclusion Criteria

Patients with age more than or equal to 18 of both the gender scheduled for elective and emergency abdominal surgeries with (ASA 1-5) in whom CVP and PVP is measured at civil hospital campus Ahmedabad between July 2019-Dec 2021.

Exclusion Criteria

- Patients with cardiorespiratory comorbidity
- Coagulation abnormality
- Morbid obesity BMI>30
- Anticipated difficult peripheral and central venous access.
- Infection at the site of insertion
- Thyromegaly or prior neck surgery

Record the demographic data- including age, sex, present illness, underlying disease, vitals, and indication for central venous placement. Following placement of the ASA standard monitors like ECG, SPO2, NIBP. Pre medication in the form of Inj. Glycopyrrolate 0.2mg, Inj. Fentanyl (2µg/kg body weight), Inj. Midazolam 2 mg; was given followed by induction with Inj. Propofol 2mg/kg, after preoxygenation with 100% oxygen for 3 minutes.

Tracheal intubation facilitated with succinylcholine (2mg /kg) and an aesthesia was maintained with O_2, N_2O, isoflurane and Inj. Atracurium 0.1mg/kg was repeated every 30minutes. Following intubation, patients were ventilated with tidal volume of 6-8ml/kg and respiratory rate 12-16/min- maintaining end-tidal CO_2 between 30-35. Right IJV was used for measuring CVP in all the patients.

A linear-array ultrasound probe connected to a real-time ultrasound unit and is covered with ultrasonic gel and wrapped in a sterile plastic sheath is used. Standard ultrasound two-dimensional (2D) imaging is used to measure the depth and calibre of the IJV, evaluate its patency and compressibility, and identify whether there are any thrombi in the vein. Catheterisation is performed under continuous dynamic observation of real-time 2D images obtained by placing the transducer parallel and superior to the clavicle, over the groove between the sternal and clavicular heads of the sternocleidomastoid muscle. An 18- gauge, 10-cm needle is advanced through the skin under ultrasound guidance into the IJV. A guide wire is then placed through the needle into the vein, and the needle is removed. Double lumen (7 Fr, 16G) central venous catheter was inserted in the Right IJV under USG guidance. It was fixed 16-18 cm from the skin and intravenous location was confirmed by aspiration of blood through each lumen and by USG. the catheter was fastened to the skin by sutures and tapes and then connected to low- compliance tubing directly to a pressure transducer. The distal port of the catheter was used for pressure measurement and proximal port was left for infusion. For PVP measurements vein in the antecubital fossa was used in the all patients. CVP and PVP were measured simultaneously with pressure trans ducer in same patient.

An 18gauge peripheral venous catheter was inserted into the antecubital vein on the antecubital fossa in the measurement arm and connected to the same type of tubing and the pressure transducer as CVP. The measurement arm was abducted at 90 degrees on an arm board protected against external pressure and kept visible during surgery. Drugs and fluids are not administered through the PVP cannula, NIBP was measured on other hand to avoid hindrance to venous flow.

The pressure transducers were calibrated and zeroed separately at a level corresponding to the horizontal line extending from mid axillary line and the fourth intercostal space or phlebostatic axes (fourth intercostal space intersect with midway between xiphoid and back). Real time waveforms and numeric pressure values were displayed on the monitor throughout the procedure. The pressure line was flushed with saline. after flushing and room air zero calibration the transducer sets were re flushed with saline and maintained at mid thorax level throughout the surgery. Occlusion errors of measurement were avoided with frequent flushing of the catheters. Drugs and fluids were not administered from the arm in which the measurements were performed. Additional monitoring after tracheal intubation consisted of etco2, oropharyngeal temperature and urine output.

Mechanical ventilation using volume control mode was instituted without PEEP. Measurements were made every 20 min after tracheal intubation till 1 hour followed by measurements every 30 minutes until the end of surgery; and till 2 hrs postoperatively. Intraoperative complic ations like central venous embolism, arrhythmias and post operative complications like infection, venous throm bosis, pneumothorax were noted.

Intraoperatively, Hypotension was defined as 20% decrease in MAP from the pre-induction value, which was initially treated with bolus of 200-300ml of a

crystalloid solution. Hypotension following blood loss of >10% of total blood volume was treated with equal volumes of colloid.

After the surgery, patient was reversed with injection Neostigmine (.05mg/kg) and injection Glycopyrrolate (0.00 4g/kg) and extubated smoothly without any complications.

Patient was shifted to the PACU. Patient was monitored in the PACU with all the necessary standard monitors and measured the CVP and PVP values until 2 hour postoperatively.

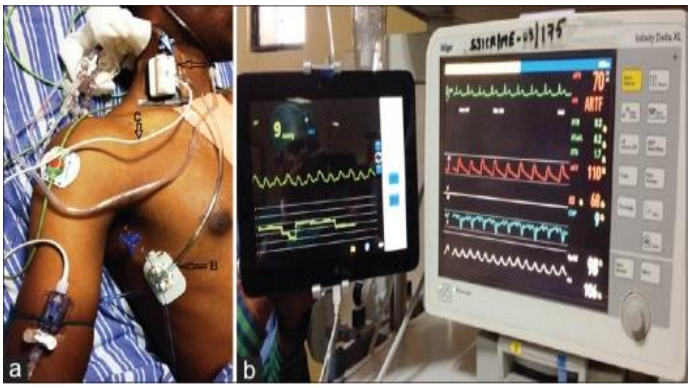


Figure 10:

Observation & Results

This prospective observational study was conducted in 60 patients undergoing major abdominal surgeries, where major blood loss was expected.

The CVP and PVP were recorded simultaneously at every 20 min interval till 1 hr, then every 30 minutes until the end of surgery and hourly till 2 hour post operatively.

The PVP was measured via a peripheral iv catheter (18 gauge) in the antecubital vein. The central catheter was inserted from the right internal jugular vein in all patients.

Results

Table 1: Demographic data

	Mean ± SD (n=60)
Age (Years)	40.6 ± 13.425
Sex: M	46(76.6%)
F	14(23.3%)
BMI (Kg/M2)	20.75 ±1.752
DURATION OF SURGERY (Hr)	4.08 ± 1.26

$p<0.05$ is considered as significant

The patients included in the study had a mean age of 40.6±13.425, with a mean BMI of 20± 1.752. Out of 60 patients included in the study 46 where male (76%) and 14 where female (23%).

Among the 60 patients selected 36% where kidney recipients, in which fluid resuscitation and use of vasopressor agents or diuretic therapy in fluid overloaded patients is frequently require CVP monitoring as fluid guide.

Table 2: Types of Surgery

Type of surgery	Number (N=60)
Open renal tx	22
Open nx/ partial nx	11
Laparotomy	6
Resection and anastomosis	3
Partial hepatectomy	2
Open adrenelectomy	4
Ureteric reimplant	2
Splenectomy	2
Ivc thrombectomy	2
Open pyeloplasty	5
Whipplessx	1

The above data shows different type of surgeries, in which the study was conducted. About 36% of the patients were renal transplant recipients in which you can expect major hemodynamic changes

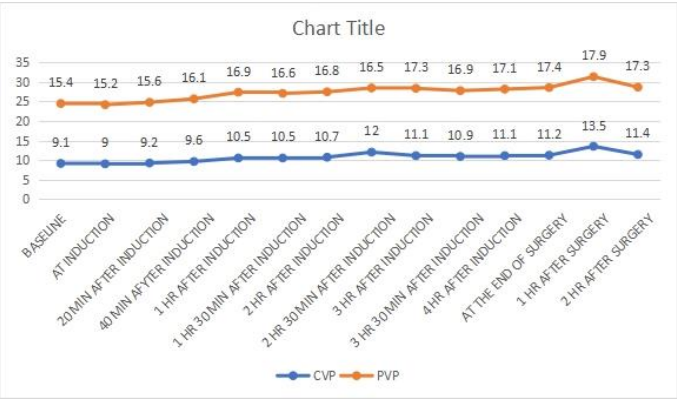
Table 3: Comparison between Cvp and PVP

Time	CVP Mean ± sd (n=60)	Pvp Mean ± sd (n=60)	P- value
Baseline	9.1 ± 2.1	15.4±2.0	<0.001*
At the time of induction	9.0 ± 2.1	15.2±1.9	<0.001
20 min after induction	9.2 ± 2.1	15.6±1.9	<0.001
40 min after induction	9.6 ± 2.1	16.1±2.3	<0.001
60 min after induction	10.5 ± 2.2	16.9±2.4	<0.001
1 hr 30 min after induction	10.5 ± 1.9	16.6±1.5	<0.001
2 HR after induction	10.7 ± 1.7	16.8±1.4	<0.001*
2 HR 30 min after induction	12.0 ±1.7	16.5±1.6	0.04
3 HR after induction	11.1± 1.7	17.3±1.7	<0.001
3 HR 30 min after induction	10.9± 1.3	16.9±1.4	<0.001
4 HR after induction	11.1 ± 1.3	17.1±1.2	<0.001
at the end of surgery	11.2 ± 1.6	17.4±1.9	<0.001
1 HR after surgery	13.5 ± 1.3	17.9±1.8	0.69
2 HR after the surgery	11.4 ± 1.4	17.9±1.2	<0.001

While comparing the mean CVP and PVP , it was found that PVP always had a significantly high value throughout the study period compared with CVP ($p < 0.001$)., the difference being minimum 2 hr 30 min after induction (difference of 4 mm hg) and maximum at 40 min after induction (difference of 6mmhg).

*P<0.05 significant

Chart 1: Comparison between CVP and PVP.



*p value <0.001 is significant.

The mean CVP was 10.7 ± 1.228 mm Hg and the mean PVP was 16.64 ± 0.80 mm Hg and the p value <0.001, hence this observation is statistically significant. Higher PVP was noted throughout.

Most of the time changes in CVP were coincided with similar changes in PVP.

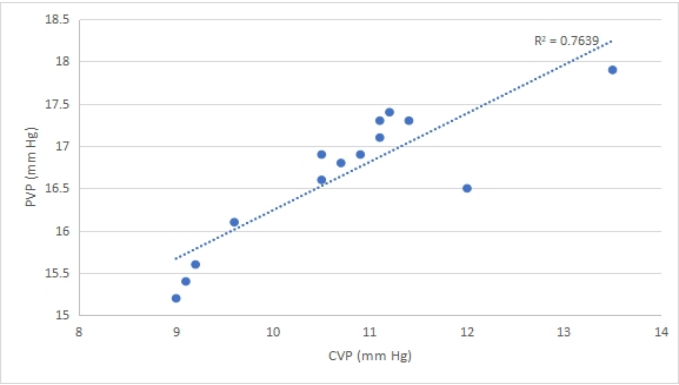
Table 4: Correlation between CVP and PVP.

Time	Cvp Mean±sd (n=60)	Pvp Mean± sd (n=60)	Correlation coefficient (r)
Baseline	9.1 ± 2.1	15.4±2.0	0.89
At the time of induction	9.0 ± 2.1	15.2±1.9	0.91
20 min after induction	9.2 ± 2.1	15.6±1.9	0.90
40 min after induction	9.6 ± 2.1	16.1±2.3	0.86
60 min after	10.5 ± 2.2	16.9±2.4	0.88

induction			
1 hr. 30 min after induction	10.5 ± 1.9	16.6±1.5	0.90
2 hr. after induction	10.7 ± 1.7	16.8±1.4	0.85
2 hr. 30 min after induction	12.0 ±1.7	16.5±1.6	0.25
3 hr. after induction	11.1± 1.7	17.3±1.7	0.95
3 hr. 30 min after induction	10.9± 1.3	16.9±1.4	0.90
4hr after induction	11.1 ± 1.3	17.1±1.2	0.88
At the end of surgery	11.2 ± 1.6	17.4±1.9	0.91
1 hr after the surgery	13.5 ± 1.3	17.9±1.8	0.05
2 hr after the surgery	11.4 ± 1.4	17.9±1.2	0.92

Statistical interpretation of correlation revealed that there was a positive correlation existing between CVP and PVP throughout the study period except at 2 hr 30 min after induction (r= 0.25) and 1 hr after the surgery(r= 0.05).

Chart 2: Correlation between CVP and PVP



Scatter diagram of Mean ± SD values of CVP and PVP is as shown in this figure. This implies that there is a positive correlation between these two with r^2= 0.76

Bland alt man plot – to assess the limits of agreement.

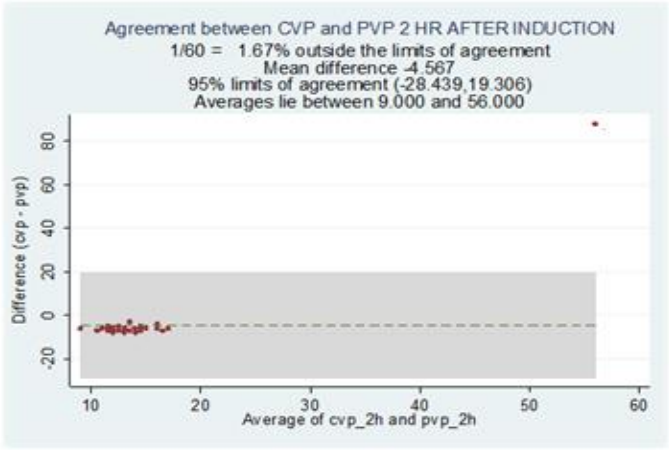
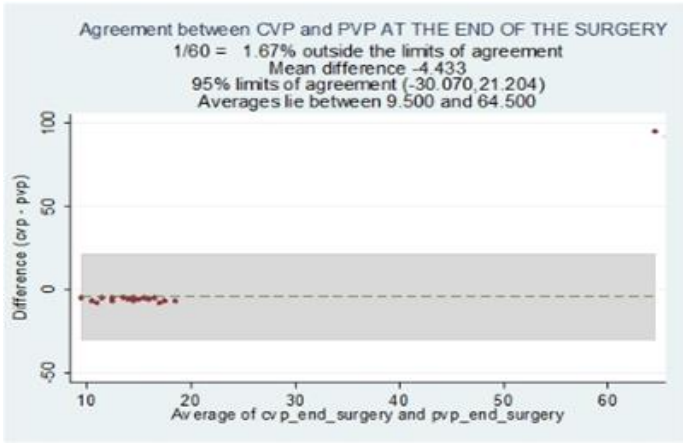


Chart 3:

This figure shows the Bland Altman plot at 2 hour of surgery, here the difference between simultaneous CVP and PVP data plotted against their average. The (mean ± SD) bias was 4.5 ± 1.2mmhg with 95% limits of agree ment.

Chart 4:



This figure shows Bland Altman plot at the end of surgery. Difference between simultaneous CVP and PVP data plotted against their average. The (mean ±SD) bias was 4.4± 1.3mmhg with 1.67% outside the limits of agreement and 95% within the limits of agreement.

This data shows that MBP and CVP were statistically significant and well correlated except at 2 hr 30 min of surgery (r= 0.01, p=0.90) .

Table 5: Comparison and correlation between PVP And MBP.

Time	Cvp mean ± sd N=60	Mbp mean ± sd a N=60	P value	Correlation Coefficient (r)
Baseline	9.1 ± 2.1	97.2 ± 10.7	0.0004	0.44
At the time of induction	9.0 ± 2.1	92 ±14.8	0.005	0.44
20 min after induction	9.2 ± 2.1	89.4 ± 14.2	<0.001	0.56
40 min after induction	9.6 ± 2.1	90.7 ± 12.4	<0.001	0.58
60 min after induction	10.5 ± 2.2	97 ± 9.7	<0.001	0.51
1 hr 30 min after induction	10.5 ± 1.9	95.3 ± 9.5	0.0029	0.37
2 hr after induction	10.7 ± 1.7	92 ± 8.8	0.0001	0.47
2 hr 30 min after induction	12.0 ±1.7	94.3 ± 10.7	0.90	0.01
3 hr after induction	11.1± 1.7	96 ± 7.2	<0.001	0.54
3 hr 30 min after induction	10.9± 1.3	94.2 ± 10.4	0.003	0.37
4hr after induction	11.1 ± 1.3	92.6 ± 10.5	0.42	0.10
At the end of surgery	11.2 ± 1.6	95.9 ± 12.2	0.01	0.32
1 hr after the surgery	13.5 ± 1.3	105.5 ± 11.8	0.08	0.22
2 hr after the surgery	11.4 ± 1.4	95.6 ± 8.4	0.01	0.31

This data shows that MBP and CVP were statistically significant and well correlated except at 2 hr 30 min of surgery (r= 0.01, p=0.90)

Table 6: Comparison and correlation between PVP and MBP

Time	pvp Mean± sd (n=60)	Mbp Mean ± sd (n=60)	P value	Correlation Coefficient (r)
Baseline	15.4±2.0	97.2 ± 10.7	<0.001	0.52
At the time of induction	15.2±1.9	92 ±14.8	0.006	0.34
20 min after induction	15.6±1.9	89.4 ± 14.2	<0.001	0.58
40 min after induction	16.1±2.3	90.7 ± 12.4	<0.001	0.63
60 min after induction	16.9±2.4	97 ± 9.7	<0.001	0.64
1 hr 30 min after induction	16.6±1.5	95.3 ± 9.5	0.0004	0.44
2 hr after induction	16.8±1.4	92 ± 8.8	<0.001	0.64
2 hr 30 min after induction	16.5±1.6	94.3 ± 10.7	<0.001	0.66

3 hr after induction	17.3±1.7	96 ± 7.2	<0.001	0.59
3 hr 30 min after induction	16.9±1.4	94.2 ± 10.4	0.01	0.32
4hr after induction	17.1±1.2	92.6 ± 10.5	0.31	0.13
At the end of surgery	17.4±1.9	95.9 ± 12.2	0.003	0.37
1 hr after the surgery	17.9±1.8	105.5 ± 11.8	0.15	0.18
1 hr after the surgery	17.9±1.2	95.6 ± 8.4	0.009	0.33

This data shows comparison and correlation of MBP and CVP. They were statistically significant and positively correlated throughout the study except at 4 hr of surgery (r=0.13, p=0.31)

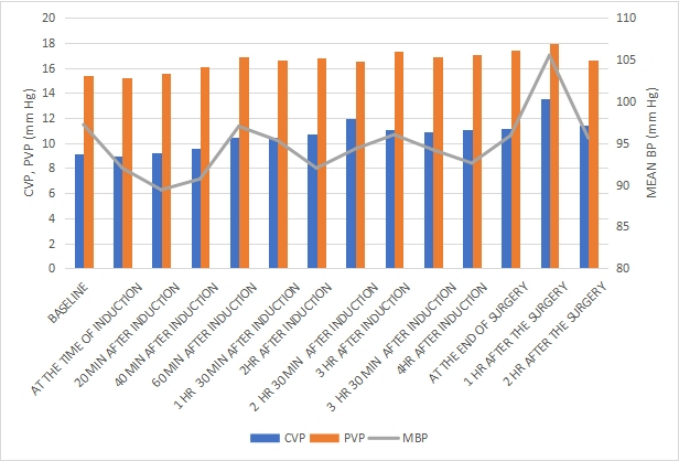


Chart 5: shows graphical representation of comparison between MBP, CVP and PVP

Table 7

Complications

Complications	No: of patients N=60
Hematoma	0
Arrhythmia	3
Embolism	0
Catheter displacement/ occlusion	1
Extravasation	2
Bleeding	4
Infection	0

Among 60patients, only 16% of the patients are encountered with complications, with occurrence of arrythmia, catheter displacement / occlusion, extra vasation, bleeding are 5%, 1.6%, 3.3%, 6.6% respectively.

Discussion

Although it is mandatory to insert catheters into peripheral veins of all surgical patients, measurement of PVP from those veins is not commonly practiced. Despite the more invasive nature of the procedure and inherent complications involved with central venous cannulation, anesthesiologist are accustomed to monitor CVP [24]. Peripheral venous catheter which is easy to place and free of complications is indicated whenever central venous cannulation is not accessible due to in accessible neck, surgical site or position of the patient contraindicates catheter placement. Literature shows that venous pressure measured from PVCs closely related to pressure measured by central venous catheter intra operatively and in ICU.

As PVP is linked to CVP by a continuous fluid column, comparing them usually shows a consistent correlation. Various studies have demonstrated that pressures measured from peripheral venous catheters closely esti mate the CVP and/or CVP trends [1] [30] [4] [31] [18] [32]. As the difference between CVP and PVP mea surements usually remain in a constant range, serial assessment of PVP can be used to monitor the changes occurring in CVP during the intraoperative bleeding, hypotension, or mechanical ventilation, advantages being

cost effectiveness and avoidance of complications asso ciated with central venous catheterization [24].

This study describes a simple inexpensive and minimally invasive technique that can be used as a substitute to the monitoring of CVP. As single point estimates of CVP are of limited clinical value unless they are low (< 5mmhg) and confirm an existing suspicion for hypovolemia [28] [29]. Trends and their correspondence to clinical evidence of organ function and perfusion help to create a more meaningful picture of fluid needs and euvolemia.

Our study shown that PVP always had a significantly high value compared with CVP throughout the study period (p< 0.001) except at 2 hr. after induction (p 0.04) and at the end of surgery. We observed that PVP measured in the antecubital vein lies more than 4-5mmhg of CVP ,95% of the time during the surgery. This observation was supported by study conducted by Rajan Sunil et al**.** They proved that throughout the study period a PVP had positive trend with a significantly higher value than CVP by 6-7mmhg (p< 0.001) [24]. Similarly, Munis et al, conducted a study on 15 patients undergoing major surgeries, where they reported that mean PVP value of 13mmhg and CVP of 10mmhg with a PVP – CVP difference of 3mmhg [1] Above identical results were observed with N Hadi mioglu et al. Who reported in a study of 30 kidney recipients in which mean PVP was 13.5mmhg, CVP was 11 and the difference between them is 2mmhg. Repeated measures analysis variance indi cated a highly significant relationship between them [19]. Similar to this in our study we had patient population undergoing renal transplantation, but we had PVP - CVP difference is higher**.** This significant variability in PV P-CVP difference amongst subjects and authors is due to venous valves and local venous tone are suspected to intervene between peripheral and central veins. [30] Amar et al studied correlation between CVP and PVP in cardiothoracic surgeries in which PVP being higher than CVP by 2mmhg (p<0.001) [33]. Furthermore, Tugrul et al reported PVP showed strong relation with CVP. PVP on a higher limit as compared to CVP by 5mmhg [34]. Thus majority of studies have reported that the tendency of higher PVP than CVP which is due to the additional hydrostatic effect of the blood column between central and peripheral veins [2]. The observed difference between PVP and CVP is likely to be because of the resistance to venous drainage from large veins.

Our study showed a positive correlation (r^2 = 0.76) throughout the study period, as the study was conducted in a group of people with and without cardiovascular comorbidities. In the context of avoiding invasive intra operative monitoring, PVP has been tested as an alternative to CVP. Since the early 2000 many investigators have shown that a strong correlation exist between CVP and PVP during surgery [6]. comparing to other studies, some were conducted on a specific group of patients such as Charalambous et al did a study in a group of critically ill patients, where the change in PVP may help to predict the direction of change in CVP. The direction of significant changes in CVP (equal to greater than 2mmhg) is predicted by similar changes in PVP with an accuracy of 91 % [18] In a study by Dessiris et al among hypo volaemic dogs, the CVP and PVP showed a good correlation even when the CVP was as low as 0 mmhg and Fluid resuscitation produced parallel rise in both CVP and PVP [35]. Munis et al observed that the overall correlation from 1026 paired measurements of CVP and PVP was found as r=0.89 and their trends being parallel with each other in 15 neuro surgical patients [1].

Amar et al, showed a consistent, and high degree of agreement between PVP and CVP in the perioperative period in 100 patients without significant cardiac dysfunction. Data of the first 50 showed a good

correlation between the two (r=0.82) and in next 50 patients (r=0.88), one group was given fluid challenge further the increase in CVP and PVP were measured shows parallel trend [33]. Nayani Radhakrishna et al 's study results revealed strong correlation between CVP and PVP in patients in varying positions (r=0.89). CVP and PVP trends changed parallel with each other.[36]

Nir Hoft man et al in patients undergoing liver transplantation demonstrated that PVP correlated well with CVP both during times of hemodynamic stability and instability. Thus clinically unstable conditions that includes large swings in CI, SVR, heart rate and SBP did not affect the correlation. There is a much weaker CVP – PVP correlation at lower filling pressures, the coefficient in which PVP is 7 mm hg was r= 0.63, compared to the pooled data (r=0.95) due to low filling pressures peripheral veins intermittently collapses interrupting their continuity .so patient population with interrupted fluid column may not exhibit a good correlation [37]. Similar to our study Kimsh et al proved a definitive positive correlation between overall CVP and PVP (r=0.96) [6] in laparoscopic colorectal surgery.

A meta-analysis conducted by Filippo Sanfilippo et al showed a significant correlation of PICC and CICC. Where measured CVP and PVP values found by four clinical studies (correlation coefficient ranging from 0.92- 0.99) [38] In our study the strong correlation suggests an uninterrupted venous fluid column between the antecubital vein and the superior vena cava. Although the actual anatomy was not studied, because of our small sample size, we cannot comment on anatomic variations. Contrary to our study, study conducted by Rajan Sunil et al observed that PVP showed a positive trend with persistently high value of PVP than CVP, a statistically insignificant correlation between the two was established. Because their study population included different types of surgeries and positions of the hand were variable causing interruption to the accurate PVP value [24].

Our study showed perfect agreement between CVP and PVP with 95 % confidence interval with a mean difference of CVP and PVP 4.4 ±1.3 was established (figure 7). Because the bias did not show any trend as a function of average pressure, PVP was adjusted by the rounded bias. mtugrul et al in a their study used of different sizes .peripheral catheters and positions in 500 cases , 1953 paired measurements were obtained and the mean CVP value was 11±3.7mmhg , PVP was 13±4 mm hg and mean difference was 2 ± 1.8 mm hg with 95% limits of agreement [34] . N Had imioglu et al did a study on kidney recipients, where the bland alt man analysis showed a perfect agreement between CVP and PVP with a bias of 2.7±3.6 [19]. In a study conducted by soo joo choi et al in 50 adult living donors reported the mean difference PVP-CVP was less than 2mmhg with 95% limits of agreement although keeping low CVP has been advocated during hepatectomy because elevated CVP is considered as the major determinants of bleeding from liver parenchyma and excessive fluid administration can decrease hepatic blood flow and oxygenation and induce graft edema secondary to extravasation [2]. Previous studies like. Amar et al used different sizes of peripheral catheter (14, 16, 18,20, and 22 G) to measure CVP in their study and he stated that the gauge of the peripheral catheter did not affect the PVP measurement [30]. same type of study was conducted by Mehmet tugrul et al in which they found out the relationship between CVP and PVP in different patient positions, catheter sizes and insertion sites involving different types of surgeries.

However in their study the limits of agreement were not narrow enough to encourage clinicians to use 2 methods inter changeably. They have used a paired measurement

and a constant relationship was shown between CVP and PVP. Probable reason for this is the venous valves and local venous tone are suspected to intervene between peripheral and central veins producing a significant variability between subjects. In this study wide variety of patients, catheter sites and sizes were studied in a large group of patients. The prone position gave the worst correlation between the measurements and the PVP - CVP reached maximum value by 7-8 mm hg. Neither the peripheral catheter size nor the site of the catheter placement in the arm affected the agreement between the PVP and CVP [34]. In a study conducted by lulu sheriff et al showed an agreement between CVP and PVP in burns patients. The overall mean difference between CVP and PVP was 1.628±0.84 mm hg and upper limit of agreement correlated to the clinically acceptable limits and were comparable with the data. Thus PVP may be useful as an alternative to CVP in burns emergencies [22].

Against to our study, study done by Rojer et al in cardiac surgical patients, they observed that the range of agreement between CVP and PVP was broader in awake patients than when under general anesthesia. This could be explained by the alterations in the autonomic nervous system during anesthesia which can theoretically reduce the peripheral vasoconstriction, that some patients experi ence when awake and anxious prior to the operation. We also had good agreement between CVP and PVP might be due to general an aesthesia, used in our study. The same limitations in the clinical value of CVP also apply to PVP [4]. In a study conducted by Dharmendra Kumar et al to test the correlation between CVP and PVP after applying a fluid challenge by passive leg raise of 45 degrees, their finding suggest that the two variables are fairly correlated (r=0.483, p= 0.004) because their study was not designed to assess the fluid responsiveness to PLR but simply to assess the correlation between CVP and PVP and they have measured using water column manometer [23]. jay Prakash et al conducted a study on neuro surgical patients showed a strong correlation between CVP and PVP (r= .89, 95% CI P < 0.001) mean CVP was 5.7±0.8 mm hg, mean PVP was 10.4±0.6mmhg and the bias between CVP and PVP was 4.7±0.4. Bland alt man showed the limits of agreement to be 4- 5.5 mm hg [21] which was very similar to the results obtained by our study.

In our study we have compared MBP and CVP, MBP and PVP. They were also showing statistically significant and positive correlation except at 2 occasions. while comparing to the blood loss there was not much variations occurred in the MBP, as we treated blood loss by using Crystalloids, colloids, on blood according to amount of blood loss to maintain intravascular volume and it is positively correlated with CVP and PVP.

Although there are disadvantages in measuring PVP, the advantages outweigh the disadvantages. The peripheral veins are so thin walled, more easily subjected to occ lesion and compression by the surrounding tissues, its venous valve anatomy positional change everything will affects the PVP data [2]. In our study we have avoided all those possible chances by using vein in antecubital fossae and arm is kept straight on armrest without any compression. Central venous cannulation places patients at risk of complications either related to the procedure of catheter insertion or also to the presence of an indwelling in a circulation. So during the cannulation arterial puncture, pneumothorax, hemothorax, infection, throm bosis, arrhythmias can occur. In our study among 60 patients only 16% of the patients are encountered with complications, with occurrence of arrythmia, catheter displacement / occlusion, extravasation, bleeding are 5%, 1.6 %, 3.3%, 6.6% respectively. It is very much

expensive to deal with all complications of central venous cannulation. Even with availability of USG, trained practitioner is necessary to cannulate the IJV without any complications. This study demonstrated that a simple, minimally invasive monitoring could be an attractive alternative to CVP in major surgical patients.

Conclusion

This prospective observational study was undertaken to assess the correlation between cvp and pvp in major abdominal surgeries. 60 Patients of (ASA 1-5) age more than or equal to 18 years with no cardiovascular comorbidities were enrolled in the surgery. Simultane ous measurements of CVP and PVP were undertaken using pressure transducer.

- While comparing the mean CVP and PVP , it was found that PVP always had a significantly high value throughout the study period compared with CVP ($p < 0.001$)., the difference being minimum at 2 hr 30 min after induction (difference of 4 mm hg) and maximum at 40 min after induction (difference of 6mmhg).
- Both the variables shows a positive correlation with each other

($r^2 = 0.76$). Except at 2 hr 30 min after induction ($r= 0.25$, $p= 0.04$) and 1 hr after the surgery ($r= 0.05$, $p= 0.69$) although there was a positive trend .

- Bland Altman plots were created to study the limits of the agreement (defined as ±2 standard deviation from the mean difference) and the relationship of the variability of the two method as a function of the average venous pressure. According to this, the overall mean difference between CVP and PVP was 4.4±1.3 mm hg with 95 % limits of agreement. They s showed a perfect agreement between the two pressures throughout the study period.

We concluded that as the changes in CVP parallel with the changes in PVP, showing a strong correlation and a high level of agreement between them, measurement of PVP can be considered as an attractive alternative to CVP monitoring without any complication.

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