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A STUDY TO COMPARE CENTRAL AND PERIPHERAL VENOUS PRESSURES IN DIFFERENT BODY POSITIONS IN PATIENTS UNDERGOING LAPAROSCOPIC HYSTERECTOMY

Anaesthesiology

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ABSTRACT

1. PURPOSE: To correlate CVP & PVP in different body positions in patients undergoing laparoscopic hysterectomy.
2. METHODS: Study Design- Prospective study Settings- Ethical Committee Approved study in Tertiary Care Hospital in rural settings.
Subjects- 126 ASA I & II patients meeting inclusion criteria undergoing Laparoscopic Hysterectomy.
Inclusion Criteria: ASA I-II patients, aged between 20-60 yrs, not having contraindications for Central venous catheterization, posted for elective laparoscopic surgeries and consenting to participate in the study.
Intervention: Central venous catheterization performed in Right Internal Jugular Vein by Arrow (8F) Double Lumen Central Line. Peripheral venous cannulation done using Intracath (20G).
Measurement: Heart rate, Saturation, Systolic, Diastolic and mean arterial pressure, etCO2, CVP, PVP,temperature.
3. RESULTS: We found a difference of 2-5 mm of Hg between central and peripheral venous pressures (peripheral pressures being higher). The values (CVP, PVP) varied with change in position from Supine (6.71, 9.01) to Lithotomy (8.76, 12.28) to Trendlenburg (16.08, 18.57) position & during CO2 insufflation of peritoneal cavity (12.65, 15.99) but this relationship remained same. Some inter patient variations noted could be attributed to the difference in the body mass index, the difference in haemoglobin values, ongoing intra surgical blood losses, temperature of the operating room & duration of surgery leading to variations in systemic vascular resistance.
4. CONCLUSIONS: Almost all patients posted for surgical procedures have peripheral IV cannula in place, and hence, monitoring only PVP will not only contribute to reductions in costs & complications but also would reduce the intraoperative time.

KEYWORDS

Introduction

Peripheral Venous Pressure (PVP) recording has never been a routine clinical practice till date attributing it to the easy compressibility as well as the presence of one way valves in veins which supposedly would interfere with pressure measurements. Knowledge of the relationship between Central venous pressure (CVP) & PVP dates back to the middle of twentieth century when a gradient of 4-7 mm Hg was demonstrated between a vein in upper extremity & right atrium.[1] Though a correlation between CVP & PVP has been reported earlier, controversies still exist as to whether this correlation is maintained at all the times with change in body positions or with a change in intravascular volume. Laparoscopic surgery though hailed as Minimally Invasive Surgery (MIS) is Maximally Insulting Surgery (MIS) to the body physiology. The CO_2 pneumoperitoneum as well as the Trendelenburg position induce haemodynamic alterations like-increase in central venous pressure (CVP), pulmonary artery occlusion pressure, and mean arterial pressure (MAP)and also affect respiratory mechanics altering various lung functions [2,3,4]

A central venous catheter is inserted to measure CVP to monitor the trend in cardiac preload especially in prolonged operations. Frequent monitoring of CVP during major surgery is not a common practice because of associated potentially serious complications (accidental arterial puncture, haematoma, and pneumothorax etc)[5], deterring one to use it as the risks often outweigh the benefits. CVP monitoring would be helpful but not absolutely indicated in the management of patients undergoing major surgery especially where great fluid shifts are expected. Kim et al have shown a good correlation between CVP and PVP, though the degree of difference between the two varies between patients.[5] CVP increases by an average of 8 mm of Hg when intra abdominal pressure is raised to 15 mm of Hg in the supine position & further by an additional 6

mm of Hg at similar intra abdominal pressure in the Trendelenburg position. Advantages of measuring PVP over CVP are many: PVP measurement is less invasive, less time consuming & does not add to the monetary cost of surgery as peripheral venous cannula is almost always present even during minor surgery. Though there is an agreement that PVP is a function of CVP when the arm is well below heart level in the supine subject, it remains contentious whether measurements of PVP could totally replace CVP in routine practice.

Aims and Objectives

The present study was taken up with an objective to:

1. To correlate CVP & PVPs in patients undergoing Laparoscopic Hysterectomy.
2. To assess the effect of different body positions- Supine, Lithotomy and Trendelenburg on CVP & PVP.
3. To estimate CVP and PVP values in patients undergoing Laparoscopic Hysterectomy.

Material and Methods

The study was conducted in 126 ASA I & ASA II patients fulfilling the inclusion criteria posted for laparoscopic hysterectomy, after approval from the institutional ethics committee.

The procedure for induction and maintenance of anesthesia was similar in all cases. All patients were premedicated with Glycopyrrolate (0.008 mg/kg IV) & Fentanyl (1mcg/kg) through 20G peripheral venous cannula placed on dorsum of left hand. Anesthesia was induced with Thiopentone (5mg/kg) and maintained on Halothane in a mixture of Oxygen and Nitrous Oxide. Skeletal muscle relaxation was attained with Pancuronium (0.1 mg/kg).

The right internal jugular vein was cannulated under all aseptic precautions, after the induction of anaesthesia. The CVP & PVP were measured concurrently using disposable pressure transducers connected to HemoMed® pod from Drager Corp, Germany. In addition to CVP & PVP measurements, the heart rate, non invasive systolic and diastolic blood pressures including Mean Arterial pressure were recorded simultaneously in supine position & later after every 1 minute for the first 8 minutes after the change in body position - Lithotomy, Trendelenburg & after pneumoperitoneum created by insufflation of CO_2. The temperature of the operating room is maintained between 22-25^0 C.

Statistical analysis of the collected data was done using Karl Pearson's Correlation Coefficient with 95% confidence interval and Student's "t" test at 5% and 1% level of significance. Regression analysis presuming a straight line relationship (y =a + bx) between dependent variable-Y

(CVP) and independent variable-X (PVP) was also done.

Results

Out of the selected 126 rural female patients posted for laparoscopic hysterectomy in age group of 40-60 yrs, 92 were in ASA I & 34 were in ASA II. All the patients were enrolled according to the preset inclusion and exclusion criterion. The central venous catheterizations were successfully performed without complications under controlled conditions. Patient characteristics have been summarized in table 1. The ASA II patients had well-controlled systemic diseases including anemia, hypertension and diabetes mellitus.

Table 1: Patient's characteristics and operative data (Data are presented as Mean ± SD)

	Mean ± S.D
Age (yr)	54.6 ± 5.2
Height (cm)	156.7 ± 9.8
Weight (kg)	52.3 ± 4.9
ASA (I/II)	92/34
Operative time (min)	165.3 ± 22.8
Anaesthesia time (min)	185.7 ± 17.6

In supine position, the overall mean CVP was 6.71 mm of Hg and the mean PVP was 9.01 mm of Hg. A difference of 2-5 mm of Hg between central and peripheral venous pressures (peripheral pressures being higher) was noted in all our study patients. These values varied with change in position from Supine to Lithotomy to Trendlenburg position & during CO_2 insufflation of peritoneal cavity but this relationship remained same. Mean values of CVP & PVP in different body positions are given in the following table:

Table 2: Mean values of CVP and PVP

Sr No	Position	Mean CVP ± SD (mmHg)	Mean PVP ± SD(mmHg)
1.	Supine	6.71± 2.2	9.01± 1.8
2.	Lithotomy	8.76± 1.6	12.28± 2.4
3.	Pneumoperitoneum	12.65± 1.9	15.99± 1.5
4.	Trendelenburg	16.08± 2.9	18.57± 2.5
5.	Recovery	9.41± 3.4	12.47± 2.6

The data were analysed by Karl Pearson Coefficient. High and significant values of 'r" in all positions indicates strong and positive correlation of CVP and PVP. The't' test for Pearson coefficient revealed 'p' value to be < 0.001 in different body positions.

Table 3: Correlation and Regression analysis of the data

Position	n	R	p value	95% CI	Line of regression of CVP on PVP	Line of regression of PVP on CVP
Supine	126	0.81	<0.001	0.74-0.86	*CVP=0.99PVP-2.21	**PVP=0.66CVP+4.58
Lithotomy	126	0.12	<0.001	-0.06-0.29	*CVP=0.08PVP+7.78	**PVP=0.18CVP+10.70
Pneumoperitoneum	126	0.26	<0.001	0.09-0.42	*CVP=0.33PVP+7.37	**PVP=0.20CVP+13.46
Trendelenburg	126	0.87	<0.001	0.82-0.91	*CVP=1.01PVP-2.67	**PVP=0.75CVP+6.51
Recovery	126	0.87	<0.001	0.82-0.91	*CVP=1.14PVP-4.80	**PVP=0.66CVP+6.26

* to estimate CVP when PVP is known
** to estimate PVP when CVP is known

Discussion

During the present study of 126 ASA I and II patients undergoing elective laparoscopic hysterectomy, even though the surgical team maintained relatively low intra abdominal pressure of 12 to 13 mm of Hg, the alterations in haemodynamic recordings were noticeable. The heart rate remained relatively stable but there was an increase in mean arterial pressure during and after creation of pneumoperitoneum. Inter-patient variation in haemodynamic variables during creation of pneumoperitoneum and changing body positions was also observed.

Depending on the degree & rate of rise of intra abdominal pressure during creation of pneumoperitoneum, the distribution of aortic blood flow varies. A greater percentage of cardiac output is diverted to the head and upper body and the regional after-load is altered with the rise in intra-abdominal pressure. In a study done by Haxby et al[6], a significant increase in the index of systemic vascular resistance from 1092 to 2079 (P<0.05) was noted. This increase in systemic vascular resistance led to raised peripheral venous pressures. They also found that during trendelenburg position, the systemic vascular resistance index remained significantly raised compared with baseline values even after the deflation of abdomen. Similar findings were noticed in the present study, wherein after deflation of the pneumoperitoneum and reversal of neuromuscular blockade, the CVP & PVP values decreased, but these did not return to the baseline value. Elevated values of CVP and PVP persisted throughout the recovery period when patients were continuously monitored in post anaesthesia care unit.

Kim et al[5] observed a high agreement between CVP & PVP during laparoscopic colorectal surgery but found the difference between the two decreased with increasing CVP caused by pnemoperitoneum & trendlenburg position, which exert a backward force on veins impeding blood flow from veins to right atrium & render the peripheral veins more patent.

Amoozgar et al[7] in a study of PVP as a predictor of CVP while monitoring children continuously found a consistent correlation between CVP & PVP despite different placement sites of peripheral catheter in upper / lower extremity & CVP catheter in either internal jugular vein. They suggested that since the CVP & PVP measurements remained almost constant over a period of time, the estimation of changes occurring in CVP via changes in PVP is possible.

Santos et al[8] concluded a similar study in adults. They found that CVP & PVP cannot be used interchangebly but PVP can be considered as a noninvasive alternative to CVP in post cardiac surgery patients..

It has been suggested that an increase in CVP results from increased intrathoracic pressure related to the pneumoperitoneum and head tilt, rather than from changes in the intrathoracic blood volume[9,10]. PVP reflects an upstream variable which is coupled to CVP by a continuous column of blood. It is not surprising that CVP & PVP trends are linked; given the two sites of measurements are parts of the same continuum. Munis et al 11 reported that PVP measurement might provide a method of estimating mean systemic pressure during normal circulatory function while Kim et al5 suggested that the trends in PVP might be useful for monitoring intravascular volume status & fluid management.

Analysing the data using Karl Pearson correlation coefficient and Students unpaired T test, we have shown a strong correlation between the CVP & PVP. This correlation is maintained right from the induction of anesthesia until the reversal of neuromuscular blockade (Figures 1, 2, 3, 4,5). Some inter patient variations noted here could be attributed to the difference in the body mass index, the difference in haemoglobin values, ongoing intra surgical blood losses , temperature of the operating room & duration of surgery leading to variations in systemic vascular resistance.

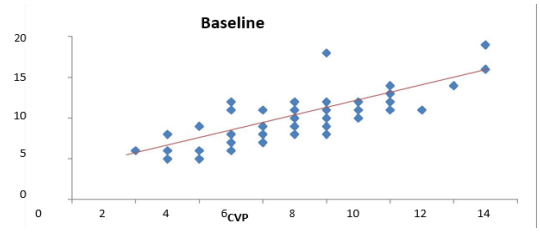

Figure 1: Scatter Diagram showing correlation between baseline values of CVP and PVP

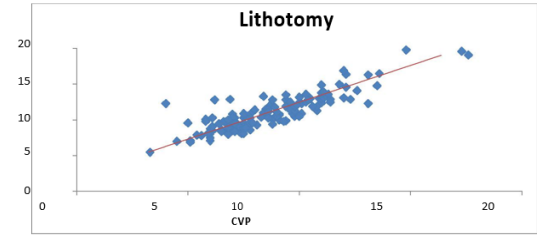

Figure 2: Scatter Diagram showing correlation between values of CVP and PVP in Lithotomy position

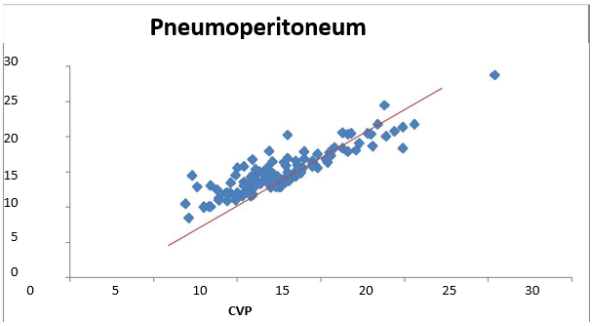

Figure 3: Scatter Diagram showing correlation between values of CVP and PVP after creation of Pneumoperitoneum

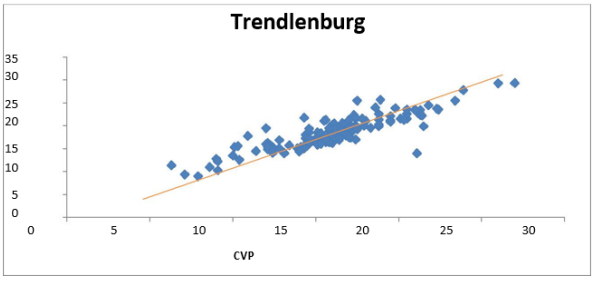

Figure 4: Scatter Diagram showing correlation between values of CVP and PVP in Trendelenburg position

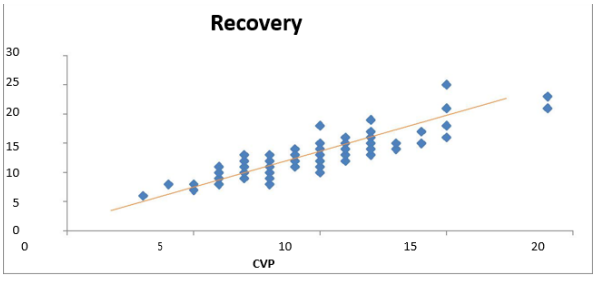

Figure 5: Scatter Diagram showing correlation between values of CVP and PVP at recovery

Conclusion

It is well known that placement of CVP catheter can infrequently be associated with complications like inadvertent arterial puncture, iatrogenic pneumothorax, haematoma & very rarely with mortality as well. Almost all patients posted for surgical procedures have peripheral IV cannula in place, and hence, monitoring only PVP will not only contribute to reductions in costs &complications but also would reduce the intraoperative time.

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