
Central venous pressure from common iliac vein reflects right atrial pressure

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Purpose: To determine whether central venous pressure at the common iliac vein reflects right atrial pressure in adult patients.

Methods: In this prospective, non-blinded study 26 mechanically-ventilated adult patients were studied. Simultaneous pressure readings were obtained from the right atrium (TCVP) and the common iliac vein (ACVP).

Results: There was a correlation between TCVP and ACVP ($r = 0.987$; $P < 0.0001$). The mean difference between TCVP and ACVP was 0.93 mm Hg. And the limits of agreement were: -1.93 to 1.77 mm Hg.

Conclusion: Venous pressure recorded from the common iliac vein reflects that in the right atrium. Adopting a femoral route for central venous pressure measurement may avoid some of the complications associated with the subclavian route.

Objectif : Déterminer si la pression veineuse centrale à la veine iliaque commune correspond à la pression auriculaire droite chez des patients adultes.

Méthodes : L'étude prospective et ouverte a porté sur 26 patients adultes, sous ventilation mécanique. Des relevés de pression simultanés ont été obtenus de l'oreillette droite (PVCT) et de la veine iliaque commune (PVCA).

Résultats : Il y avait une corrélation entre la PVCT et la PVCA ($r = 0,987$; $P < 0,0001$). La différence moyenne entre PVCT et PVCA était de 0,93 mmHg et les limites de l'intervalle de confiance étaient de -1,93 à 1,77 mmHg.

Conclusion : La pression veineuse enregistrée à la veine iliaque commune correspond à celle de l'oreillette droite. En adoptant la voie fémorale pour mesurer la pression veineuse centrale, on peut éviter certaines complications associées à la voie sous-clavière.

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CENTRAL Venous Pressure (CVP) measurement is a common procedure in the intensive care unit (ICU). However, access through the internal jugular or subclavian veins may lead to several complications such as pneumothorax, haemothorax, air embolism, arterial puncture, bleeding, dysrhythmias and thoracic duct injury.¹ In contrast, femoral vein venipuncture is safe and is a standard procedure for venous access in resuscitation and burns.^{2,3} It has some complications such as local haematoma, femoral artery laceration and occasional femoral nerve damage.⁴ Measuring CVP from femoral route could obviate complications associated with subclavian approach. Several reports have examined whether measurements from the femoral route reflects CVP measured from the subclavian route in animals,⁵ and paediatric patients.^{6,7} Others⁸ noted that IVC measurements from above the diaphragm reflect right atrial pressure. No studies have examined CVP measurements in adults from the common iliac veins which are more accessible than the IVC. We studied the correlation between the pressures in the right atrium [accessed through subclavian or internal jugular sites (TCVP)] and common iliac vein [accessed through femoral site (ACVP)].

Methods

This study was approved by the Ethical Committee of King Khalid University Hospital, Riyadh. This prospective, non-blinded study in critically ill adults requiring mechanical ventilation (Table I). Patients were excluded if they had any intra-abdominal pathology, ascites or femoral vein thrombosis. A central venous catheter was inserted via the internal jugular or subclavian vein into the right atrium in each patient using a 14G, 18 cm Vygon single lumen leader catheter as described.⁴ The position of the catheter was confirmed radiographically. A similar catheter was inserted into the common iliac vein via a femoral route.⁴ The femoral route was cannulated only if there was a clinical indication for additional central venous access such as coagulopathy, haemodialysis or chronic illness requiring repeated access. Measurements were made with the patient supine. Direct pressure was monitored from both catheters simultaneously using HPM 1166A, Model 68.5, with write out capability.

Pearson correlation coefficient of the difference between TCVP and ACVP was calculated. The difference between TCVP and ACVP was plotted against their mean to determine whether there was any relationship between the measurement error and the true value.⁹ Differences within ± 2 SDs were calculated; *P* value less than 0.05 was considered statistically significant.

TABLE I Patients characteristics

Number	Age	Sex	Diagnosis	Ventilation	PEEP
01	58	M	Peritonitis	CMV	5
02	42	M	Septic shock	CMV	8
03	32	M	Acute myocardial infarction	ACMV	5
04	70	F	Septic shock	CMV	5
05	50	F	Septic shock	CMV	5
06	28	F	SLE, ARDS, Pneumonia	CMV	10
07	80	M	Upper GI bleed ARDS	ACMV	5
08	14	F	Hodgkin's Dis./Septic shock	CMV	8
09	80	F	Septic shock	CMV	5
10	40	F	Pneumonia, ARDS	CMV	10
11	42	M	Pneumonia, ARDS	CMV	10
12	58	F	Septic shock	ACMV	5
13	60	F	Septic shock	CMV	5
14	80	F	COPD with acute resp. failure	ACMV	5
15	60	M	Upper GI bleed	ACMV	5
16	42	M	Status epilepticus	ACMV	5
17	45	F	Septic shock with ARDS	ACMV	5
18	60	M	Upper GI bleed	ACMV	5
19	80	F	COPD with bl. pneumonia	ACMV	5
20	70	M	Acute myocardial infarction	CMV	5
21	60	F	Septic shock	CMV	6
22	20	M	Cardiomyopathy with CHF	ACMV	5
23	90	M	Septic shock	CMV	6
24	70	M	IHD with resp. failure	ACMV	8
25	52	F	Septic shock	ACMV	8
26	36	F	Sepsis with ARDS	CMV	8

CMV = Control Mechanical Ventilation

ACMV = Assist Control Mechanical Ventilation

PEEP = Positive End Expiratory Pressure

Results

Twenty six patients were studied (12 male, 14 female). Their mean age \pm SD was 53 ± 18 yr. There were no complications related to catheter insertion. The lungs of all patients were ventilated using the control or assist control mode. There was a correlation between TCVP and ACVP ($r = 0.987$; $P < 0.0001$) (Figure 1). The mean difference between TCVP and ACVP was 0.93 mm Hg. The limits of agreement were -1.93 to 1.77 mm Hg (Figure 2). Except for one measurement, the differences between TCVP and ACVP did not extend beyond the limits of agreement.

Discussion

In this study, the pressure measured at the common iliac vein in mechanically ventilated adult patients

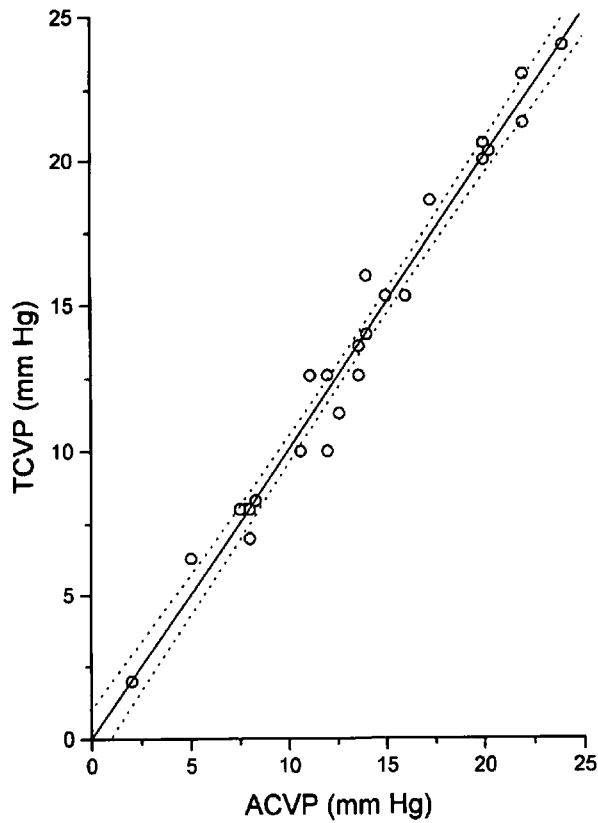


FIGURE 1 Relationship between thoracic and abdominal CVP measurements. Dotted lines represent 95% confidence interval.

reflects the pressure at the right atrium. Therefore, common iliac measurements through the femoral route represent CVP. Several complications have resulted from thoracic vascular puncture.^{4,10-11} The US Food and Drug Administration has recommended serial chest radiography to ensure the accuracy and safety of thoracic central catheters.¹² With the use of the femoral route, such complications and radiographic monitoring may be avoided.

Lioyed *et al.* took measurements through the femoral route in paediatric non-ventilated patients by rapid catheter pull back from right atrium to IVC and found equal pressures at both sites.⁶ Subsequently, they confirmed, in animals, that simultaneous measurements, from IVC and SVC during apnea, mechanical ventilation and spontaneous breathing were equal.⁵ Chait *et al.* took measurements in paediatric patients undergoing cardiac surgery and found close correlation between abdominal CVP and right atrial pressure in ventilated and spontaneously breathing patients.¹³ Others recorded similar findings in ventilated pediatric patients using a water column technique.¹⁴ Similarly, Nahum *et al.* found that mechanical ventilation did

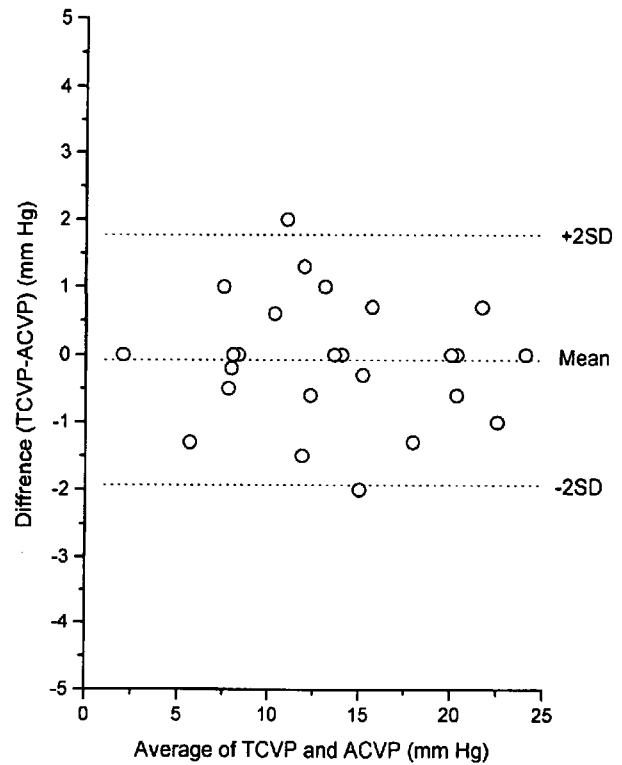


FIGURE 2 Average of TCVP and ACVP (mmHg)

not influence measurement of CVP from IVC in the abdomen of paediatric patients over a wide age range.⁷

Recently Joynt *et al.*⁸ measured CVP from the IVC above the diaphragm near the right atrium in adult ventilated patients and found that it reflected right atrial pressure. However, the methods they used might not be easily applicable to clinical practice, as they used a long catheter to reach the IVC from the femoral site and confirmed the position radiographically. Our study is different from others.^{6-8,14} First, we measured the CVP in adult ventilated patients using the usual size catheter without the need to determine its position, and secondly, our measurements were done from the common iliac vein or IVC below the diaphragm.

The close correlation between the CVP in the right atrium and the common iliac vein may be explained by the absence of venous valves above the femoral vein¹⁵ which establishes an uninterrupted column of blood from the common iliac vein to the right atrium. A low level of PEEP (5-10 cm H₂O) was used in all our patients although its effect has not been studied. However, previous reports showed that PEEP < 15 cm H₂O has no effect on intra-abdominal pressure.¹⁶

The results of this study are limited by the small number of patients, the measurements were not taken repetitively in the same patients and the effects of fluid loading were not studied.

In conclusion, measurement of CVP in the common iliac vein through the femoral route, using a standard catheter is accurate and reflects right atrial pressure. Adoption of the femoral route might reduce the risk of complications associated with thoracic route.

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