Original Research Article

COMPARISON OF ULTRASONOGRAPHIC MEASUREMENT OF IVC DIAMETER TO CVP FOR ASSESSMENT OF FLUIDSTATUS IN MECHANICAL VENTILATED PATIENTS IN THEINTENSIVE CARE UNIT: A PROSPECTIVEOBSERVATIONAL STUDY

Tariq Ahmad Bhat[1], Reecha Panghal[2], Sanjeev Kumar[3], Vivek Mittal[4], Rushal Nayar[2], Amandeep Kaur[3]

[1]Senior Resident, Department of Anaesthesia, GMC Baramulla, Jammu and Kashmir, India.
[2]Assistant Professor, Adesh Medical College and Hospital, Kurukshetra, Haryana, India.
[3]Associate Professor, Adesh Medical College and Hospital, Kurukshetra, Haryana, India.
[4]Professor and Head, Adesh Medical College and Hospital, Kurukshetra, Haryana, India.

Received : *16/05/2026*
Received in revised form : *06/07/2026*
Accepted : *22/07/2026*

Corresponding Author:
Dr. Reecha Panghal,
Assistant Professor, Adesh Medical College and Hospital, Kurukshetra, Haryana, India.
Email: reechapanghal@gmail.com

DOI: 10.70034/ijmedph.2026.3.202

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2026; 16 (3); 1270-1276

ABSTRACT

Background: Accurate assessment of intravascular fluid status is essential for the management of critically ill patients requiring mechanical ventilation. Although central venous pressure (CVP) is widely used to guide fluid therapy, its invasive nature and limited ability to predict fluid responsiveness have prompted interest in non-invasive alternatives such as ultrasonographic assessment of inferior vena cava (IVC) diameter and the IVC distensibility index (IVC-DI). The objective is to compare sonographic measurements of IVC diameter and IVC distensibility index with CVP for assessing intravascular fluid status and to evaluate the correlation between these parameters in mechanically ventilated intensive care unit (ICU) patients.
Materials and Methods: This prospective observational study was conducted in the ICU of Adesh Medical College and Hospital, Shahbad, Kurukshetra, from May 2023 to December 2024. Thirty-five mechanically ventilated adult patients with a functioning central venous catheter were enrolled. Baseline measurements of CVP, IVC diameter, IVC-DI, heart rate, and mean arterial pressure were recorded before administration of 1 L of balanced crystalloid solution over 2 hours. Serial measurements were obtained at baseline, 30 minutes, 60 minutes, 120 minutes, 6 hours, 12 hours, and 24 hours. Pearson's correlation coefficient and paired t-test were used for statistical analysis, with $p<0.05$ considered statistically significant.
Results: The study population had a mean age of 46.4 ± 9.6 years, with a predominance of males (62.86%). Polytrauma was the commonest indication for ICU admission (37.14%). Hemodynamic parameters and IVC measurements remained relatively stable during follow-up. Correlations between CVP and IVC-derived parameters were variable across different time points, with only a few statistically significant associations. Age, sex, body mass index, and comorbidities did not significantly influence CVP or ultrasonographic measurements.
Conclusion: Bedside ultrasonographic assessment of IVC diameter and IVC distensibility index is a rapid, non-invasive, and repeatable method for evaluating intravascular fluid status in mechanically ventilated critically ill patients. Although the correlation with CVP was inconsistent, IVC ultrasonography may serve as a valuable adjunct to conventional hemodynamic monitoring. Larger multicenter studies are warranted to validate its routine clinical application.
Keywords: Inferior vena cava, central venous pressure, ultrasonography, fluid responsiveness, mechanical ventilation, intensive care unit.

INTRODUCTION

Intravenous (IV) fluid therapy is a cornerstone of critical care medicine and plays a pivotal role in the management of shock, maintenance of intravascular volume, and correction of electrolyte and metabolic disturbances. Globally, millions of liters of intravenous fluids are administered daily to critically ill patients. Despite their widespread use, IV fluids are often not prescribed and monitored with the same degree of vigilance as other pharmacological interventions, although they possess distinct indications, contraindications, and potential adverse effects. Inappropriate fluid administration can result in significant morbidity and mortality due to fluid overload, tissue edema, impaired organ function, and delayed recovery, highlighting the importance of accurate assessment of a patient's fluid status before initiating fluid therapy.[1]

Optimal fluid management remains one of the most challenging aspects of intensive care practice, particularly in mechanically ventilated patients. Adequate intravascular volume is essential for maintaining cardiac output, tissue perfusion, and oxygen delivery to vital organs. Both inadequate and excessive fluid administration can adversely affect patient outcomes. Consequently, determining whether a patient is likely to benefit from fluid administration, commonly referred to as fluid responsiveness, has become a key objective in hemodynamic monitoring. Fluid responsiveness is defined as an increase in cardiac output following fluid administration and serves as an important guide for tailoring fluid resuscitation. Accurate prediction of fluid responsiveness helps avoid unnecessary fluid loading, reduces cumulative fluid balance, and facilitates safer de-resuscitation strategies without compromising hemodynamic stability.[2,3]

Traditionally, static parameters of cardiac preload, such as central venous pressure (CVP), pulmonary artery occlusion pressure, and echocardiographic estimates of ventricular filling pressures, have been used to guide fluid therapy in critically ill patients. Among these, CVP has long been regarded as a standard measure for assessing intravascular volume status and right ventricular preload. However, CVP measurement requires central venous catheterization, an invasive procedure associated with several complications, including arrhythmias, pneumothorax, haemothorax, vascular injury, bleeding, catheter-related bloodstream infections, thrombosis, and pulmonary embolism.[4] Furthermore, although CVP continues to be widely used in clinical practice, accumulating evidence suggests that it has limited value in predicting fluid responsiveness. Several studies and systematic reviews have demonstrated a weak correlation between CVP and circulating blood volume and have shown that baseline CVP values or changes in CVP following fluid administration are poor predictors of the hemodynamic response to fluid challenges.[5].

In recent years, bedside ultrasonography has emerged as a valuable non-invasive tool for hemodynamic assessment in critically ill patients. The inferior vena cava (IVC), the largest capacitance vein in the body, undergoes dynamic changes in diameter in response to variations in intravascular volume and venous return. Because of its high compliance, respiratory variations in IVC diameter may provide important information regarding a patient's volume status. During inspiration, increased venous return results in a reduction in IVC diameter, whereas expiration is associated with relative venous filling and restoration of its baseline size. In hypovolemic states, these respiratory fluctuations are more pronounced, while they tend to diminish in hypervolemic conditions.[6,7]

Assessment of IVC diameter and the Inferior Vena Cava Collapsibility Index (IVC-CI) has emerged as a rapid, portable, repeatable, and non-invasive method for evaluating intravascular volume status. Although several studies have demonstrated its utility in predicting fluid responsiveness in mechanically ventilated patients, evidence regarding its correlation with central venous pressure (CVP) remains limited [6–8]. Therefore, the present study was undertaken to compare sonographic measurements of IVC diameter and Caval index with CVP and to evaluate their correlation in mechanically ventilated ICU patients.

MATERIALS AND METHODS

This prospective observational study was conducted in the Intensive Care Unit (ICU) of Adesh Medical College and Hospital, Shahbad, Kurukshetra, over a period of 19 months from May 2023 to December 2024. The study included critically ill adult patients admitted to the medical and surgical ICUs who required mechanical ventilation and had a properly positioned and functioning central venous catheter (CVC) inserted through either the internal jugular or subclavian vein for clinical indications.

A total of 35 patients aged more than 18 years were enrolled after obtaining approval from the Institutional Ethics Committee. Written informed consent was obtained from the patients' legally authorized representatives or first-degree relatives prior to participation. Patients with cardiac diseases such as heart failure, pulmonary hypertension, or cor pulmonale; liver diseases including cirrhosis or hepatic cysts; increased intra-abdominal or intrathoracic pressure due to conditions such as pneumothorax or pleural effusion; recent abdominal surgery; morbid obesity resulting in technically difficult ultrasonography; fluid-restricted states such as chronic kidney disease (CKD) or chronic obstructive pulmonary disease (COPD); and those in whom IVC ultrasonography was not feasible due to burst abdomen, extensive burns, or excessive bowel gas were excluded from the study.

All enrolled patients were mechanically ventilated using standardized volume-controlled ventilation settings with a tidal volume of 6–8 mL/kg, respiratory rate of 12 breaths/min, and zero positive end-expiratory pressure (PEEP). Standard monitoring included heart rate (HR), electrocardiography (ECG), pulse oximetry (SpO_2), and non-invasive blood pressure (NIBP). Continuous invasive arterial blood pressure monitoring was established using a 20-gauge arterial cannula. Central venous pressure (CVP) was measured through the indwelling central venous catheter connected to a pressure transducer and monitor after appropriate zeroing at atmospheric pressure.

Ultrasonographic assessment of the inferior vena cava (IVC) was performed using a Sonosite ultrasound machine equipped with a 2–5 MHz curvilinear probe. With the patient in the supine position, the probe was placed in the subxiphoid region to obtain a longitudinal view of the IVC. Using M-mode ultrasonography, the maximum and minimum anteroposterior internal diameters of the IVC were measured approximately 3 cm distal to the right atrial-IVC junction during the respiratory cycle. The Inferior Vena Cava Collapsibility Index (IVC-CI) was calculated using the formula:

IVC-CI (%) = [(Maximum IVC diameter during expiration − Minimum IVC diameter during inspiration) / Maximum IVC diameter during expiration] × 100

Baseline measurements of CVP, IVC diameter, IVC-CI, HR, respiratory rate (RR), mean arterial blood pressure (MABP), SpO_2, urine output, and ventilatory parameters were recorded. Subsequently, fluid resuscitation was performed using balanced crystalloid solution administered through a wide-bore peripheral venous cannula. Patients received 1 L of crystalloid over 2 hours, delivered as 250 mL every 30 minutes, followed by maintenance fluid administration at 50 mL/hour for 24 hours. Following fluid administration, all hemodynamic and ultrasonographic parameters were reassessed and recorded.

Sample Size Calculation: The sample size was calculated based on the study by Mostafa Ibrahim et al,[9] evaluating the correlation between central venous pressure and inferior vena cava diameter for assessment of fluid status in ICU patients. Assuming a Pearson correlation coefficient (r) of 0.547, a power of 90% ($Z\beta = 1.28$), and a confidence level of 95% ($Z\alpha = 1.96$), the required sample size was estimated using Fisher's Z transformation formula:

$n = [(Z\alpha + Z\beta)^2 / C^2] + 3$

where,

$C = ½ \ln [(1 + r)/(1 − r)]$

The calculated sample size was 32 patients. After accounting for a 10% attrition/non-response rate, the final sample size was increased to 35 patients.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) version 27.0. Quantitative variables were expressed as mean ± standard deviation (SD). Pearson's correlation coefficient was used to assess the relationship between CVP and ultrasonographic parameters, including IVC diameter and IVC-CI. Comparisons of hemodynamic and ultrasonographic variables before and after fluid administration were performed using the paired t-test. A p-value of <0.05 was considered statistically significant.

RESULTS

During the study period a total of 35 patients were enrolled in the study as per the inclusion and exclusion criteria.

[Table 1] summarizes the demographic and clinical characteristics of the 35 mechanically ventilated patients included in the study. The majority of participants belonged to the 41–61 years age group (74.29%), while 25.71% were aged between 21 and 40 years. There was a male predominance, with 22 (62.86%) male patients and 13 (37.14%) female patients. Regarding comorbidities, 24 (68.57%) patients had no documented underlying medical illness, whereas diabetes mellitus and hypertension were present in 17.14% and 14.29% of patients, respectively. The mean body weight of the study population was 73.44 ± 13.34 kg, the mean height was 170.68 ± 23.05 cm, and the mean body mass index (BMI) was 24.43 ± 4.04 kg/m², indicating that most participants had a normal to slightly overweight body habitus. Polytrauma was the most common indication for ICU admission, accounting for 37.14% of cases, followed by exploratory laparotomy and meningitis/bilateral hydropneumothorax, each contributing 17.14%. Hepatic encephalopathy and sepsis/shock each constituted 14.29% of the study population. Overall, the study cohort predominantly comprised middle-aged male patients with relatively few comorbidities and a diverse range of critical illnesses requiring mechanical ventilation.

[Table 2] presents the serial changes in cardiovascular and ultrasonographic parameters of the study participants over a 24-hour observation period following fluid administration. The mean heart rate remained relatively stable throughout the study, ranging from 88.74 ± 2.85 to 99.51 ± 7.22 beats/min, with a slight decline observed at 24 hours. Mean arterial pressure (MAP) was generally maintained within an acceptable range during the observation period, although a transient increase was noted at 60 minutes (180.71 ± 6.25 mmHg), following which it returned to values comparable with baseline. The mean central venous pressure (CVP) showed a gradual decline from a baseline value of 9.00 ± 0.59 mmHg to 7.66 ± 0.76 mmHg at 6 hours, followed by a modest increase to 8.33 ±

0.48 mmHg at 12 hours and 8.00 ± 0.59 mmHg at 24 hours. Similarly, the mean inferior vena cava diameter (IVCD) demonstrated only minor fluctuations during follow-up, varying between 17.00 ± 2.84 mm and 18.33 ± 1.74 mm, with the highest value observed at 6 hours. The inferior vena cava distensibility index (IVCDI) remained consistently below 0.5 at all measured time points, indicating minimal respiratory variation in IVC diameter among the mechanically ventilated patients. Overall, the hemodynamic and ultrasonographic parameters remained relatively stable throughout the study period following fluid therapy.

Table 1: Demographic details of study participants

Parameters		**Number**	**Percentage**
Age (years)	21-40	9	25.71%
	41-61	26	74.29%
Gender	Male	22	62.86%
	Female	13	34.14%
Co-morbidities	Diabetes Mellitus	6	17.14%
	Hypertension	5	14.29%
	None	24	68.57%
Weight	Mean ± SD	73.44 ± 13.34	
Height	Mean ± SD	170.68 ± 23.05	
BMI	Mean ± SD	24.43 ± 4.04	
Diagnosis	Exp. Laparotomy	6	17.14%
	Hepatic Encephalopathy	5	14.29%
	Meningitis/B/L Hydropneumothorax	6	17.14%
	Polytrauma	13	37.14%
	Sepsis/Shock	5	14.29%

Table 2: Cardiovascular Parameter of the study participants

Time	**Heart Rate**	**MAP**	**CVP**	**IVCD (mm)**	**IVCDI**
0 min	93.4 ± 4.79	112.25 ± 2.82	9 ± 0.59	17.83 ± 1.5	<0.5 ± 0
30 min	96.65 ± 4.64	108.97 ± 5.21	8.86 ± 0.48	17.66 ± 1.28	<0.5 ± 0
60 min	99.51 ± 7.22	180.71 ± 6.25	8.16 ± 0.38	17.66 ± 0.48	<0.5 ± 0
120 min	93.91 ± 7.63	105.68 ± 4.37	7.83 ± 0.92	17.83 ± 1.10	<0.5 ± 0
6 hr	94.74 ± 4.95	113.94 ± 3.80	7.66 ± 0.76	18.33 ± 1.74	<0.5 ± 0
12 hr	94.25 ± 7.49	107.42 ± 5.23	8.33 ± 0.48	17.17 ± 1.24	<0.5 ± 0
24 hr	88.74 ± 2.85	107.2 ± 3.40	8 ± 0.59	17 ± 2.84	<0.5 ± 0

MAP=Mean Arterial Pressure, CVP=Central Venous Pressure, IVD=Inferior Vana Cava Diameter, IVCDI=Inferior Vana Cava Distensibility Index.

Table 3: Pearson's Correlations for Central Venous Pressure and Maximum Diameter of Inferior Vena Cava

Pearson's Correlations for Central Venous Pressure and MaximumDiameter of Inferior Vena Cava								
Maximum Diameter of Inferior Vena Cava		**Central Venous Pressure**						
		0 min	**30 mins**	**60 mins**	**120 mins**	**6 hrs**	**12 hrs**	**24 hrs**
0 mins	Pearson's r	0	-0.32	0.35	-0.52	0.40	-0.40	0.39
	p-value	1	0.19	0.14	0.12	0.09	0.09	0.10
30 mins	Pearson's r	0.23	-0.18	0.12	-0.64	0.41	-0.37	0
	p-value	0.35	0.45	0.63	0.30	0.08	0.12	1
60 mins	Pearson's r	0	0.25	0.31	-0.13	-0.31	-0.25	0
	p-value	1	0.31	0.20	0.60	0.20	0.31	1
120 mins	Pearson's r	0.54	0.55	0.07	-0.20	-0.07	0.77	0.27
	p-value	0.40	0.31	0.78	0.41	0.78	< .001	0.27
6 hrs	Pearson's r	0.84	-0.27	-0.61	-0.18	0.21	0.27	-0.34
	p-value	< .001	0.26	0.20	0.47	0.38	0.26	0.16
12 hrs	Pearson's r	0	-0.19	-0.06	-0.74	0.61	-0.68	-0.47
	p-value	1	0.44	0.80	0.08	0.007	0.60	0.24
24 hrs	Pearson's r	-0.73	0	0.32	0.26	-0.08	-0.25	0.20
	p-value	< .001	1	0.19	0.28	0.75	0.30	0.40

[Table 3] presents the Pearson's correlation analysis between central venous pressure (CVP) and the maximum inferior vena cava diameter (IVCD) measured at different time intervals. Overall, the correlations varied in both magnitude and direction throughout the study period, with most showing no statistically significant association ($p>0.05$). However, significant positive correlations were observed between CVP at 6 hours and maximum IVCD at baseline ($r = 0.84$, $p < 0.001$) and between CVP at 12 hours and IVCD at 6 hours ($r = 0.61$, $p = 0.007$). Additionally, a strong positive correlation was found between CVP at 120 minutes and IVCD at 12 hours ($r = 0.77$, $p < 0.001$), whereas a significant negative correlation was observed between CVP at 24 hours and baseline IVCD ($r = −0.73$, $p < 0.001$). These findings indicate that although certain time-point measurements demonstrated significant associations, the overall relationship between CVP and maximum IVCD was inconsistent over time.

Table 4: Pearson's Correlations for Central Venous Pressure and Inferior Vena Cava Diameter

Pearson's Correlations for Central Venous Pressure and Inferior Vena Cava CI								
Inferior Vena Cava Diameter		**Central Venous Pressure**						
		0 mins	**30 mins**	**60 mins**	**120 mins**	**6 hrs**	**12 hrs**	**24 hrs**
0 mins	Pearson's r	0.27	0.22	-0.51	0.52	-0.49	0.36	-0.55
	p-value	0.26	0.36	0.52	0.42	0.23	0.15	0.31
30 mins	Pearson's r	-0.46	-0.04	0.75	0.36	-0.57	-0.23	0.81
	p-value	0.05	0.85	0.18	0.14	0.31	0.34	0.17
60 mins	Pearson's r	0.31	0	0.06	-0.47	0.54	0.38	0.39
	p-value	0.20	1	0.81	0.04	0.41	0.11	0.10
120 mins	Pearson's r	0	0.30	-0.25	1.4×10-16	0.19	0.40	-0.24
	p-value	1	0.22	0.30	1	0.44	0.09	0.32
6 hrs	Pearson's r	0.11	0.13	2.3×10-16	0.21	-0.51	-0.13	-0.22
	p-value	0.66	0.59	1	0.39	0.23	0.59	0.38
12 hrs	Pearson's r	-0.55	-0.15	0.76	-0.23	1.7×10-16	-0.67	0.55
	p-value	0.51	0.55	0.46	0.34	1	0.30	0.41
24 hrs	Pearson's r	-0.88	-0.35	0.56	0.33	-0.31	-0.85	0.33
	p-value	< .001	0.14	0.51	0.18	0.20	0.47	0.18

[Table 4] presents the Pearson's correlation analysis between central venous pressure (CVP) and inferior vena cava diameter (IVCD) at different time intervals. Overall, the correlations were variable and predominantly not statistically significant ($p>0.05$). A significant negative correlation was observed between CVP at 24 hours and baseline IVCD ($r = -0.88$, $p < 0.001$), while a significant inverse correlation was also noted between CVP and IVCD at 60 minutes ($r = -0.47$, $p = 0.04$). The remaining correlations demonstrated weak to moderate positive or negative associations without statistical significance. These findings suggest that the relationship between CVP and IVCD was inconsistent across different time points, indicating limited agreement between the two parameters for assessing intravascular fluid status.

Pearson's correlation analysis demonstrated no statistically significant association between patients' age and inferior vena cava diameter (IVCD) measured at baseline and at 30 minutes, 60 minutes, 120 minutes, 6 hours, 12 hours, and 24 hours ($p>0.05$). Similarly, one-way analysis of variance (ANOVA) revealed no significant differences in central venous pressure (CVP), maximum inferior vena cava diameter, or inferior vena cava diameter across patients with different comorbidity status at any of the measured time points ($p>0.05$). These findings indicate that neither age nor the presence of comorbidities significantly influenced the hemodynamic or ultrasonographic parameters evaluated during the study.

DISCUSSION

Accurate assessment of intravascular volume status remains a major challenge in the management of critically ill patients receiving mechanical ventilation. Although central venous pressure (CVP) has traditionally been used to guide fluid therapy, its invasive nature and limited ability to predict fluid responsiveness have prompted increasing interest in non-invasive alternatives such as ultrasonographic assessment of inferior vena cava (IVC) diameter and the inferior vena cava distensibility index (IVC-DI). The present prospective observational study evaluated the correlation between these sonographic parameters and CVP in 35 mechanically ventilated ICU patients.

The study population predominantly comprised middle-aged patients (mean age 46.4 ± 9.6 years), with a male predominance (62.86%). Polytrauma was the most common indication for ICU admission, followed by exploratory laparotomy, meningitis, hepatic encephalopathy, and septic shock. Hemodynamic parameters, including heart rate, mean arterial pressure, and CVP, remained relatively stable during the 24-hour observation period following fluid administration. Similarly, only minimal variations were observed in the maximum and minimum IVC diameters, while the IVC distensibility index remained below 0.5 throughout the study period, suggesting relatively stable intravascular volume status in the study cohort.

Correlation analysis demonstrated variable associations between CVP and IVC measurements across different time points. Although a few individual measurements showed statistically significant positive or negative correlations, no consistent relationship was observed throughout the study period. Furthermore, age, sex, body mass index, and comorbidities did not significantly influence CVP or ultrasonographic measurements, indicating that these demographic and clinical variables had minimal impact on the assessed hemodynamic parameters.

The findings of the present study are consistent with the systematic review and meta-analysis by Marik et al., who concluded that static CVP measurements have limited utility in predicting fluid responsiveness and that dynamic ultrasound-based indices provide better assessment of intravascular volume status.[10] Similarly, Ismail et al. reported a significant correlation between IVC collapsibility index and invasive CVP measurements, supporting the use of bedside ultrasonography as a practical alternative for volume assessment.[9] Mahrous et al. also demonstrated a significant negative correlation between CVP and IVC collapsibility index in mechanically ventilated patients with septic shock and concluded that IVC ultrasonography is a rapid, simple, and reliable adjunct for assessing fluid responsiveness.[11].

Comparable findings have also been reported by Pathania et al., who observed a significant positive correlation between inspiratory and expiratory IVC diameters and CVP, while the relationship between IVC collapsibility index and CVP was negative but not statistically significant.[12] Likewise, Singh et al. demonstrated a strong positive correlation between CVP and both maximum and minimum IVC diameters, together with a significant inverse correlation between CVP and IVC collapsibility index, suggesting that IVC ultrasonography may serve as a reliable non-invasive substitute for CVP monitoring in critically ill surgical patients [13]. Similar observations were reported by Mohammed et al., who found a strong correlation between CVP and both IVC diameters and caval index in patients presenting with shock.[14]

The present findings are also supported by the studies of Thanakitcharu et al. and Ilyas et al., both of whom demonstrated significant correlations between CVP and IVC-derived parameters, emphasizing the clinical utility of bedside ultrasonography for intravascular volume assessment.[15,16] However, Govender et al. and Citilcioglu et al. reported weak or non-significant correlations between CVP and IVC measurements, particularly in mechanically ventilated patients, suggesting that both techniques should be interpreted as complementary rather than independent measures of fluid status [17,18]. These differences may be attributed to variations in patient characteristics, ventilator settings, timing of measurements, and underlying disease severity across studies.

The present study has certain limitations. It was conducted at a single center with a relatively small sample size and included only mechanically ventilated patients. Additionally, ultrasonographic assessment of IVC parameters and CVP monitoring was limited to the first 24 hours following administration of a standardized 1-L crystalloid fluid protocol. Therefore, larger multicenter studies with longer follow-up periods and more heterogeneous critically ill populations are required to further validate the role of IVC ultrasonography as a non-invasive guide for fluid management.

CONCLUSION

The present study suggests that bedside ultrasonographic assessment of IVC diameter and the IVC distensibility index is a rapid, non-invasive, and repeatable method for evaluating intravascular fluid status in mechanically ventilated critically ill patients. Although the correlation with central venous pressure (CVP) was variable, IVC ultrasonography may serve as a useful adjunct to conventional CVP monitoring. Its simplicity, safety, and bedside applicability make it a promising tool for fluid assessment. Further large-scale multicenter studies are needed to confirm its clinical utility.

REFERENCES

1. Malbrain ML, Langer T, Annane D et al. Intravenous fluid therapy in the perioperative and critical care setting: executive summary of the International Fluid Academy (IFA). Annals of intensive care. 2020;10:1-9.
2. El Gkotmi N, Kosmeri C, Filippatos TD et al. Use of intravenous fluids/solutions: a narrative review. Current Medical Research and Opinion,2017;33(3):459-71.
3. Monnet X, Marik PE, Teboul JL. Prediction of fluid responsiveness: an update. Annals of intensive care. 2016;6:1-1.
4. Martin ND, Codner P, Greene W et al. Contemporary hemodynamic monitoring, fluid responsiveness, volume optimization, and endpoints of resuscitation: an AAST critical care committee clinical consensus. Trauma Surgery & Acute Care Open. 2020;5(1):e000411.
5. McIntyre LA, Cook DJ, Rankin N et al. Fluid resuscitation in the management of early septic shock (FINESS): a randomized controlled feasibility trial. Canadian Journal of Anesthesia. 2008;55(12):819.
6. El-zayaat AM, Othman HA, Elsayed KM et al. Prediction of Fluid Responsiveness in Shocked Mechanically Ventilated Patients: An Overview. NeuroQuantology. 2022;20(10):2830.
7. Uthoff H, Siegemund M, Aschwanden M et al. Prospective comparison of noninvasive, bedside ultrasound methods for assessing central venous pressure. Ultraschall in der Medizin-European Journal of Ultrasound. 2012;33(07):E256-62.
8. Rizkallah J, Jack M, Saeed M et al. Non-invasive bedside assessment of central venous pressure: scanning into the future. PLoS One. 2014;9(10):e109215.
9. Ismail MT, El-Iraky AA, Ibrahim EE-DA, El Kammash TH, Abou-Zied AE. Comparison of IVC collapsibility and CVS in assessing volume status in shocked patients. Afr J Emerg Med 2022;12:165–71.
10. Marik PE, Baram M, Vahid B. Does central venous pressure predict fluid responsiveness?*: A systematic review of the literature and the tale of seven mares. Chest. 2008;134(1):172-8.
11. Mahrous M, Hassanin AA, Sabra M et al. Correlation of Ultrasound Guided Measurement of Inferior Vena Cava Diameter to Central Venous Pressure to Assess the Volume Status in Septic Shock of Mechanically Ventilated Patients. AIMJ. 2022;3(2):128-33.
12. Pathania M, Kumar S, Sood D et al. USG guided determination of inferior vena cava diameter and collapsibility index for non-invasive evaluation of intravascular volume status as an alternative to invasive CVP measurement. International Journal of Anesthesiology. 2022; 22(3):86-93.
13. Singh DR, Thapa AS, Limbu Y et al. Correlation of Inferior Vena Cava diameter and IVC Collapsibility Index with Central Venous Pressure (CVP) in critically ill surgical patients. JSSN. 2021;24(1):19-22.
14. Mohammed YM, El Shahed GS, Galal IH et al. Assessment of inferior vena cava diameter measured by ultra-sonography in correlation with central venous pressure value in patients with sepsis. Ain Shams Medical Journal. 2019;70(4):285-97.
15. Thanakitcharu P, Charoenwut M, Siriwiwatanakul N. Inferior vena cava diameter and collapsibility index: a practical non-invasive evaluation of intravascular fluid

volume in critically-ill patients. J Med Assoc Thai. 2013;96 Suppl 3:S14-22.
16. Ilyas A, Ishtiaq W, Assad S et al. Correlation of IVC Diameter and Collapsibility Index With Central Venous Pressure in the Assessment of Intravascular Volume in Critically Ill Patients. Cureus. 2017;9(2):e1025.
17. Citilcioglu S, Sebe A, Ay MO et al. The relationship between inferior vena cava diameter measured by bedside ultrasonography and central venous pressure value. Pak J Med Sci. 2014;30(2):310-5.
18. Govender J, Postma I, Wood D et al. Is there an association between central venous pressure measurement and ultrasound assessment of the inferior vena cava? Afr J Emerg Med. 2018;8(3):106-109.