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Role Of Lung Ultrasound , CVP And Inferior Vena Cava Diameter And Collapsibility Index In Assessment Of End Point Of Fluid Therapy In Critically ILL Patient With Sepsis

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Abstract

Severe physiological and biochemical abnormalities provide a significant risk of death in the clinic, making sepsis a potentially fatal illness. Sepsis is now defined as "organ dysfunction induced by a dysregulated host response to infection," under the Third International Consensus (Sepsis-3). Our research aimed to determine the best methods for determining whether a critically sick patient with sepsis had reached the end of fluid treatment by comparing the results of lung ultrasonography, central venous pressure, and IVC diameter and collapsibility index. Methods: Forty-five patients from the intensive care unit at Banha university hospital participated in the cohort research. Results: At admission, this research found that hypovolemia was linked to lower CVP, lower dIVC max and lower dIVCmin, and greater IVC CI, but that there was no significant difference between hypo and euvolemia in LUSS. Over the course of 120 minutes, CVP, dIVC max, dIVC min, LUSS, and IVCCI all rise gradually, whereas IVCCI falls gradually over the first 30 minutes. The AUCs for predicting hypervolemia using IVC CI and LUSS were moderate. The current investigation demonstrated a robust positive link between CVP, LUSS, and dIVCmin/max following fluid consumption over time, and a substantial negative correlation between IVCCI and these same variables. Prediction of hypervolemia for the purpose of discontinuing fluid infusion was thought to be possible with a lower IVC-CI and a greater LUSS. In conclusion, assessing the endpoint of fluid treatment in patients with hypovolemic shock due to sepsis is made more easier and more accurate using lung ultrasound due to its noninvasive nature and high sensitivity and specificity. Prediction of hypervolemia for the purpose of discontinuing fluid resuscitation in septic patients was shown to be best accomplished by a combination of a lower IVC-CI and a higher LUSS. Evaluation of the collapsibility index of the inferior vena cava provides a low-risk, high-sensitivity alternative to monitoring central venous pressure. A low CVP was shown to be an unreliable indicator of fluid responsiveness.

Key words: Lung Ultrasound - CVP - Inferior Vena Cava Diameter - Collapsibility Index - End Point - Fluid Therapy - Critically ILL Patient - Sepsis

1.Introduction:

To put it simply, sepsis is a medical emergency caused by the body's reaction to an infection that has already caused damage to vital organs and tissues. To put it simply, sepsis is now understood to be a potentially fatal organ failure due to an unbalanced host response to infection. Sepsis is still the leading cause of death in the non-coronary critical care unit, despite advances in our knowledge of this complicated disease process (1).

Hypovolemia, myocardial depression, increased metabolic demands, and vasoregulatory perfusion anomalies define the growing circulatory insufficiency that leads to septic shock and multi-organ failure from sepsis (2).

Using bedside lung ultrasonography to direct fluid treatment has been shown to be effective. Having a positive net fluid balance is related to a greater risk of death in sepsis patients because it is correlated with increased levels of extravascular lung water (EVLW). Acute circulatory failure monitoring may be performed with EVLW detection using the Fluid Administration Limited by Lung Sonography (FALLS)-protocol if B lines are present (3).

Non-invasive, low-cost, and easy to perform, the inferior vena cava (IVC) diameter is the ideal method for evaluating the efficacy of fluid resuscitation (4).

One of the most popular static ways of evaluation is central venous pressure (CVP) monitoring, which requires an intrusive procedure to get a reading of right atrial pressure, a proxy for left ventricular volume (5).

Our research was to evaluate the value of lung ultrasonography, central venous pressure, and IVC diameter and collapsibility index for determining whether a critically sick patient with sepsis had reached the end of fluid treatment.

2.Patients and Methods

2.1Study type: cohort study

2.2Study patients:

The study was conducted on 45 patients admitted to ICU at Benha University after obtaining of informed written consent from all participants before enrollment in the study.

2.3All studied cases received fluid resuscitation guided by :

- simplified lung ultrasound .
- ultrasound measurement of the diameter and collapsibility index of inferior vena cava before and after initiation of resuscitation .

The variability of the IVC with respiration (ΔIVC) is used as a marker of FR (fluid resuscitation) . The difference between

the diameters of IVCe (IVC during expiration) and IVCi (IVC during inspiration) is regarded as collapsibility, and collapsibility index was defined as [IVCe – IVC I / IVCe]

- CVP.

2.4Ethical approval :

An approval from research ethics committee in Benha faculty of medicine was obtained.

2.5Inclusion criteria :

- ICU patients above 18 years old from both sex .
- acute circulatory failure with mean systolic blood pressure < 90 mmHge.

2.6Exclusion criteria :

- Patients less than 18 years old.
- Patients with obstructive shock
- cardiogenic shock
- valvular heart disease
- atrial fibrillation.
- patients with severe orthopnea, morbid obese BMI above 50kg/m2.
- Patients who refused to participate
- Mechanically ventilated patients.
- Suspected or diagnosed raised intraabdominal or intrathoracic pressures as known pregnancy, portal hypertension, or mediastinal mass.

All participants were subjected to:

1-Full history including: Patients′ demographic data: age, sex, body weight, and height.

Past Medical History including diseases as diabetes mellitus, hypertension, chronic kidney disease, chronic liver disease, cardiac history, cerebrovascular stroke, History of previous allergy, History of any drug or toxin intake.

Past surgical history.

Past history of any infection causing entry to ICU.

2-Complete clinical examination:

a. **Measurement**of the patient's hemodynamic parameters: complete assessment of air ways, breathing, blood pressure ,heart rate and capillary refill time in case of shocked patients.as well as assessment of Glasgow Coma Scale.
b. **-Monitoring:** Standard monitoring was applied, including non-invasive arterial blood pressure, electrocardiography (ECG) and pulse oximetry using the multichannel monitor.
c. **-Fluid resuscitation:** If there are signs of hypovolemia (BP fluid challenge test was done to assess fluid response of patients.

Fluid responder patients will receive 30ml/kg of crystalloid solution over one hour. Then according to CVP measurement additional fluid was administrated. Fluid infusion was stopped if CVP increased to a value ≥12 cm H2O.

3-Routine laboratory investigations:

Complete blood count, Liver function tests, Kidney function tests, Blood gases, CRP, blood culture and urine culture.

4-Radiological:

Lung US, Chest X-ray, and Echocardiography

Measured parametrs :

1- Arterial blood pressure (systolic ,diastolic and mean arterial Bl.P will be measured on admission ,after every 1000 ml of IV Fluids during resuscitation)

2-urine out put : urinary catheter will be inserted on admission to measure U.O.P every hour

3-central venous pressure : central venous line will be inserted on admission to measure CVP ON admission and during resuscitation

4- Ejection fraction of the heart (ECHO)

Measurement of Central venous pressure and Inferior vena cava diameter and collapsibility index by ultrasound:

- All the readings of IVC diameter assessment and CVP measurements were recorded concomitantly.
- All ultrasonographic examinations were performed with the patients in supine position by the same physician throughout the study, using a portable ultrasonography unit.
- All readings were taken by the researcher ,as he sought specialized training in use of bed side US bytaking POCUS course.

Technique of CVP measurement:

- CVP was recorded at the mid-axilla. Technically, this is the phlebostatic axis, where lines from the mid-sternal fourth intercostal space and mid-axilla intersect. In practice, a small ink mark is usually made on the skin to ensure consistent use of the site. The patient was fully informed of the procedure before carrying out CVP measurement. Patients ideally lied flat in a supine position to reflect right atrial pressure.

Steps for measuring a patient's CVP: under complete aseptic condition .

- check physician's order and client care plan for measuring CVP.
- discuss procedure with client.
- provide privacy.
- place client in horizontal {supine}position..

- mark an "x" with the indelible pen at the level of the right atrium.
- connect the intravenous fluids to the three-way stopcock and flush the other two ports with the fluids.
- connect the CVP manometer to the upper port of the stopcock.
- allow IV fluid to drip rapidly into patient for several seconds,with stopcock closed to manometer.
- turn stopcock off to patient and fill manometer with fluid.
- hold manometer at "x" on thorax and turn stopcock off to IV fluids.
- observe the oscillated fluid in manometer with the client's respiration.
- take reading of CVP .
- record in nurses' notes and or on flow sheet the CVP reading .

IVC Diameter Measurement:

- A low-frequency phased array curvilinear transducer (3.5–5 MHz) was used to evaluate the IVC, which lies in the retroperitoneum to the right of the aorta. There is considerable variability in the literature regarding the location at which the IVC diameter should be measured. theIVC was assessed just proximal to the hepatic veins, which lie approximately 0.5 to 3 cm from the right atrium.

Steps for IVC diameter measurement:

1- Patients lied flat in a supine position, Measurements in patients were obtained during their normal spontaneous inspiration and expiration while trying to avoid Valsalva maneuvers.

2-Placing the probe and measuring the short axis to image the IVC, the probe was placed in the subxiphoid 4-chamber position with the probe marker oriented laterally to identify the right ventricle and right atrium. As the probe was progressively aimed toward the spine, the convergence of the IVC with the right atrium would be seen. The IVC should have been followed inferiorly, specifically looking for the confluence of the hepatic veins with the IVC.

3- Measuring the long axis The IVC was also evaluated in the long-axis plane. For this view, the probe was turned from a 4-chamber subxiphoid to a 2-chamber subxiphoid orientation, with the probe now in a longitudinal orientation.

Although this view allowed visualization of the IVC throughout the length of the hepatic segment, the true size of the IVC may be underestimated in the long axis due to a common error known as the cylinder tangent effect.

This effect occurs when the ultrasound beam travels through the vessel longitudinally in an off centered plane. One way was done to avoid underestimating the size of the IVC was to angle the probe laterally and medially until the greatest dimension was identified. The diameter of the IVC should have been measured perpendicular to the long axis of the IVC at end-expiration and end inspiration.

Movement of the diaphragm, especially during forceful inspiration or sniffing, may displace the IVC relative to the probe, making it difficult to obtain comparative measurements at the same location. So frequent angling of the IVC inferiorly and/or laterally was done to avoid tangential measurement due to displacement of the IVC and to observe the changes of the IVC through several respiratory cycles.

4- Measuring IVC Diameters using the M-mode:

M-mode Doppler sonography of the IVCwas used to graphically document the absolute size and dynamic changes in the caliber of the vessel during the patient’s respiratory cycle in the long axis.

5- Measurement of IVC Diameters: Minimum (Inspiratory)IVC diameter(iIVCd) was measured at the end of inspiration and the Maximum (Expiratory) IVC diameter(eIVCd) was measured at the end of expiration.

6-calculating the IVC collapsibility index (IVC CI) =[(expiratory IVC diameter-inspiratoryIVC diameter)/expiratory IVC diameter].

Statistical Methods

The collected data was revised, coded, tabulated and introduced to a PC using Statistical package for Social Science **(IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp.).** Data were presented and suitable analysis was done according to the type of data obtained for each parameter.

- **Normality of data**

Kolmogorov-Smirnov test was used as a test of normality, if the significance level is greater than 0.05, then normality is assumed.

- **Descriptive statistics**
- Mean, Standard deviation (± SD), Median and range for numerical data.
- Frequency and percentage of non-numerical data.
- **Analytical statistics:** Student T Test, Mann Whitney Test (U test), Correlation analysis, The ROC Curve (receiver operating characteristic) and regression analysis were used.
- **Probability of results**

All reported p values were two-tailed and p <0.05 was considered to be significant.

Results:

Table (1). Association of CVP with IVC, LUSS at admission.

At admission	hypovolemic CVP < 8 cmH2O N=41				euvolemic CVP between 8–12 cmH2O N=4				p
	mean	±SD	minimum	maximum	mean	±SD	minimum	maximum	
CVP	4.3	1.6	2	7	8.3	0.5	8	9	<0.001
IVC-CI (%)	52.7	16.1	20	80	24.5	6.4	18	30	0.001
dIVC min (mm)	0.5	0.2	0.1	1.1	0.6	0.2	0.4	0.9	0.761
dIVC max (mm)	1.3	0.4	0.4	2.1	0.8	0.2	0.6	1.1	0.021
LUSS	1.7	1.5	0	5	2	1.4	1	4	0.705

Student t test and Mann Whitney tests were used for comparison.

At admission, hypovolemia was signigfcantly associated with lower CVP and dIVCmax, higher IVC-CI . While dIVC min and LUSS did not differ significantly between hypo and euvolemia.

Table (2). Association of CVP with IVC, LUSS at 30 minutes.

30 min	hypovolemic CVP < 8 cmH2O N=39				euvolemic CVP between 8–12 cmH2O N=6				p
	mean	±SD	Minimum	maximum	mean	±SD	minimum	maximum	
CVP	4.1	1.2	2	6	8.2	0.4	8	9	<0.001
IVC-CI (%)	53	16.8	10	85	41.3	13	20	60	0.111
dIVC min (mm)	0.6	0.2	0.2	1.1	0.7	0.2	0.4	0.8	0.260
dIVC max (mm)	1.4	0.4	0.5	2.1	1.1	0.1	1	1.3	0.048
LUSS	1.7	1.5	0	5	1.5	0.8	1	3	0.790

Student t test and Mann Whitney tests were used for comparison.

At 30 minutes, hypovolemia was significantly associated with lower CVP, higher dIVC max. While dIVC min IVC CI and LUSS did not differ significantly between hypo and euvolemia.

Table (3). Association of CVP with IVC, LUSS at 60 minutes.

60 min	hypovolemic CVP < 8 cmH2O N=39				euvolemic CVP between 8–12 cmH2O N=6				p
	mean	±SD	minimum	maximum	mean	±SD	minimum	maximum	
CVP	5.2	1.1	3	7	9	0.6	8	10	<0.001
IVC-CI (%)	44.4	13.7	18	70	28.5	6.2	23	40	0.288
dIVC min (mm)	0.8	0.2	0.5	1.2	0.9	0.1	0.8	1	0.045
dIVC max (mm)	1.6	0.4	1	2.4	1.3	0.1	1.2	1.5	<0.001
LUSS	2.9	1	2	6	2.7	1	2	4	0.575

Student t test and Mann Whitney tests were used for comparison.

At 60 minutes, hypovolemia was significantly associated with lower CVP, higher dIVC min and max. decrease in IVC CI, While LUSS did not differ significantly between hypo and euvolemia.

Table (4). Association of CVP with IVC, LUSS at 90 minutes.

90 min	hypovolemic CVP < 8 cmH2O N=30				euvolemic CVP between 8–12 cmH2O N=15				p
	mean	±SD	minimum	maximum	mean	±SD	minimum	maximum	
CVP	6.4	0.6	5	7	8.8	1.1	8	11	<0.001
IVC-CI (%)	43.7	10.1	20	60	40.7	11.7	20	55	0.381
dIVC	1	0.1	0.7	1.3	1	0.1	0.7	1.2	0.878

min (mm)									
dIVC max (mm)	1.9	0.3	1.5	2.5	1.8	0.3	1.5	2.2	0.196
LUSS	3.7	1.4	2	6	3.2	1.4	2	6	0.305

Student t test and Mann Whitney tests were used for comparison.

At 90 minutes, hypovolemia was significantly associated with low CVP,. While IVC CI ,dIVC min , dIVCmax, and LUSS did not differ significantly between hypo and euvolemia.

Table (5). Association of CVP with IVC, LUSS at 120 minutes.

120 min	**euvolemic CVP between 8–12 cmH2O N=40**				**hypervolemic CVP > 12 cmH2O N=5**				**p**
	mean	**±SD**	**minimum**	**maximum**	**mean**	**±SD**	**minimum**	**maximum**	
CVP	9.8	1.3	8	12	13.2	.4	13	14	<0.001
IVC-CI (%)	42.4	10.5	20.0	60.0	29.2	10.6	20.0	46.0	0.011
dIVC min (mm)	1.2	0.2	0.8	1.5	1.4	0.2	1.2	1.5	0.049
dIVC max (mm)	2.2	0.2	2.0	2.5	2.1	0.1	2.0	2.2	0.474
LUSS	7.8	3.9	2	16	11.2	4.8	5	15	0.043

Student t test and Mann Whitney tests were used for comparison.

At 120 minutes, hypovolemia was significantly associated with higher CVP, dIVC max , dIVC min , LUSS. And lower IVC CI .

Table (6). Validity of IVC CI and LUS score for prediction of hypervolemia (CVP>12) at 120 minutes.

	AUC	**95% CI**	**Cut off**	**Sensitivity (%)**	**Specificity (%)**
IVC CI	0.778	0.526-1	≤30	80	80
LUS score	0.753	0.507 -0.998	>13	60	92.5

AUC, area under ROC curve; CI, confidence interval.

Receiver operating characteristic (ROC) curve of IVC CI and LUS score was conducted for prediction of hypervolemia (CVP>12) at 120 minutes. Moderate accuracy AUCs were found (AUC=0.778, 0.753 respectively). IVC CI best cut off value was 30, at which sensitivity was 80 and specificity was 80. LUSS best cut off value was 13, at which sensitivity was 60 and specificity was 92.5

Table (7). Correlation of CVP, IVC and LUSS with other studied parameters at admission, 30, 60, 90, 120 minutes.

	CVP		**IVC CI**		**LUS score**	
	rho	**p**	**rho**	**p**	**rho**	**p**
dIVC min	0.734	<0.001	-0.510	<0.001	0.631	<0.001
dIVC max	0.402	<0.001	0.200	0.003	0.455	<0.001
CVP	-	-	-0.472	<0.001	0.611	<0.001
IVC-CI%	-	-	-	-	-0.292	<0.001

Rho, correlation coefficient.

Correlation of CVP, IVC and LUSS was conducted with other studied parameters at admission, 30, 60, 90, 120 minutes.

CVP showed significant positive correlation with dIVC min and dIVC max.

IVC CI showed significant positive correlation with dIVC max, and significant negative correlation with CVP and dIVCmin .

LUS score showed significant positive correlation with dIVC min, dIVC max, CVP and significant negative correlation with IVC-CI%.

Table (8). Regression analysis for prediction of hypervolemia in order to stop fluid infusion.

	p	***OR***	***95% CI***	
Age	0.932	0.997	0.928	1.071
Gender	0.739	1.186	0.434	3.245
BMI	0.887	0.988	0.837	1.166
SBP	0.246	1.031	0.979	1.086
DBP	0.664	0.986	0.927	1.049

MAP	0.731	1.012	0.946	1.082
HR	0.825	0.992	0.922	1.067
IVC-CI%	**0.022**	0.939	0.890	0.991
LUSS	**0.010**	1.212	1.180	1.363

OR, odds ratio; CI, confidence interval.

Regression analysis was conducted for prediction of hypervolemia in order to stop fluid infusion, using age, gender, BMI, SBP, DBP, MAP, HR, IVC-CI, LUSS as confounders. Lower IVC-CI and higher LUSS were considered predictors for prediction of hypervolemia in order to stop fluid infusion.

4.Discussion

At admission, hypovolemia was linked with lower central venous pressure, greater IVC-CI, and higher dIVC max. Although there was no significant difference in dIVC min or LUSS between hypo and euvolemia.

Consistent with Ilyas et alfindings, .'s we found a negative connection between CVP and the collapsibility index (percent) of the IVC. CVP was observed to have a significant positive relationship with both the maximum and lowest IVC diameters. The hypovolemic group had smaller CVP and IVC minimum diameters, whereas the hypervolemic group had larger diameters. The results also showed that the IVC collapsibility index was significantly greater in the hypovolemic group and lower in the hypervolemic group. The minimum diameter of the inferior vena cava (IVC) was significantly larger in the hypervolemic group and smaller in the hypovolemic group (6).

The current investigation demonstrated a progressive rise in dIVCmax, dIVCmin, CVP, and LUSS, and a progressive reduction in IVC-CI with time.

Mean arterial pressure, pulse pressure, and UOP were all shown to rise significantly after fluid delivery, as reported by Moussa et al. Both the UOP and the mean arterial pressure were favourably linked with the BP fluctuations. (7).

As reported by Al Arnous et al., whereas the average IVC collapsibility index was 37.86 on day 1, with a range of 33-43%, by day 3, it had dropped to 29.44, with a range of 25-35%. Initially, the mean CVP was 4.44 within a range of 3-6 mmH2O; however, on the third day, it had risen significantly to 9.39 within a range of 6-12 mmH2O. (8).

In the current investigation, hypovolemia was observed to be related with lower CVP and greater dIVCmax after 30 minutes.

as compared to euvolemia, there was no significant difference in dIVCmin or LUSS. Hypovolemia was linked with decreased CVP, greater dIVCmin and dIVCmax at 60 minutes. While there was no significant difference between hypovolemia and euvolemia in IVCCI or LUSS. At 90 minutes, hypovolemia was substantially linked to decreased CVP, whereas there were no significant differences between hypovolemia and euvolemia in IVCCI, dIVCmin, dIVCmax, or LUSS. There was a statistically significant relationship between hypovolemia and decreased IVCCI, increased dIVCmin, and increased LUSS after 120 minutes. There was no significant difference between hypovolemia and euvolemia for CVP or dIVCmax.

While volume resuscitation reduced increased mean arterial pressure in the majority of patients, as reported by Azzam, There was a strong negative correlation between the central venous pressure and the IVC-CI, as the caval index value declined with central venous pressure increase during patient resuscitation and subsequent hemodynamic improvement, indicating that measurement of the IVC-CI is a good non invasive indicator of fluid responsiveness in shockees with a decreased HR, elevated CVP, and a decreased IVC-CI (volume responders, or euvolemia) (9).

However, despite receiving the maximum amount of fluid resuscitation possible, some patients (14 of 40) showed no response or even deterioration with volume resuscitation in regards to low MAP, high HR, low central venous pressure, and high fixed IVC-CI; these patients are considered volume non responders (9).

For the purpose of predicting hypervolemia (CVP>12) at 120 minutes, a receiver operating characteristic (ROC) curve of the IVC CI and the LUS score was performed. The area under the curve for accuracy was determined to be moderate (AUC=0.778 and AUC=0.753). At the cutoff value of 30, the sensitivity and specificity of the IVC CI both reached 80%. The optimal cut off value for LUSS was 13, where sensitivity was 60% and specificity was 92.5.

Abdalazeem et al. found that measures of central venous pressure (CVP), urine output (VO), and blood pressure (BP) were linked with lung US score. Lung ultrasound and central venous pressure (CVP) had a very significant positive link at admission, after the first 1000 ml, after 15, 30, 45, and 60 minutes of the second 1000 ml infusion, and after the

second extra 200 ml of fluid is infused. Additionally, ROC curve analysis was performed for evaluation and confirmation of endpoint (score 16) of fluid treatment using US in patients with hypovolemic shock due to the strong positive association between lung US and BP and UOP measures throughout a wide range of fluid resuscitation stages. Average positive predictive value was 98%, negative predictive value was 86%, sensitivity was 95%, specificity was 92%, and overall accuracy was 95%. Which lined up with our research to a T. (10).

The findings of Ismail et al. corroborate our own. According to their findings, a LUS score of 10 or above indicates that fluid resuscitation is complete, has a strong link with hypoxia index and central venous pressure measurements, and has a sensitivity of 84.21 percent and a specificity of 90.48 percent for LUS. (11).

Present research demonstrated a negative connection between CVP and IVC CI at admission, 30-60-90-120 minutes after fluid treatment, and 120 minutes after fluid therapy was discontinued. Consistent with the findings of Al Arnous et al., who found a negative correlation of -0.975, -0.864, and -0,723 between the IVC collapsibility index and CVP across three days of assessment. The optimal IVC CI threshold for diagnosing low CVP is 28.5%, with a corresponding area under the curve of 0.998, sensitivity of 100%, specificity of 94%, PPV of 94%, NPV of 100%, and accuracy of 97.2%. On days one, two, and three, there was a statistically significant positive connection between the IVC collapsibility index and the matching heart rate. The IVC collapsibility index was negatively correlated with mean arterial pressure (MAP) on day one alone, and with urine production at the same time on days one, two, and three (8).

Collectively, the results of the current investigation demonstrated that CVP was significantly correlated negatively with IVC CI and positively with both dIVC min and dIVC max.

The IVC CI was significantly inversely related to both the minimum and maximum values of dIVC. There was a positive link between LUS and minimum dIVC, maximum dIVC, and central venous pressure (CVP), and a negative correlation between LUS and IVC-CI percent.

In line with the findings of a research by Wiryana et al. including more than 70 patients. There was a normal distribution of ages (18-64) and BMIs (25-35). Of all the patients, 65.7% were men and 34.3% were women. The average central venous pressure was 11 cmH2O, with a range of 6-18 cmH2O; the average maximum IVC diameter was 1.67 mm, with a range of 1.50 mm to 2.50 mm; and the average IVC collapsibility index was 29.6 percent, with a range of 40.32 percent to 69.28 percent. CVP was discovered to have a very significant inverse relationship with the collapsibility index of the inferior vena cava. These findings were consistent with those of the current investigation (12).

And, similar to us, Karacabey et al. (13) found similar outcomes. Studying a total of 83 people, the average age of the men in the group was 48. Generally speaking, people were 7.3611.2 years old on average. Systolic blood pressure varied between 60-220 mmHg, with a mean of 117.6 mmHg and a standard deviation of 37.7 mmHg. Diastolic pressure was measured between 30 and 140 mmHg, with a mean of 70.5 mmHg and a standard deviation of 24.3 mmHg. Average heart rate was 102.32 25.8 beats per minute, with a range of 50-170 bpm.

Measurements of IVC collapsibility were inversely related to CVP. These findings were consistent with those of the current investigation. (13).

Additional research by Shalaby et al. found the same thing; their sample included more than 50 adult patients. The ages ranged from 30-60. Measuring CVP was shown to be inversely related to the IVC collapsibility index. Patients who are breathing on their own will show a positive association between CVP and IVC variability during respiration (14).

Using age, sex, BMI, SBP, DBP, MAP, HR, IVC-CI, and LUSS as confounders, a regression analysis was performed to predict hypervolemia in order to halt fluid infusion. Prediction of hypervolemia for the purpose of discontinuing fluid infusion was thought to be possible with a lower IVC-CI and a greater LUSS.

Data analysis by Nagi et al. showed that a baseline IVCCI of 0.32 had a sensitivity of 72.41 percent, a specificity of 82.76 percent, and an AUC of 82.9 percent for predicting a positive response to fluid resuscitation.

(15).

IVC diameter was not a strong predictor of fluid responsiveness, according to a study by Airapetian et al. on patients in the intensive care unit with suspected hypovolemia who were breathing on their own, but respiratory variations of IVC> 42% had a high specificity to anticipate an increase in cardiac output after fluid administration (16).

5.Conclusion:

In patients with hypovolemic shock due to sepsis, lung ultrasound offers a straightforward noninvasive method for assessing the endpoint of fluid treatment with excellent sensitivity and specificity. Prediction of hypervolemia for the purpose of discontinuing fluid resuscitation in septic patients was shown to be best accomplished by a combination of a lower IVC-CI and a higher LUSS. Evaluation of the collapsibility index of the inferior vena cava provides a low-risk, high-sensitivity alternative to monitoring central venous pressure. A low CVP was shown to be an unreliable indicator of fluid responsiveness.

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