

Correlation Between Inferior Vena Cava Collapsibility Index And Central Venous Pressure To Assess Volume Status Of Critical Patients In Intensive Care Unit In RSUP H. Adam Malik Medan

M. Aldi Rivai Ginting*, Akhyar Hamonangan Nasution**, Soejat Harto**

* Resident of Anesthesiology and Intensive Care, Sumatera Utara University Medical Faculty, RSUP H. Adam Malik Medan

**Department of Anesthesiology and Intensive Care, Sumatera Utara University Medical Faculty, RSUP H. Adam Malik Medan

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ABSTRACT

Introduction: Assessment of intravascular volume are essential in improving the patient's condition during critical care, but no single standard examination is ideal.² Sonographic examination is emerging as a potential non-invasive diagnostic tool for assessing intravascular fluid status by measuring IVC diameter.³

Objective: To determine correlation between Central Venous Pressure and Inferior Vena Cava Collapsibility Index to assess volume status of critically ill patients in ICU care.

Methods: This is an observational analytic study, with cross sectional method which performed at Intensive Care Unit (ICU) RSUP H. Adam Malik Medan in July-September 2020. Samples were patients aged 18-65 years, with a BMI of 18-30, hospitalized in ICU with central venous catheter. Exclusion criteria were patients with heart defects and pregnant women. The study conducted by examining value of central venous pressure in patients who were admitted to the ICU, then assessing inferior vena cava collapsibility index using Doppler ultrasound. Then, an assessment correlation inferior vena cava collapsibility index and central vena pressure was assessed using the Pearson Correlation test or independent T-test.

Results: This study was followed by 31 subjects who met the inclusion criteria. Based on characteristics of sample, sample mean age was 43.45 ± 16.7 years with $p = 0.069$ and number of female samples was 17 samples (54.8%). There was a correlation between IVC CI and CVP with $r = -0.937$ and $p = 0.001$, which means there is a strong negative correlation between it and statistically significant. In addition, in correlation between IVC CI and CVP values on use of mechanical ventilation, there was no statistically significant difference in IVC CI values in mechanically ventilated sample with sample not using mechanical ventilation ($p = 0.250$).

Conclusion: There is a strong negative correlation between inferior vena cava collapsibility index (IVC CI) and central venous pressure (CVP) in assessment of volume status patients hospitalized in ICU.

Keywords: Central Venous Pressure, Inferior Vena Cava Collapsibility Index, Volume status

Introduction

Early determination of hydration status in critically ill patients, such as adequacy of fluids, is very important in critical care management. There are various methods of assessment, but none of them is the gold standard. Although Central Venous Pressure (CVP) has proven to be unreliable, it is still used worldwide.¹ Assessment of intravascular volume are essential in improving

the patient's condition during critical care, but no single standard examination is ideal.²

Sonographic examination is emerging as a potential non-invasive diagnostic tool for assessing intravascular fluid status by measuring IVC diameter.³ Both CVP and IVC diameter measurement have similarities in that are methods that view central vein even though measured parameters are different. Several studies have found an association between CVP and variations in IVC diameter. The purpose of this study to

determine correlation between Central Venous Pressure and Inferior Vena Cava Collapsibility Index to assess volume status of critically ill patients in ICU care.

Methods

This is an observational analytic study, with cross sectional method performed at Intensive Care Unit (ICU) RSUP H. Adam Malik Medan in July-September 2020. Samples are patients 18-65 years old, with a BMI of 18-30, hospitalized in ICU with central venous catheter. patients with heart defects, pregnant women, and administered vasopressor or inotropic agents are excluded. This research was conducted after obtaining approval from Health Research Ethics Committee Universitas Sumatera Utara Medical Faculty and H. Adam Malik General Hospital.

The study are performed by examining central venous pressure value in patients who were admitted to ICU, then assessing inferior vena cava collapsibility index using Doppler ultrasound, early after ICU admission (examination performed by researcher and confirmed by ICU supervisor). Basic data collection such as gender, age, admission diagnosis, laboratory results, and urine output monitoring by volunteers. Then, correlation inferior between vena cava collapsibility index and central vena pressure assessed using Pearson Correlation test or independent T-test.

Result

This study followed by 31 subjects who met inclusion criteria. Based on characteristics of sample, sample mean age are 43.45 ± 16.7 years with $p = 0.069$ and female samples are 17 samples (54.8%). Patient under mechanical ventilator are 20 samples (64,5%). Mean IVC CI value are $0,47 \pm 0,18$ ($p = 0,051$), while CVP are $9,5 \pm 3,92$ ($p = 0,073$).

There is a correlation between IVC CI and CVP with $r = -0.937$ and $p = 0.001$, which means there is a strong negative correlation between them and statistically significant. In correlation between CVP and IVC CI with volume status, there is a strong positive correlation between CVP and volume status with $r = 0.803$ ($p = 0.001$).¹ In addition, in correlation between IVC CI and CVP values on use of mechanical ventilation, there is no statistically significant difference in IVC CI values in mechanically ventilated sample with sample not using mechanical ventilation ($p = 0.250$).

Discussion

Assessment of intravascular volume very important in improving patients condition during critical care, but there is no ideal examination.² In this study, it is known that IVC CI value has a strong negative correlation with CVP value ($r = -0.937$, $p = 0.001$). Rinaldi, et al. revealed strong association between CVP values and IVC DI regardless type of ventilation of patient. This is based on hypothesis that physiologically

tendency to stretch (distensibility) and tendency to collapse (collapsibility) of blood vessel is influenced by vascular compliance, where compliance is amount of volume change with each change in pressure that occurs.⁴

Thanakitcharu et al, in their study found a significant correlation between CVP and IVC CI ($r = -0.612$, $p < 0.001$) in critically hospitalized patients.⁵ Meanwhile, in our study there is no association between use of mechanical ventilation and IVC CI value. This also known in study of Airapetian et al., both IVC diameter and IVC CI were inaccurate in predicting fluid adequacy of patients with spontaneous breathing undergoing ICU care.⁶ Because, in patients with spontaneous breathing there is a decrease in intra-thoracic pressure and increase in intra-abdominal pressure during inspiration which increases venous return. Thus, IVC diameter can decrease due to a decrease in IVC transmural pressure.⁷ But, Several research reported a good correlation between right atrial pressure and variation in respiratory IVC in patients with spontaneous breathing.

This study has several limitations, first, number of samples obtained is quite small, so wider sample size is needed to confirm the results obtained in this study. Second, not homogeneous samples using mechanical ventilation could influence the assessment of IVC CI and CVP.

Conclusion

There is a strong negative correlation between inferior vena cava collapsibility index (IVC CI) and central venous pressure (CVP) in assessment of volume status patients hospitalized in ICU. There was no relationship between use of mechanical ventilation with IVC CI and CVP values.¹

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Correspondence

Muhammad Aldi Rivai, MD. Resident of Anesthesiology and Intensive Care USU Medical Faculty, Haji Adam Malik Central Hospital Medan, North Sumatra, Indonesia. Email : aldi.oneal@yahoo.com, phone : +62 812 6460091

Appendix

Tabel 1. Demographic Characteristic

Characteristic	Subject	P-value ^a
Ages (year, mean \pm SD)	43.45 \pm 16.7	0,069
Gender		
Male (n, %)	14 (45,2%)	0.001
Female(n, %)	17 (54,8%)	
BMI	24,6 \pm 2,28	0,138
IVC CI	0,47 \pm 0,18	0.051
CVP	9,5 \pm 3,92	0,073
Volume Status		
Hipovolume	8 (25,8%)	0,001
Euvolume	13 (41,9%)	
Hipervolume	10 (32,3%)	
Ventilator		
Yes	20 (64,5)	0,001
No	11 (35,5)	

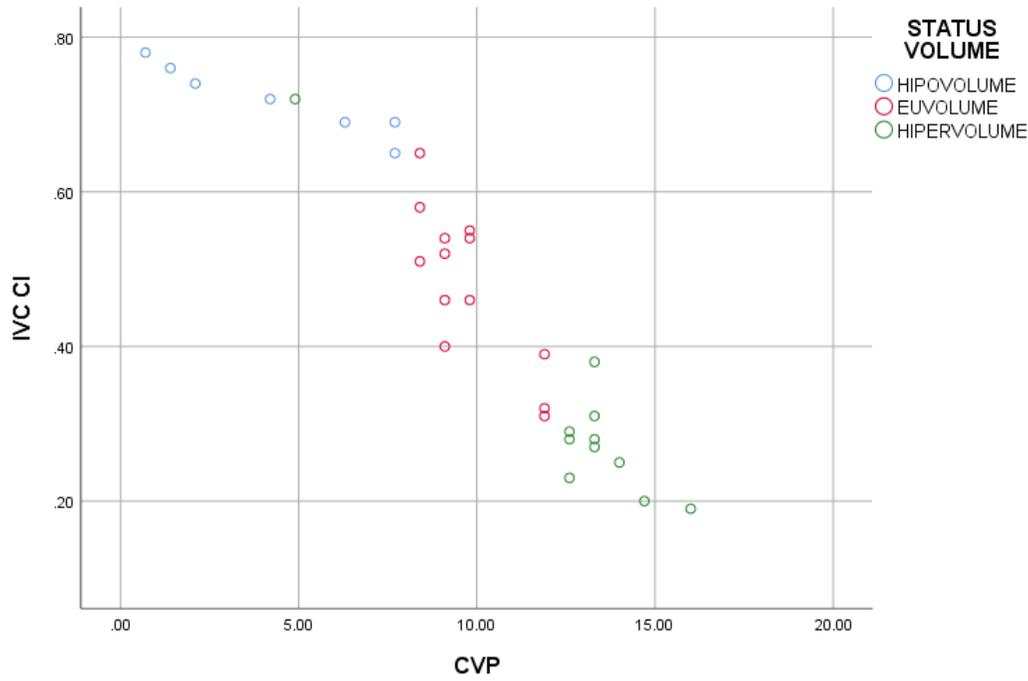


Figure 1. Correlation distribution between IVC CI and CVP with volume status

Table 2. Relationship between IVC CI and CVP values with mechanical ventilation

	IVC CI	CVP
Mechanical Ventilation		
Ya (n=20)	0,44 ± 0,19	9,7 ± 4,27
Tidak (n=11)	0,52 ± 0,16	8,9 ± 3,27
p-value	0,250 ^c	0,227 ^c

^c) T-test independent