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Original Article

Assessing Jugular Venous Pressure In Icu Patients In Resource-Limited Border Area Hospitals: A Comparative Study

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ABSTRACT

This comparative study aimed to assess the utility of jugular venous pressure (JVP) measurements in evaluating changes in central venous pressure (CVP) among critically ill patients in resource-limited border area hospitals. The study included 100 patients admitted to the intensive care unit (ICU) with a central venous catheter inserted in the chest. JVP and CVP measurements were performed, and the data were analyzed using the Wilcoxon signed-rank test. The results revealed significant differences between direct CVP and JVP measurements. However, when the measurements were categorized into low, normal, and high ranges, a 98% concordance was observed between CVP and JVP values, with no significant differences noted. The findings suggest that JVP measurement is a reliable non-invasive method for assessing right atrial pressure and fluid volume status in ICU patients, particularly in resource-limited settings. Nurses working in border area hospitals with limited resources can benefit from categorizing JVP measurements as low, normal, or high to monitor patients' hemodynamic status effectively. The study highlights the importance of JVP measurement as a valuable tool for nurses in ICUs, general wards, and emergency departments to detect changes in CVP and monitor fluid volume status in critically ill patients.

INTRODUCTION

Basic healthcare services are a fundamental right for every Indonesian citizen. Access to basic healthcare services is a governmental obligation to ensure both urban residents and those residing in border areas, islands, and remote regions. However, the availability of healthcare services and supporting facilities in these remote, border, and island regions remains relatively low, necessitating reinforcement of facilities, infrastructure, and healthcare personnel. These essential elements are predominantly centralized in provincial capitals and major cities.[1] The equitable distribution of healthcare services is significantly influenced by several factors, such as accessibility, healthcare personnel availability, facilities and infrastructure, and other contextual elements. Disparities in basic healthcare services and economic conditions are evident in border areas, where there is a notable gap between actual and expected healthcare services, with a discrepancy as high as 10.8 (expectation score of 31.11 and reality score of 20.33). This disparity

can be attributed to various factors, including challenges in accessing healthcare facilities, limited infrastructure and resources in border regions, insufficient healthcare personnel capacity, communication barriers, and differences in healthcare service provision between border and urban areas [2]. Similar challenges are prevalent in other border areas, including those within North Kalimantan Province, where significant gaps in healthcare services persist, particularly in border regions within Kalimantan. These border areas often feature extreme topography, including small islands and mountainous terrain, accessible primarily by chartered flights or challenging river routes.[1,3,4]

In North Kalimantan Province, two regencies share a border with Malaysia, The Malinau and Nunukan Regencies. Both regencies host regional hospitals serving communities in border, island, and remote areas. These regions face limitations in terms of healthcare infrastructure, personnel, accessibility, and facilities. One notable challenge is the provision of critical care in intensive care units. Through interviews conducted with several nurses working in the intensive care units of these hospitals, the following findings emerged: one hospital experienced a shortage of permanent specialist anesthesiologists, leading to monthly rotations of anesthesiology staff. Additionally, the number of nurses working in the intensive care unit is limited, leading to potential challenges in delivering nursing care when the unit reaches full capacity. Furthermore, limited resources and infrastructure, such as blood gas analysis reagents and central venous catheters, are common, resulting in infrequent monitoring of central venous pressure in patients. Based on the aforementioned description, the solution to the issue of central venous pressure monitoring can be substituted by conducting jugular venous pressure examinations. This method is non-invasive and capable of detecting increases in central venous pressure directly linked to the right side of the heart. Moreover, it can be performed autonomously by nurses.[5] Nurses employed in intensive care units bear the responsibility of continuous hemodynamic monitoring because of the potential hemodynamic instability of patients admitted to these units, which may lead to abrupt deterioration in their condition.[6]

Several research findings indicate significant differences between the scores obtained for central venous pressure and jugular venous pressure.[7,8] However, some studies have stated that jugular venous pressure measurements can assess pressure in the central veins.[9,10] Monitoring central venous pressure is considered a minimal requirement in healthcare facilities and basic competency for nurses working in primary Intensive Care Unit (ICU) settings.[11] Therefore, given the limitations of healthcare facilities in border areas, alternative examinations such as jugular venous pressure are expected to replace central venous pressure monitoring. Based on the above description, the research question was formulated as follows: "*Can jugular venous pressure measurements be used to detect changes in central venous pressure?*" This study aimed to identify the results of jugular venous pressure measurements in assessing changes in central venous pressure and their use in the field, especially the use of JVP measurement results in predicting central venous pressure in the intensive care unit.

METHODS

This study employed a comparative approach by comparing the measurement results of central venous pressure (CVP) and jugular venous pressure (JVP). The study was conducted in the intensive care units of referral hospitals in North Kalimantan Province, which shares a direct border with Malaysia, from September 2022 to January 2023. The study population consisted of all adult patients admitted to the intensive care unit. The samples were selected from this population using the two-sample mean difference formula, resulting in a sample size of 100 respondents. The inclusion criteria for the study required patients to have a central venous catheter placed in the subclavian vein and to receive treatment in the intensive care unit. Conversely, the exclusion criteria were patients with central venous catheters placed in the femoral area or those receiving treatment outside the intensive care unit. The study employed Purposive sampling was used as the sampling method.

JVP and CVP measurements were carried out by the second researcher (Yuliana) who worked in the intensive care room using the central venous pressure (CVP) measurement method using a

water manometer with units of cmH2O. Subsequently, these measurements were converted to millimeters of mercury (mmHg) by dividing the measured CVP by 1.36. Jugular venous pressure (JVP) was measured using two rulers, with the JVP measurement obtained by adding 5 cm (the distance between the right atrium and sternal angle)[12]. The normality of the CVP and JVP data was tested using the Kolmogorov–Smirnov test (*p*-value = < 0.03) (SPSS version 27). Because the data distribution was non-normal, the employed bivariate test was the Wilcoxon signed-rank test. CVP and JVP measurements were categorized into three categories: low, normal, and high. Subsequently, the categorization results of both measurements were compared using the Wilcoxon matched-pair test (SPSS version 27). This study obtained ethical approval from the research ethics committee of Tarakan General Hospital approval number 049/KEKP-RSUD KALTARA/IX/2022.

RESULTS

The study was conducted in the intensive care unit (ICU) of Dr. H. Jusuf SK, with 100 respondents who had central venous catheters (CVC) placed in the chest area (subclavian vein) and underwent measurements of central venous pressure (CVP) and jugular venous pressure (JVP) during their stay in the intensive care unit. The research results, in both univariate and bivariate forms, are presented as follows:

Table 1. Values of Central Venous Pressure Measurements (cmH2O) and their Conversion to Millimeters of Mercury (mmHg), along with Jugular Venous Pressure (JVP) Values in Critically Ill Patients in the Intensive Care Unit

Variables	Median	Min	Max
CVP (cmH2O)	6	-2	14
CVP (mmHg)	4.4	-7	10.3
JVP Value	3	-4	9

According to the data presented in Table 1, it is evident that both central venous pressure (CVP) measurements in centimeters of water (cmH2O) and their conversion to millimeters of mercury (mmHg) units exhibit higher median values than jugular venous pressure (JVP) measurements. Moreover, the maximum values followed a similar trend, suggesting a consistent pattern across measurements.

Table 2. Classification of Central Venous Pressure Measurement Values (cmH2O) in Critically Ill Patients in the Intensive Care Unit

CVP Value Classification	Number	Percentage
Low	37	37
Normal	56	56
High	7	7

Table 2 shows that the findings of central venous pressure measurements predominantly aligned with the normal range, encompassing 56% of the observed cases.

Table 3. Classification of Jugular Venous Pressure (JVP) Measurement Values in Critically Ill Patients in the Intensive Care Unit

JVP Value Classification	Number	Percentage
Low	37	37
Normal	54	54
High	9	9

Table 3 shows that the predominant proportion of respondents' jugular venous pressure measurements aligned with the normal range, constituting a total of 54%.

Table 4. Comparison of Central Venous Pressure (cmH2O) and Jugular Venous Pressure (JVP) Values in Critically Ill Patients in the Intensive Care Unit

Variables	Median (Min – Max)	*p*-value
CVP (cmH2O)	6 (-2 – 14)	0.001
JVP Value	3 (-4 – 9)	

Upon examination of Table 4, it becomes apparent that the median, minimum, and maximum values were notably elevated in the central venous pressure (CVP) measurements. The Wilcoxon signed-rank test yielded a *p*-value of 0.001, indicating a statistically significant disparity between the central venous pressure (CVP) and jugular venous pressure (JVP) among critically ill patients in the intensive care unit.

Table 5. Comparison of Central Venous Pressure (cmH2O) and Jugular Venous Pressure (JVP) Values in Critically Ill Patients in the Intensive Care Unit

Variables	Median (Min – Max)	*p*-value
CVP (cmH2O)	2 (1 – 3)	0.317
JVP Value	2 (1 – 3)	

Table 5 shows the congruence observed between the median, minimum, and maximum values for both central venous pressure (CVP) and jugular venous pressure (JVP) measurements. After the Wilcoxon signed-rank test, a *p*-value of 0.317 was obtained, indicating the absence of a statistically significant difference between the values of central venous pressure (CVP) and jugular venous pressure (JVP) among critically ill patients in the intensive care unit.

Table 6. Concordance of Central Venous Pressure (cmH2O) with Jugular Venous Pressure (JVP) Values in Critically Ill Patients in the Intensive Care Unit

Central Venous Pressure	Jugular Venous Pressure			%
	Low	Normal	High	
Low	37	0	0	98
Normal	0	54	2	
High	0	0	7	

Table 6 illustrates a concordance rate of 98% between the recorded central venous pressure and jugular venous pressure values after categorization. A marginal deviation of 2% was observed within the normal value classification, transitioning to a high category. Nonetheless, a notable concordance was observed for both low and high values.

DISCUSSION

Central Venous Pressure and Jugular Venous Pressure Measurements

The central venous pressure and jugular venous pressure measurements of the respondents undergoing treatment in the intensive care unit primarily displayed normal values. This finding aligns with the assessment conducted by Mubarak, Lubis, and Dewi (2023), who noted that the majority of respondents exhibited a central venous pressure of 5.52 ± 2.47[13], while some respondents showed both low and high central venous pressure values.[14]

Comparison between Central Venous Pressure and Jugular Venous Pressure

A disparity was found between the two following a comparative analysis (Wilcoxon signed-rank test) between central venous pressure and jugular venous pressure measurements. This observation is in line with Davidson and Canon's findings (1974), which indicated a weak

correlation between central venous pressure and jugular venous pressure measurements. Discrepancies of 2 cm were observed in up to 47% of the respondents' measurements, while variations of 3 and 4 cm were also noted. Consequently, the study concluded that central venous pressure values differ from jugular venous pressure values.[15] Demeria *et al*. (2004) similarly asserted that central venous pressure and jugular venous pressure yield different results, indicating a weak relationship between the two measurements.[8] Furthermore, Leonard *et al*. (2008) reported disparities between the two measurements, particularly in the lateral position, wherein central and jugular venous pressure values manifested discrepancies.[9] According to the researchers' observations, nurses in the intensive care unit seldom perform jugular venous pressure examinations when patients are equipped with central venous catheters. Instead, nurses rely on invasively measured central venous pressure to gauge pressure in the right atrium or monitor vascular volume. Central venous pressure is a direct indicator of pressure in the right atrium; hence, the established standard for determining right atrial pressure, measured as central venous pressure, is invasive, utilizing a catheter inserted into the right atrium via venous blood vessels.[16]

The Utility of Jugular Venous Pressure Measurements in Assessing Central Venous Pressure

Upon categorizing the measurements of central venous pressure and jugular venous pressure into low, normal, and high ranges, a concordance of 98% was observed. Only a 2% discrepancy was noted in the normal values, which was high in the jugular venous pressure measurements. Diab *et al*. (2021) suggested that central venous pressure can be predicted using external jugular vein examination in ventilated patients. Critically ill patients often experience fluctuations in hemodynamic status, including the central venous pressure. Therefore, in predicting fluid volume status, external jugular vein pressure can be relied upon, offering the advantage of being a non-invasive procedure.[17] Another study by Wengrofsky *et al*. (2022) reported a correlation between central venous pressure and jugular venous pressure measurements, with correlations ranging from high to low. Jugular venous pressure is a reliable examination for predicting fluid volume status in patients with acute decompensated heart failure (ADHF), particularly those with low body mass index (BMI), low average ejection fraction (EF), and high levels of B-type natriuretic peptide.[18] To predict right atrial pressure invasively, internal jugular venous (IJV) pressure can be relied upon. Additionally, jugular venous pressure may serve to elucidate the cardiac hemodynamic status, assess filling pressure, and indirectly reflect central venous pressure. Various non-invasive techniques can be used to estimate right atrial pressure, including echocardiography, which provides information on the inferior vena cava, systemic and hepatic veins, and right atrial dimensions.[16] Ruge and Marhefka (2022) noted that the standard method for determining central venous pressure is through pulmonary artery catheterization, but this carries the risk of complications, such as pneumothorax and cardiac conduction abnormalities. Non-invasive examination of the inferior vena cava is highly effective because it does not change the vessel diameter during hypovolemia.[19] Another non-invasive method for predicting central venous pressure is ultrasound examination of the jugular vein, where jugular venous pressure accurately predicts pressure in the right atrium and central venous pressure (CVP).[20] Central venous pressure has a positive relationship with internal jugular vein (IJV) pressure and is associated with stroke volume (SV).[21] Wang, et. all. (2022) carried out JVP measurements on 100 patients experiencing heart failure and compared them with invasive measurements of right atrial pressure and found that the results of ultrasound JVP measurements were 94.6% accurate in predicting an increase in right atrial pressure.[22] Research conducted by Mulder, et. all. (2024), found that there was a correlation between high external jugular venous pressure measurements, high internal jugular venous pressure, and narrowing of the diameter of the inferior vena cava to an increase in central venous pressure (CVP) in patients.[23] Noninvasive central venous pressure measurement is a measurement that can replace invasive central venous pressure measurement.[24] Based on the researchers' observations, the use of jugular vein examination as a non-invasive modality for assessing central venous pressure is a viable option for nurses to monitor fluid dynamics and right atrial pressure. This holds particular significance for intensive

care nurses operating in border regions, where resources for central venous pressure assessment in critically ill patients are constrained. Given its minimal skill and equipment requirements, competence in jugular venous pressure assessment is deemed essential for nurses across general wards, intensive care units, and emergency departments. To facilitate the detection of central venous pressure and the ongoing monitoring of the patient's fluid volume status, it is advised to interpret jugular venous pressure measurements as falling within the low, normal, or high categories, recognizing that direct numerical readings may not directly correlate with central venous pressure.

CONCLUSIONS

Differences were noted in the direct measurements of central venous pressure and jugular venous pressure in critically ill patients in the intensive care unit. After categorization, the results of central and jugular venous pressure measurements showed a concordance of 98%, with no significant differences observed. Hence, for the clinical benefit of nurses, particularly those working in border areas with limited resources, it is advisable to categorize central venous pressure measurements as low, normal, or high when conducting jugular venous pressure measurements. The implementation of jugular venous pressure measurement in the intensive care unit is beneficial in detecting the cardiac hemodynamic status and fluid volume status of patients, especially in cases where central venous catheters are not inserted, and in hospitals with limited resources and infrastructure.

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