dx.doi.org/10.5380/ce.v26i0.72689

Cogitare enferm. 2021, v26:e72689

Cogitare Enfermagem

ORIGINAL ARTICLE

INCIDENCE OF EXCESS FLUID VOLUME IN PATIENTS UNDER INTENSIVE CARE

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ABSTRACT

Objective: to identify the incidence of the Excess Fluid Volume nursing diagnosis in patients hospitalized in an Intensive Care Unit, in the period of three months.
Method: cross-sectional, descriptive, and exploratory study, in an Intensive Care Unit in the southern region of Brazil. The clinical characteristics obtained from the medical records and physical examination of 31 patients, admitted between March and May 2018, were analyzed by frequency distribution, and bivariate analysis with Chi-square test.
Results: 54,8% of patients developed Excess Fluid Volume, with the defining characteristics prevailing: edema, decreased hemoglobin and hematocrit, anasarca and electrolyte imbalance. Neurological impairment, mechanical ventilation, sedation, and more than four days of hospitalization were evidenced as the main related factors.
Final considerations: this study contributes to the diagnostic accuracy of the Excess Fluid Volume of patients hospitalized in intensive therapy and expands the possibility of developing this nursing diagnosis.

DESCRIPTORS: Nursing Diagnosis; Incidence; Body Fluids; Fluid Shifts; Intensive Care Units.

INCIDENCIA DE VOLUMEN LÍQUIDOS EXCESIVO EN PACIENTES ADULTOS BAJO CUIDADOS INTENSIVOS

RESUMEN:

Objetivo: identificar la incidencia del diagnóstico de enfermería Volumen Líquido Excesivo em pacientes ingresados en una Unidad de Cuidados Intensivos durante un periodo de tres meses. Método: estudio transversal, descriptivo y exploratorio, en una Unidad de Cuidados Intensivos del sur de Brasil. Las características clínicas obtenidas en registros médicos y exámenes físicos de 31 pacientes, ingresados entre marzo y mayo de 2018 se analizaron mediante la distribución de frecuencias y el análisis bivariado con el test de Chi-cuadrado. Resultados: El 54,8% de los pacientes desarrollaron un Volumen Líquido Excesivo, predominando las características definitorias: edema, hemoglobina y hematocrito disminuidos, anasarca y desequilibrio electrolítico. El deterioro neurológico, la ventilación mecánica, la sedación y más de cuatro días de hospitalización se evidenciaron como los principales factores relacionados. Consideraciones finales: este estudio contribuye a la precisión diagnóstica del Volumen Líquido Excesivo en pacientes hospitalizados en cuidados intensivos y amplía la posibilidad de desarrollar este diagnóstico de enfermería.

DESCRIPTORES: Diagnóstico de Enfermería; Incidencia; Líquidos Corporales; Transferencias de Fluidos Corporales; Unidades de Cuidados Intensivos.

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INTRODUCTION

In the complex context of an Intensive Care Unit (ICU), nurses are fundamental within the multi-professional team since they are committed to direct and uninterrupted care to patients in critical health situations [1]. In order to systematize this care, nurses can and should use the Nursing Process, which is a tool that qualifies care by reducing errors and increasing patient safety [2]. Among the taxonomies that standardize the language of the Nursing Process is NANDA-I, which includes Nursing Diagnoses (ND).

One of the prevalent NDs in ICUs is the Excess Fluid Volume (EFV) [3], which was approved in 1982 and revised in 1996, 2013, and 2017. It has level of evidence 2.1, a classification necessary for acceptance for inclusion in the NANDA-I taxonomy, from the evaluation of all components (title, definition, defining characteristics, related or risk factors) and from the literature. It is part of domain 2 - Nutrition, in its class 5 - Hydration, defined as "excessive fluid intake and/or retention"[4].

Since the ND is the basis for determining the care plan, one should prioritize those that achieve the expected results about the patient's clinical condition. It is also pertinent to consider similar NDs or those whose signs and symptoms are remarkably similar so that there is no low diagnostic accuracy [4]. Specifically, in relation to the EFV, clinical indications of altered blood pressure and respiratory pattern, and restlessness may characterize other NDs, such as Ineffective Breathing Pattern and decreased cardiac output, and impair diagnostic accuracy.

From this perspective, the intention was to study the EFV ND in ICU patients, due to its frequency in this context, verified from clinical experience and the lack of research addressing this issue and supporting nurses for diagnostic accuracy. Above all, because hydric overload has deleterious effects on health, since it increases the patient's hemodynamic instability, can cause organ congestion, and can even lead to death [5-6].

Thus, the purpose of this study was to identify the incidence of EFV nursing diagnosis in patients admitted to an Intensive Care Unit over a three-month period, as well as to identify the defining characteristics and related factors prevalent in patients with EFV.

METHOD

Cross-sectional, descriptive, and exploratory study conducted in an adult ICU in the southern region of Brazil, between the months of March and May 2018. In this unit, the monthly average is 11 admissions. For the sample calculation, the population of 33 patients was considered bearing in mind the three-month period of the study, with a confidence level of 95% and margin of error of 5%, obtaining a sample of 31 patients. The criterion for composition of the sample was patients over 18 years old in a critical life situation. Patients who had not completed 24 hours in the ICU due to death or transference to another unit were excluded from the sample.

Data collection followed two steps guided by a semi-structured instrument. Patients were evaluated and followed up for a maximum of 10 days. The maximum follow-up time was established with a pilot study, which showed that the ND under study was manifested before 10 days of hospitalization. The pilot study also allowed the variables of the data collection instrument and the pre-established protocol to reach the goal.

The first step was the analysis of the patients' medical records, with emphasis on demographic variables (gender, age, marital status, profession/occupation, place of

birth, education), clinical characterization (background/comorbidities, allergies, medical diagnosis, nursing diagnoses, factors related to the EFV ND, defining characteristics of the EFV ND, length of stay, outcome), complementary tests, drug therapy, invasive devices used, nursing interventions. The daily physical examination of the patient constituted the second stage and was aimed at assessing the patient's general health status, checking for the presence of signs and symptoms of the nursing diagnosis EFV and the presence of invasive devices.

The data obtained were organized in an Excel® 2010 spreadsheet and later analyzed using the Statistical Package for Social Sciences® (SPSS) version 20.0 software. Descriptive statistics with absolute and relative frequencies were used. Multivariable analysis was performed in order to identify risk factors for EFV. Variables that were considered to be associated with EFV (edema, decreased hemoglobin and hematocrit, electrolyte disturbance, anasarca, sedation, mechanical ventilation, diuretic use, electrolyte replacement, cumulative fluid balance and outcome) were included in the multivariable analysis, thus adjusting the mentioned factors to identify predictors of EFV, this way, minimizing confounding bias in the study. The Chi-square test was used to investigate the association of categorical variables. A two-sided significance level of $p<0.05$ was assumed.

To list the ND, we adopted the NANDA-I guideline of a minimum of four defining characteristics to narrow the choice and differentiate similar diagnoses, avoiding the most common ones that characterize several NDs, such as altered blood pressure, altered breathing pattern, and restlessness.

Patients and/or family members were invited to participate, clarified about the study and included by signing the Informed Consent Form. The ethical precepts of Resolution 466/2012 of the National Health Council were respected, with the consent of the Research Ethics Committee of the institution, under opinion no. 2424231.

RESULTS

Thirty-one patients were evaluated. Considering the demographic characteristics, most were male (58.1%; n=17), married people totaled 48.4% (n=15), and 32.3% (n=10) were retired. The mean age was 59.5±16.75 years, with variability from 22 years to 84 years.

Regarding the origin of the patients, most of them (54.8%; n=17) were from the Emergency Unit, followed by those from the Surgical Block five (16.1%) and transferred from another hospital five (16.1%). A minority came from the Clinical or Surgical admission Unit four (13%). Regarding prognosis, 58.1% (n=18) were discharged from the ICU to another admission unit, seven (22.6%) remained in the ICU for more than 10 days, four (12.9%) died and two (6.5%) were transferred to another institution.

The medical diagnoses of the evaluated patients resulted from disorders that compromise mainly the organ systems: neurological 41.9% (n=13), respiratory five (16.1%) and cardiologic four (12.9%). The priority NDs that prevailed on ICU admission were: Risk for Ineffective cerebral tissue perfusion 16 (51.6%), Ineffective breathing pattern five (16.1%), Activity intolerance five (16.1%), Impaired gas exchange three (9.7%), and Acute pain two (6.5%).

In addition to the conditions responsible for the ICU admission, some patients had associated conditions, i.e., comorbidities, that may collaborate to the development of the ND EFV. These comorbidities involve compromised regulation mechanisms and were subdivided for better presentation. The sum presented exceeds 100% because some patients have more than one impaired regulatory mechanism. Also, considering the

moment of admission, it was identified that only one patient presented a factor related to excess of liquids and two presented a factor related to excess of sodium. These data are shown in Table 1.

Table 1 - Components of the Nursing Diagnosis Excessive Fluid Volume manifested by patients. Uruguaiana, RS, Brazil, 2018

		n	%
Related Factor	Excess fluid	1	3,2
	Excess sodium	2	6,4
Associated Condition	Impaired regulatory mechanism: cardiovascular function	18	58
	Impaired Regulatory Mechanism: Metabolic function	9	29
	Impaired Regulatory Mechanism: Renal function	2	6,4
No related factors or associated conditions		8	25,8
Defining characteristics	Alteration of mental state	22	71
	Adventitious noises	20	64,5
	Decreased hemoglobin	19	61,3
	Decreased hematocrit	19	61,3
	Altered breathing pattern	19	61,3
	Dyspnea	18	58,1
	Alteration in blood pressure	18	58,1
	Edema	18	58,1
	Ingestion greater than elimination	16	51,6
	Azotemia	14	45,2
	Anxiety	13	41,9
	Electrolyte imbalance	10	32,2
	Restlessness	8	25,8
	Orthopnea	7	22,6
	Pulmonary congestion	6	19,4
	Presence of B3	6	19,4
	Anasarca	5	16,1
	Distension of the jugular vein	4	12,9
	Hepatomegaly	4	12,9
	Oliguria	3	9,7

Source: Authors (2018).

Among the 27 defining characteristics of EFV, four of them could not be measured: change in urine specific gravity, change in pulmonary arterial pressure, increase in central venous pressure, and weight gain over a short period. However, such weakness did not

impact the definition of the EFV ND. Three defining features were not manifested: pleural effusion, paroxysmal nocturnal dyspnea, and positive hepatojugular reflex. Other signs and symptoms were evident in the sample, as shown in Table 1.

In the analysis between the length of ICU stay and other variables, it was evident that the longer the length of ICU stay, the greater the probability of developing EFV and the greater the need for intensive care. These data are presented in Table 2. It is noteworthy that the existence of a temporal association reinforces the evidence for time exposure, above four days of ICU stay and higher prevalence above eight days, to be a possible cause of the outcome studied, the EFV ND.

Table 2 - Association of independent variables with length of stay in ICU. Uruguaiana, RS, Brazil, 2018

Variables	Length of stay in ICU								
	Up to 3 days		4 to 7 days		8 to 10 days		Total		p-value
	n	%	N	%	n	%	n	%	
Patients with impaired neurological system at the time of admission	2	6,5	4	13	12	38,7	18	58	0,203
Patients with positive accumulated water balance	5	16	6	19,4	7	22,6	18	58	0,367
Patients discharged from the ICU	5	16	9	29	4	12,9	18	58	0,017
Patients who died	1	3,2	2	6,5	1	3,2	4	12,9	0,017
Patients who developed EFV	1	3,2	4	13	12	38,7	17	54,8	0,005
Mechanically ventilated patients	2	6,5	4	12,9	12	38,7	18	58	0,018
Sedation patients	2	6,5	3	9,7	13	42	18	58	0,002

Source: Authors (2018).

The mean follow-up time for data collection was 6.1 days, with a median of seven days, and with minimum variability of two days and maximum of 10 days. During this period, 17 patients developed EFV. Therefore, the overall incidence was 54.8%. Regarding the day of EFV development, no patient manifested four defining characteristics on the first day of hospitalization, three manifested on the second day, three on the third day, seven on the fourth day, two on the fifth day, one on the seventh day, and one on the eighth day.

Also, regarding the results presented in Table 2, patients who survived in the ICU were predominantly discharged between the fourth and seventh day of stay (29%; n=9). Death was the outcome of 12.9% (n=4) of the patients evaluated in the study. Other findings, even without statistical significance, regarding the association of independent variables with the length of ICU stay, are relevant. It is noteworthy that 58% (n=18) of the evaluated patients presented impairment of the neurological system at the time of admission, and of these, 38.7% (n=12) with a length of stay longer than eight days. Considering the positive accumulated fluid balance, 16% of the patients presented this volume condition already in the first three days of admission.

An association was found between the development of EFV and the defining characteristics: edema, decreased hemoglobin and hematocrit, anasarca, and electrolyte imbalance; demonstrating that these signs are indicative of the diagnosis in critically ill patients. Mechanical ventilation and sedation were evidenced as risk factors for the development of the diagnosis. Neurological impairment at the time of admission, patients discharged from the ICU, patients who died, patients who remained in the ICU, and patients transferred to other institutions were also associated with the development of EFV, as shown in Table 3.

Table 3 - Multivariate analysis to identify the defining characteristics and factors related to Excessive Fluid Volume in ICU patient. Uruguaiana, RS, Brazil, 2018

Variables	EFV patients		Total		p-value	OR	CI: 95%	
	n	%	n	%			Min	Max
Edema	15	83,3	18	58,1	0	27,5	3,908	193,489
Decreased hemoglobin and hematocrit	16	84,2	19	61,3	0	58,667	5,377	640,146
Electrolyte imbalance	9	90	10	32,3	0,007	14,625	1,548	138,187
Anasarca	5	100	5	16,1	0,027	2,167	1,43	3,282
Mechanical ventilation	13	72,2	18	58,1	0,022	5,85	1,222	27,994
Sedation	14	77,8	18	58,1	0,003	11,667	2,125	64,039
Continuous serum therapy	16	59,3	27	87,1	0,199	4,364	0,4	0,199
Electrolyte replacement	3	75,5	4	12,9	0,385	2,786	0,256	30,273
Diuretic use	8	66,7	12	38,7	0,293	2,222	0,496	9,964
Positive cumulative fluid balance	9	50	18	58,1	0,524	0,625	0,147	2,664
Patients discharged from ICU	5	27,8	18	58,1	0,004	-	-	-
Death	3	75	4	13	0,004			
Remained in ICU	7	100	7	22,6	0,004	-	-	-
Transfer to another institution	2	100	2	6,5	0,004	-	-	-
Impairment of the neurological system at the time of admission	12	70,6	18	58,1	0,049	-	-	-

Legend: ELV: excessive liquid volume; OR: Odd Ration; CI: confidence interval; Min: minimum value; Max: maximum value.
Source: Authors (2018).

Observing Table 2 and Table 3, it can be seen that continuous serotherapy, electrolyte replacement, use of diuretics and positive accumulated fluid balance had no direct association with length of ICU stay or with the development of EFV, also not being evidenced as a risk factor for the diagnosis. On the other hand, sedation and mechanical ventilation were significantly associated with length of ICU stay and with the development of EFV Moreover, neurological impairment on ICU admission was not associated with length of ICU stay, but it was associated with the development of EFV.

DISCUSSION

Like what is presented in the literature, the demographic and clinical profile of the patients showed that most of them are male, with a mean age of over 55 years. The main medical diagnosis identified among the patients is related to neurological disorders, most of them came from the emergency unit, and predominantly, the patients were discharged from the ICU to another inpatient unit [7].

Neurological patients may present hydroelectrolytic disorders for several reasons, such as administration of osmotic diuretics, fluid infusion, pituitary dysfunction and increased insensitive fluid loss. Therefore, one should consider all variables during clinical evaluation, monitor serum electrolyte levels, and rigorously record fluid intake and elimination in order to maintain stable levels. [8]

It is noteworthy that the institution where the research was conducted is a regional reference in neurology, which justifies a higher admission of neurological patients in the ICU in question. Therefore, the most frequently listed ND at admission was Risk of ineffective cerebral tissue perfusion. It is also noteworthy that diagnoses considered inherent to critical patients, such as Risk of infection, which is conditioned by exposure to invasive procedures [9], were not listed.

The factor compromising regulatory mechanisms occurs when there are failures in the pH of body fluids, in osmotic pressure and in the equity between cations and anions, causing an imbalance between intake and elimination of water and electrolytes [10]. These circumstances include patients with renal failure, cardiovascular problems and heart failure, who develop EFV and require care to prevent and control such a problem [11].

The factor excessive fluid intake or administration indicates that the patient is receiving more fluid than is metabolized. The factor excessive intake or administration of sodium may result from an inadequate diet or volume replacement with 0.9% saline solution, triggering fluid retention, overloading the renal system, and hindering fluid filtration and elimination [11]. As only one patient was identified with excess fluid and two with excess sodium upon ICU admission, it is inferred that these factors are not the cause for the development of EFV in this study. As to the defining characteristics to identify the EFV, this study partially coincides with another important study that states that the most used are oliguria, ingestion greater than elimination, change in respiratory pattern, dyspnea, orthopnea, adventitious respiratory sounds, pulmonary congestion, weight gain in a short period, edema and anasarca [11].

The high alteration in mental status may be biased since most patients presented neurological impairment upon ICU admission. Changes in the respiratory pattern, adventitious sounds and dyspnea are not always associated with underlying diseases and may be a consequence of pulmonary congestion caused by excess fluid [6].

The critically ill patient is submitted to intravenous therapies that, if not properly controlled, may lead to hypervolemia due to the inflow of fluids being greater than their elimination. The volume alteration can trigger electrolyte imbalance that compromises cardiac performance, since the latter depends on electrolytes for its functioning [12].

Besides electrolyte imbalance, the decrease in hematocrit and hemoglobin is a common sign of hypervolemia [13-14], caused by hemodilution, that is, the increase of plasma in relation to the other blood components [15].

Edema is one of the main signs of EFV [9-10,16] also considered as the most sensitive for such a diagnostic inference [11]. And, although anasarca has a low percentage of manifestation, it can be observed that such characteristic occurs more in patients with EFV than in patients without this diagnosis [16] and may be considered a representative sign of

the diagnosis in question.

Regarding the associations made in this study, it is possible to infer that the longer the length of stay in the ICU, the greater the susceptibility to adverse events, such as the development of EFV, and the higher the mortality rate [17]. The reverse is also true: the occurrence of adverse events increases ICU length of stay, as well as mortality, and may conceive a cycle [18]. Both mechanical ventilation and sedation have an impact on ICU length of stay [19-20]. However, there is no correlation between sedation level and mechanical ventilation stay [21].

Assuming that positive accumulated fluid balance is the same as intake greater than elimination, a divergence of data presented in existing literature was perceived. While the present study identified that positive accumulated fluid balance has no significant association with length of ICU stay, the pre-existing literature shows a significant association between the defining characteristic "intake greater than elimination" and the variable "length of treatment" [22].

The relationship between mechanical ventilation and fluid overload is justified by the severity of the clinical picture presented by the patient, since patients with a more severe health condition need mechanical ventilation and also require a greater infusion of fluids, including volume resuscitation. This is commonly used on the first day of ICU admission. In addition, when volume resuscitation is performed with more than 5L/day, it is associated with increased mortality and increased hospital costs, except in the case of non-mechanically ventilated patients [23].

EFV may result from multiple factors, and a thorough clinical evaluation is important to guide the correct treatment, which will vary from patient to patient. Altered hemodynamic data alone, such as increased central venous pressure, is not enough to confirm water overload. It is necessary to analyze together the signs and symptoms presented, the altered hemodynamic data, and even the use of biomarkers [6]. After all, only through an accurate diagnosis is it possible to plan a resolute nursing care [4].

Further, future studies are suggested to overcome the limitations of exclusivity of service and research setting and the impossibility of measuring some hemodynamic parameters (change in urine specific gravity, change in pulmonary arterial pressure, increase in central venous pressure, and weight gain in a short period of time) that may also evidence the EFV.

FINAL CONSIDERATIONS

The investigation brought new contributions about the diagnostic inference of EFV, to better direct the nurse to the results and interventions, as well as to reduce possible complications, considering the 54.8% prevalence of this problem in ICU patients. It was concluded that the defining characteristics edema, decreased hemoglobin and hematocrit, anasarca and electrolyte imbalance are clinical indicators that allow the accuracy of EFV diagnosis. Neurological impairment, mechanical ventilation, sedation, and more than four days of hospitalization were evidenced as the main factors related to the cause of this diagnosis in critically ill patients.

The results also expand the possibility of developing this nursing diagnosis. We intend to forward it to NANDA-I for the reformulation of related factors and consolidation of prevalent defining characteristics.

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HOW TO REFERENCE THIS ARTICLE:
Bittencourt CM, Busanello J, Harter J, Garcia RP. Incidence of excess fluid volume in patients under intensive care. Cogitare enferm. [Internet]. 2021 [accessed "insert day, monh and year"]; 26. Available from: http://dx.doi.org/10.5380/ce.v26i0.72689.

Received: 05/04/2020
Approved: 22/10/2020

Associate editor: Luciana Alcântara Nogueira

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Drafting the work or revising it critically for important intellectual content - CMB
Final approval of the version to be published - CMB, JB, JH, RPG
Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved - CMB