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Original Article

Diagnostic accuracy of the defining characteristics of the excessive fluid volume diagnosis in hemodialysis patients[1]

Maria Isabel da Conceição Dias Fernandes[2]
Miclécia de Melo Bispo[3]
Érida Maria Diniz Leite[4]
Marcos Venícios de Oliveira Lopes[5]
Viviane Martins da Silva[6]
Ana Luisa Brandão de Carvalho Lira[7]

Objective: to evaluate the accuracy of the defining characteristics of the excess fluid volume nursing diagnosis of NANDA International, in patients undergoing hemodialysis. Method: this was a study of diagnostic accuracy, with a cross-sectional design, performed in two stages. The first, involving 100 patients from a dialysis clinic and a university hospital in northeastern Brazil, investigated the presence and absence of the defining characteristics of excess fluid volume. In the second step, these characteristics were evaluated by diagnostic nurses, who judged the presence or absence of the diagnosis. To analyze the measures of accuracy, sensitivity, specificity, and positive and negative predictive values were calculated. Approval was given by the Research Ethics Committee under authorization No. 148.428. Results: the most sensitive indicator was edema and most specific were pulmonary congestion, adventitious breath sounds and restlessness. Conclusion: the more accurate defining characteristics, considered valid for the diagnostic inference of excess fluid volume in patients undergoing hemodialysis were edema, pulmonary congestion, adventitious breath sounds and restlessness. Thus, in the presence of these, the nurse may safely assume the presence of the diagnosis studied.

Descriptors: Validation Studies; Sensitivity and Specificity; Nursing Diagnosis; Signs and Simptoms; Renal Dialysis.

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[2] MSc, Professor, Departamento de Enfermagem, Universidade Federal do Rio Grande do Norte, Natal, RN, Brazil.
[3] RN, Hospital Universitário Onofre Lopes, Universidade Federal do Rio Grande do Norte, Natal, RN, Brazil.
[4] Master's student, Universidade Federal do Rio Grande do Norte, Natal, RN, Brazil. RN, Hospital Universitário Onofre Lopes, Universidade Federal do Rio Grande do Norte, Natal, RN, Brazil.
[5] PhD, Associate Professor, Departamento de Enfermagem, Universidade Federal do Ceará, Fortaleza, CE, Brazil.
[6] PhD, Adjunct Professor, Departamento de Enfermagem, Universidade Federal do Ceará, Fortaleza, CE, Brazil.
[7] PhD, Adjunct Professor, Departamento de Enfermagem, Universidade Federal do Rio Grande do Norte, Natal, RN, Brazil.

Corresponding Author:
Maria Isabel da Conceição Dias Fernandes
Universidade Federal do Rio Grande do Norte. Departamento de Enfermagem
BR 101, Campus Universitário
Bairro: Lagoa Nova
CEP: 59072-970, Natal, RN, Brasil
E-mail: bebel_6@hotmail.com

Introduction

Clinical validation of nursing diagnoses is accomplished through measures of the accuracy of their defining characteristics. From these measures, the characteristics are identified, among the set of characteristics, which predict with greater accuracy the occurrence of the investigated diagnosis. In this way, the measures of diagnostic accuracy can distinguish individuals with and without a nursing diagnosis, from the defining characteristics, thus providing greater reliability in the diagnostic choice[1].

Accordingly, it can be seen that research on this topic is relevant due to the uncertainty involved in the diagnostic judgment performed by the nurse, since the interpretation of human responses is configured as subjective impressions, so that the correct inference becomes a complex challenge[2]. Linked to this, some nursing diagnoses share identical defining characteristics, a problem that can generate doubts for nurses in the diagnostic inference[3]. The difficulties experienced by students and clinical nurses at the time of diagnostic inference, regarding the number of characteristics sufficient to elucidate the presence of a diagnosis should also be highlighted.

In view of the problems mentioned that make it difficult to establish accurate diagnoses, it is necessary to carry out studies that demonstrate the validity of the relationships between the clinical manifestations and the nursing diagnoses[3], to reduce the inaccuracy in the diagnostic choice, through selection of the nursing diagnosis most suitable for the situations/problems presented by the patient and therefore achieve positive health outcomes.

In addition, studies on diagnostic accuracy are recommended by NANDA International, which states the importance of carrying them out in specific populations, because, by virtue of taxonomic globalization, there are numerous contexts identified in the investigated populations, with geographic, economic and cultural variations. These differences interfere with the diagnostic findings, due to variation of the measures of accuracy, according to the study population[4].

From this perspective, to study the diagnosis of excessive fluid volume in patients with Chronic Kidney Disease (CKD) was chosen, as there are studies that shows the frequency of this diagnosis in this population[5-7]. Furthermore, studies on diagnostic validation are still incipient[3].

The relationship between the physiology of CKD and excess fluid volume should also be noted, as the affected kidney is unable to perform the filtration of nitrogen excreta, electrolytes and fluids, with the performance of hemodialysis not completely replacing kidney function, leading to the accumulation of these substances. Excess fluid affects the health of these patients and may cause pulmonary edema, congestive heart failure and hypertension, which, if left untreated, can lead to death[6-7].

Thus, the performance to this study is seen as important because its results will assist in the rapid and precise identification of the excess fluid volume diagnosis in renal patients undergoing hemodialysis, minimizing the previously mentioned complications and helping to reduce the risk of interventions inconsistent with the reality presented by the patient. It is expected that this study will contribute to the diagnostic inference process of nurses, reducing the uncertainty involved in the diagnostic judgment and making their work more efficient. It is also hoped that it will contribute to the teaching/learning of students in the training process regarding the proper techniques of diagnostic inference[8].

In this context, the following question arose: Are there defining characteristics of the excessive fluid volume diagnosis in hemodialysis patients with a greater degree of accuracy? In response to this question, the aim was to evaluate the accuracy of the defining characteristics of the excess fluid volume nursing diagnosis of NANDA International, in patients undergoing hemodialysis.

Method

This was a study of diagnostic accuracy, with a cross-sectional design, performed in two stages. In the first, the defining characteristics of the excess fluid volume nursing diagnosis of NANDA International were identified, in patients undergoing hemodialysis. In the second stage, the diagnostic inference was performed by specialist nurses.

In the first stage, the sample consisted of 300 patients with CKD, undergoing hemodialysis, treated during one month in a hemodialysis clinic and a university hospital of northeastern Brazil. The following parameters were used for calculating the sample, a confidence level of 95%, estimated sensitivity of the most important characteristics of 85%, length of the constructed confidence intervals of 10%, assuming that a proportion of 50% of the population presented the diagnosis investigated.

The calculated sample size was 98 individuals, opting for rounding up to 100 patients, recruited consecutively by convenience. For the recruitment, in the first hour of the hemodialysis treatment, one patient was randomly chosen, selecting one that fulfilled the inclusion and exclusion criteria explained below.

The inclusion criteria were: to present CKD and be undergoing hemodialysis treatment; to be, at the moment of data collection, in the first hour of hemodialysis; and to be aged 18 years or over. The exclusion criteria were: having impaired physical and mental conditions that prevented the collection of all items of the instrument.

The data collection of the first stage was carried out between December 2012 and April 2013, through the application of a form type instrument, based on the defining characteristics of the excess fluid volume diagnosis of NANDA International, including socioeconomic and clinical data, general physical exam, laboratory exams and follow-ups. These data measured, with appropriate reliability, in the 100 patients in the sample, the 23 defining characteristics of the diagnosis studied present in NANDA International and are presented in the results of this study[4].

For the construction of the instrument, a review of the operational definitions of the defining characteristics of the excess fluid volume diagnosis was carried out, from a previously conducted study[9]. The content of the instrument was validated by two nurse teachers, specialists in Nursing Care Systematization, with their suggestions included. Subsequently, a pre-test of the instrument was carried out, with 10% of the study sample, for the verification of possible gaps, without the need for changes to the instrument.

It should be highlighted that the data collection of the first stage was developed by eight undergraduate students of the nursing degree course, adequately trained for the standardization of the measurement methods. The training was delivered over 10 hours, divided into two meetings. In the first meeting, the theme of the study, the excess fluid volume nursing diagnosis and its defining characteristics were discussed. In the second, the research instrument was presented.

Subsequently, the data obtained from the 100 patients were analyzed for the presence or absence of the defining characteristics of the excess fluid volume diagnosis. Next, 100 spreadsheets were constructed using Microsoft Excel 2010, one for each patient studied, containing the list of defining characteristics of the nursing diagnosis in question, listed as present or absent.

The second step constituted the diagnostic inference process, with the invitation of five diagnostic nurses, specialists in nursing diagnoses and/or with experience in the clinical practice or teaching of nephrology. To choose these specialists training was conducted, explaining diagnostic accuracy, clinical rational, clientele with CKD, excess fluid volume diagnosis and operational definitions of the components of the diagnosis.

The training with the diagnostic nurses was necessary because of the absence of a gold standard for identification of nursing diagnoses, taking into account that human responses can not be measured by devices that ensure the accurate identification of a diagnosis. Therefore, the training was essential for the diagnostic nurses, to reduce the impact of the absence of a gold standard. It was also important to check the diagnostic inference capacity after the training[1].

Accordingly, the diagnostic ability of the diagnostic nurses was estimated by applying simulated case histories, containing the characteristics of the studied diagnosis. The evaluation of the responses was based on four different aspects: efficiency, trend, false positive rate and false negative rate. Only three were selected and composed the final sample for the development of the second stage of the study.

After the diagnostic nurse participants were selected for the second stage of the study, they received the 100 spreadsheets containing the medical history and a list of the defining characteristics of the nursing diagnosis studied, with their presence or absence marked in the first stage. With this, based on the inventory of defining characteristics listed above for each patient and through clinical rational and diagnostic experience, the three diagnostic nurses judged the presence or absence of excess fluid volume in the patients investigated.

Subsequently, in order to verify the correlation between the three diagnostic nurses regarding the presence or absence of the excess fluid volume nursing diagnosis, the response of each diagnostician was compared and, when in disagreement, the decision of the majority was established, considering the diagnosis present when two of the three diagnosticians identified it. This stage of the study took place between August and September 2013.

Data were analyzed based on descriptive and inferential statistics, using the IBM SPSS Statistic, version 19.0, program, calculating the relative and absolute frequencies. To investigate the accuracy of the defining characteristics of the diagnosis, the measures of sensitivity, specificity, and negative and positive

predictive values were calculated based on the inference of the occurrence of the diagnosis studied, using a 80% cutoff point for the defining characteristics, with the results above this point considered relevant. The positive and negative likelihood ratio and Diagnostic Odds Ratio (DOR) were also calculated to verify the statistical significance of each defining characteristic.

Sensitivity (Se) represents the probability of correct identification of a clinical indicator in patients with the nursing diagnosis. For its calculation the following formula was used: Se = a/ a + c. Specificity (Sp) is the probability of correct identification of the absence of an indicator in a patient without the nursing diagnosis. For its calculation the following formula was used: Sp = d/ b + d. Table 1 shows the calculation of the accuracy of the characteristics of a diagnosis[1].

Table 1 - Data for calculating the diagnostic accuracy of a clinical indicator. Fortaleza, CE, Brazil, 2012

Clinical indicator	Nursing diagnosis		Total
	Present	Absent	
Present	a*	b†	a + b‡
Absent	c§	d‖	c + d¶
Total	a + c**	b + d††	a + b + c + d

*a = True positives
†b = False positives
‡a + b = number of positive results
§c = False negatives
‖d = True negative
¶c + d = number of negative results
**a + c = number of individuals with the diagnosis
††b + d = number of individuals without the diagnosis

It should be highlighted that the judgment conducted regarding the presence and absence of the diagnosis was established by the diagnostic nurses in the second stage of the study. From the presence and absence of the diagnosis and defining characteristics, the accuracy could be calculated, as previously shown.

The performance of the study was approved by the Research Ethics Committee of the institution responsible through authorization No. 148.428, under the Certificate of Presentation for Ethical Assessment (CAAE) No. 08696212.7.0000.5537.

Results

A total of 100 patients undergoing hemodialysis were evaluated, the majority (52%) were female, 50% of brown skin color, 57% with partners and 55% retired. The mean age was 51.1 years (± 16.5), with a median of 48 months of kidney disease and 28 months undergoing treatment.

The excess fluid volume diagnosis was present in the majority of the sample (82%), in the remaining 18% of the sample the diagnosis was found to be absent. The frequencies of the defining characteristics present in the sample were: azotemia (100%), decreased hematocrit (96%), altered electrolytes (88%), intake exceeds output (88%), anxiety (85%), edema (81%), decreased hemoglobin (73%), oliguria (63%), blood pressure changes (52%), increased central venous pressure (47%), positive hepatojugular reflex (46%), restlessness (44%), weight gain (42%), pulmonary congestion (42%), adventitious breath sounds (40%), jugular vein distension (38%), orthopnea (30%), dyspnea (25%), changes in mental status (19%), pleural effusion (15%), anasarca (8%), change in respiratory pattern (4%), and S_3 heart sound (2%).

Regarding the diagnostic accuracy of the defining characteristics of the excess fluid volume diagnosis, the characteristic with greater sensitivity was edema (92.62%), with statistically significant likelihood values and DOR. The defining characteristics altered electrolytes and intake exceeds output, although within the 80% cutoff point (91.46%), need to be evaluated cautiously, as the positive likelihood ratio was not statistically significant, including the value one in their confidence intervals.

Furthermore, although the characteristics decreased hematocrit, anxiety and azotemia presented sensitivities within the cutoff point established, they did not present statistically significant likelihood values and DORs, therefore, they were not considered important characteristics to identify of the diagnosis studied.

Among the 23 defining characteristics, three revealed specificity for the excess fluid volume diagnosis, these being: pulmonary congestion, adventitious breath sounds and restlessness. In addition to high specificity, they presented statistically significant likelihood values and DORs.

Anasarca, weight gain and change in respiratory pattern presented specificity and positive predictive values of 100%. However, these should be treated with caution, considering the inability to determine their positive likelihood values and DORs.

The characteristics S_3 heart sound, jugular vein distention, pleural effusion, dyspnea and change in mental status, despite having high specificity, above the cutoff, were not considered good characteristics in this study due to lack of statistically significant likelihood ratios and DORs. These data are presented in Table 2.

Table 2 – Measures of accuracy of the defining characteristics of the excess fluid volume nursing diagnosis, in patients undergoing hemodialysis. Natal, RN, Brazil, 2014

Defining characteristics	Se*	Sp†	PPV‡	NPV§	PLR‖ (95% CI)	NLR¶ (95% CI)	DOR** (95% CI)
Restlessness	50.00	83.33	93.18	26.78	3.00(1.04-8.61)	0.60(1.04-8.61)	5.00(1.34-18.58)
Anasarca	9.75	100.00	100.0	19.56	-	0.90(0.84-0.96)	-
Anxiety	87.80	27.77	84.70	33.33	1.21(0.90-1.63)	0.43(0.17-1.12)	2.76(0.81-9.42)
Azotemia	82.00	-	-	-	-	-	-
Pulmonary congestion	50.00	94.44	97.61	29.31	9.00(1.32-61.2)	0.52(0.41-0.67)	17.00(2.16-133.74)
Pleural effusion	15.85	88.88	86.66	18.82	1.42(0.35-5.77)	0.94(0.78-1.14)	1.50(0.30-7.35)
Dyspnoea	28.04	88.88	92.00	21.33	2.52(0.65-9.75)	0.80(0.65-1.00)	3.11(0.66-14.64)
Jugular vein distension	42.68	83.33	92.10	24.19	2.56(0.88-7.41)	0.68(0.52-0.90)	3.72(1.00-13.86)
Edema	92.68	72.22	93.82	68.42	3.33(1.58-7.04)	0.10(0.04-0.23)	32.93(8.75-123.85)
Altered electrolytes	91.46	27.77	85.22	41.66	1.26(0.94-1.69)	0.30(0.10-0.85)	4.12(1.13-14.96)
Weight gain	51.21	100.0	100.00	31.03	-	0.48(0.39-0.60)	-
Decreased hematocrit	96.34	5.55	82.29	25.00	1.02(0.90-1.14)	0.65(0.07-5.97)	1.54(0.15-15.81)
Decreased hemoglobin	75.60	38.88	84.93	25.92	1.23(0.83-1.82)	0.62(0.31-1.25)	1.97(0.67-5.77)
Intake exceeds output	91.46	27.77	85.22	41.66	1.26(0.94-1.69)	0.30(0.10-0.85)	4.12(1.13-14.96)
Change in mental status	19.51	83.33	84.21	18.51	1.17(0.38-3.59)	0.96(0.76-1.21)	1.21(0.31-4.69)
Blood pressure changes	54.87	61.11	86.53	22.91	1.41(0.76-2.60)	0.73(0.47-1.14)	1.91(0.67-5.42)
Change in respiratory pattern	4.87	100.00	100.00	18.75	-	0.95(0.90-0.99)	-
Oliguria	65.85	50.00	85.71	24.32	1.31(0.80-2.14)	0.68(0.39-1.18)	1.92(0.68-5.40)
Orthopnea	32.92	83.33	90.00	21.42	1.97(0.67-5.80)	0.80(0.62-1.03)	2.45(0.65-9.21)
Increased central venous pressure	51.21	72.22	89.36	24.52	1.84(0.85-3.99)	0.67(0.47-0.97)	2.73(0.89-8.35)
Positive hepatojugular reflex	48.78	66.66	86.95	22.22	1.46(0.73-2.91)	0.76(0.52-1.13)	1.90(0.65-5.56)
Adventitious breath sounds	47.56	94.44	97.50	28.33	8.56(1.25-58.29)	0.55(0.43-0.70)	15.41(1.95-121.31)
S_3 heart sound	1.21	94.44	50.00	17.34	0.21(0.01-3.34)	1.04(0.93-1.17)	0.20(0.01-3.52)

*Se = Sensitivity
†Sp = Specificity
‡PPV = Positive predictive value
§NPV = Negative predictive value
||PLR= Positive likelihood ratio
¶NLR = Negative likelihood ratio
**DOR = Diagnostic Odds Ratio

Discussion

Regarding the prevalence of the diagnosis investigated, 82% of the patients undergoing hemodialysis presented excess fluid volume. According to the literature, patients with CKD have higher chances of presenting this diagnosis, due to fluid overload and uremic syndrome, inherent in impaired renal function[6-7,10]. In this way, fluid overload is a problem present in these patients and is related to factors that endanger the lives of the patients affected[11-13].

Studies reveals that fluid overload is associated with increased risk of death from cardiovascular disease and lower survival, due to its effects on systemic arterial pressure and overload of volume in the heart, and can accelerate the progression of decline in renal function[12,14]. Therefore, in view of the impact of fluid retention, the relevance of its control can be perceived. However, studies show that it is very difficult for patients to follow the recommended restrictions for water control. Evidence shows that measures of encouragement provided by health professionals involved in the dialysis treatment have significant association with improved adherence to the therapeutic control[15].

Regarding the frequency of the defining characteristics of the diagnosis studied, those that obtained a frequency above 50% in the population were highlighted: azotemia, decreased hematocrit, altered electrolytes, intake exceeds output, anxiety, edema, decreased hemoglobin, oliguria and blood pressure change.

Among these, despite not being the characteristic with the highest prevalence rate, edema presented the most sensitivity for the occurrence of the excess fluid volume diagnosis (92.68%). In contrast to the results observed in this study, it should be noted that another study found that the isolated analysis of this characteristic had limited value in the diagnosis of excess fluid, however, its detection is of paramount importance, being independently associated with left ventricular hypertrophy and indirectly with systolic hypertension. Thus, the recognition of this physical sign can assist in

the identification of cardiovascular risk factors, relevant in predicting mortality in dialysis patients[16].

Regarding the characteristics specific to the excess fluid volume diagnosis, pulmonary congestion was identified. It is known that the overload of body fluid can cause impairment of pulmonary function for CKD patients, due to a possible increase in intravascular pressure in the lungs, in addition to increased pulmonary capillary permeability, and is associated with pulmonary congestion and adventitious breath sounds. It should be noted that, pulmonary congestion is a major cause of hospitalization of patients undergoing hemodialysis and is associated with excessive consumption of fluids and foods high in sodium[17].

An international study revealed that pulmonary congestion in chronic renal failure patients undergoing hemodialysis is an insidious and very present problem and, although there is a reduction of congestion after the dialysis, approximately one third of patients still presents accumulation of fluid after the treatment. The study also highlights that the existence of congestion in these patients is associated with poor physical performance[18] and is a strong predictor of death and cardiovascular events[19]. Patients with very severe pulmonary congestion have a 4.2 times higher risk of death and 3.2 times higher risk of cardiac events[20].

The clinical indicator restlessness, also considered specific to the diagnosis studied, could be explained due to respiratory distress caused by the pulmonary congestion identified in the renal patients, decreasing hematosis, with consequent reduction in the amount of oxygen carried to the muscles and brain. However, the literature cites increased calcium in the body as the cause of restlessness[21], a common problem in the clientele undergoing hemodialysis.

It should also be noted that in this study, the characteristics azotemia, decreased hematocrit, altered electrolytes, intake exceeds output, anxiety, decreased hemoglobin, oliguria and blood pressure changes, despite presenting high prevalence in the sample studied, were not identified as accurate characteristics to establish the presence of excess fluid volume.

This result has a significant importance, particularly in relation to the characteristics azotemia, decreased hematocrit, decreased hemoglobin and anxiety, since the occurrence of these, according to the literature, is independent of the presence of excess fluids, occurring due to factors inherent to the kidney disease itself[22-23].

In contrast, the characteristics altered electrolytes, intake exceeds output, oliguria and blood pressure change, although not identified as accurate, present a theoretical relationship with excess fluid volume. Regarding altered electrolytes, it is known that increased dietary sodium intake predisposes to greater fluid intake and promotes the development of hypertension in these patients. Therefore, the daily intake of less than two grams of sodium is recommended. However, the literature reveals that this recommendation has low adherence for these individuals[24].

Finally, oliguria is commonly present in renal patients undergoing hemodialysis, because of the inefficiency of the renal system to filter the nitrogen excreta and liquids, which influences the retention of these substances, and decreases urine produced per day. One investigation showed that urinary excretion below 0.3 ml/kg/h, over an observation period of less than five hours, leads to a high risk of mortality[25].

Given the above, it is emphasized that patients with CKD are susceptible to developing excess fluid volume and present signs and symptoms that allow an accurate identification of the diagnosis, therefore, the clinical applicability of this study is focused on the correct diagnostic choice made by nurses, when they have this information.

A limitation in the development of this study was the fact that the study was carried out with a specific population, chronic renal failure patients undergoing hemodialysis, limiting the generalization of the results to similar populations only. Thus, diagnostic accuracy studies should be encouraged for other populations, considering that research on this topic will increase the scientific nursing knowledge and assist in the clinical practice.

Conclusion

From this study it was found that edema was the more sensitive defining characteristic for the excess fluid volume nursing diagnosis. Regarding specificity for this diagnosis, three characteristics were highlighted: pulmonary congestion, adventitious breath sounds and restlessness. These indicators presented statistically significant likelihood values and DORs.

The defining characteristics identified as accurate in this study can assist nurses in the excess fluid volume diagnostic inference process in patients undergoing hemodialysis, enabling greater security in the choice of diagnosis. The benefits generated for patients with CKD should also be mentioned, as by identifying the characteristics considered accurate for the excess fluid

volume diagnosis, the results and interventions will present a greater chance of correct targeting and efficacy.

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