



REVISIONES

Impaired physiological equilibrium syndrome in potential organ donors: identification of defining characteristics

Síndrome do equilíbrio fisiológico prejudicado em potenciais doadores de órgãos: identificação de características definidoras

Síndrome del equilibrio fisiológico deteriorado en potenciales donantes de órganos: identificación de las características definitorias

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ABSTRACT:

Introduction: Most of nursing diagnoses for potential organ donors is related to physiological changes. These patients often have all diagnoses cited for this population. However, *NANDA International* does not have a diagnosis to address this acute condition.

Objective: To identify possible defining characteristics for the diagnosis of *impaired physiological equilibrium syndrome* for brain death patients and for potential organ donors in the literature.

Method: Integrative literature review including articles published between 1997 and 2017 in the databases Web of Science, LILACS and PubMed.

Results: The sample consisted of 37 articles identifying 44 possible defining characteristics for the nursing diagnosis to be developed. The defining characteristics were divided into five major groups of changes: endocrine-metabolic changes, hemodynamic and/or cardiovascular changes, ventilatory changes, nutritional changes, coagulation changes, inflammatory and/ or immune changes.

Conclusions: Developing this diagnosis can collaborate to the taxonomy of *NANDA International*, as well as to extend the nursing knowledge of the area of maintenance of the potential organ donor, contributing to teaching and research. The practical use of this diagnosis purpose can provide a better systematization of care, enabling the proper maintenance of the potential organ donor and consequently improving the viability of organs for transplantation.

Keywords: Nursing diagnosis; Procurement of tissues and organs; Organ transplantation; Classification.

RESUMO:

Introdução: A maior parte dos diagnósticos de enfermagem prevalentes para potenciais doadores de órgãos está relacionada com alterações fisiológicas. Não raro estes pacientes apresentam todos os diagnósticos citados para esta população. Todavia, não existe na NANDA *International* um diagnóstico único que aborde este quadro agudo.

Objetivo: Identificar na literatura possíveis características definidoras para a proposta de diagnóstico *Síndrome do equilíbrio fisiológico prejudicado* para pacientes em morte encefálica e potenciais doadores de órgãos.

Método: Revisão integrativa da literatura incluindo artigos publicados entre 1997 e 2017 nas bases de dados Web of Science, LILACS e PubMed.

Resultados: A amostra foi constituída por 37 artigos identificando 44 possíveis características definidoras para o diagnóstico de enfermagem em desenvolvimento. As características definidoras foram divididas em cinco grandes grupos: alterações endócrino-metabólicas, alterações hemodinâmicas e/ou cardiovasculares, alterações ventilatórias, alterações nutricionais e alterações de coagulação, inflamatórias e/ou imunológicas.

Conclusões: O desenvolvimento deste diagnóstico pode colaborar com a qualificação da taxonomia da NANDA *International*, além de ampliar o conhecimento da enfermagem na área de manutenção do potencial doador de órgãos contribuindo para o ensino e pesquisa. O uso desta proposta de diagnóstico na prática pode proporcionar uma melhor sistematização do cuidado, auxiliando a adequada manutenção do potencial doador e consequentemente melhor viabilidade dos órgãos ofertados para transplantes.

Palavras-chave: Diagnóstico de Enfermagem; Obtenção de Tecidos e Órgãos; Transplante de Órgãos; Classificação.

RESUMEN:

Introducción: La mayor parte de los diagnósticos de enfermería sobre los potenciales donantes de órganos están relacionados a alteraciones fisiológicas. Es común que estos pacientes presenten todos los diagnósticos citados para esta población. Pero todavía no existe en NANDA *International* un diagnóstico único que sea capaz de plantear este severo caso.

Objetivo: Identificar en la literatura las posibles características definitorias para la propuesta de diagnóstico *Síndrome del equilibrio fisiológico deteriorado* en pacientes con muerte encefálica y potenciales donantes de órganos.

Método: Revisión integrativa de la literatura con estudios publicados entre el 1997 y el 2017 en las bases de datos Web of Science, LILACS y PubMed.

Resultados: La muestra constó de 37 artículos, de los cuales se identificó 44 posibles características distintas para el diagnóstico de enfermería en desarrollo. Se dividieron las características definitorias en cinco grupos principales: alteraciones endocrino-metabólicas; alteraciones hemodinámicas y/o cardiovasculares; alteraciones respiratorias; alteraciones nutricionales y alteraciones de la coagulación, inflamatorias e/o inmunológicas.

Conclusiones: El desarrollo de este diagnóstico puede colaborar con la calificación de la taxonomía de NANDA *Internacional*, así como ampliar el conocimiento de la enfermería en el campo de mantenimiento del posible donante de órganos, lo que contribuye a la enseñanza e investigación. El empleo de este diagnóstico puede mejorar la sistematización del cuidado, auxilia en el mantenimiento del potencial donante y, en consecuencia, mejora la viabilidad de órganos para trasplante.

Palabras clave: Diagnóstico de Enfermería; Obtención de Tejidos y Órganos; Trasplante de Órganos; Clasificación.

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INTRODUCTION

In the global scene of organ donation, Spain ranks first with an actual donor rate of 43.4 per million population (pmp), while Brazil ranks 28th with a rate of 14.6 actual donors pmp. In December 2017, 32,402 people were waiting for organ transplants in Brazil. In the same year, 10,629 potential donors were notified by the Brazilian National Transplant Center, but only 3,415 (32%) became effective donors, i.e. had at least an organ removed. Nationally, it is estimated that only about 40% of the annual need for kidney transplants is fulfilled; and for liver transplants, 30%⁽¹⁾.

The literature points to the failure when managing the actual donor as one of the reasons for not concluding the donation, for the disposal of organs or for transplantation of neighboring organs. Thus, performing the transplant and decreasing the wait list is not possible at times, which also produces unnecessary costs to the public system and health institutions, and affect the patients' quality of life^(2,3). In view of this, special cares for the potential donor are necessary to preserve the viability of the organs, since any malfunction can compromise the viability of the organs⁽⁴⁾.

Inefficiency of the systematization of the care for potential donors in intensive care units (ICUs) is reported in the literature. The absence of a specific protocol or of its implementation for proper maintenance is pointed, which interferes with the homogeneity of the interventions. The systematization of care for this patient is associated with the increased number of organs transplanted, the reduced loss of donors due to cardiovascular collapse, and the increased posttransplantation survival, since the viability of the organs is improved⁽⁵⁾.

The application of the nursing process (NP) in the maintenance of the potential organ donor can help in the proper care for this patient. The use of NP guides nurses in the practice and provides a bases to a systematic care process. The use of standardized language systems in the steps of diagnosis, intervention and results of nursing encourages critical thinking and clinical reasoning of nurses contributing, thus, to the monitoring of the care quality. The taxonomy of NANDA International (NANDA-I), which includes nursing diagnoses (ND), is one of the most known and used in several countries, including in Brazil⁽⁶⁻⁸⁾.

A ND consists of title, definition, related or risk factors, and defining characteristics (DCs), in addition to a numeric code to be used in computer systems. The DCs are clues/inferences that can be observed and group as a manifestation of ND (for example, signs or symptoms). In the edition NANDA-I 2018-2020, two new categories of clinical indicators for most NDs that cannot be independently modified by nurses were included. The so-called risk populations are groups of people who share some characteristic making each member be susceptible to a particular human response. In turn, the conditions associated are medical diagnoses, procedures, medicines, among others⁽⁹⁾.

Studies showing the prevalent NDs for potential organ donors or for patients with brain death (BD) are scarce, despite the relevance of the topic. The most prevalent NDs identified in some studies were: *Hypothermia, risk for deficient fluid volume, risk for decreased cardiac output, decreased cardiac output, ineffective airway clearance, impaired gas exchange, impaired bed mobility, risk for unstable blood glucose level, risk for bleeding, risk for infection and decreased intracranial adaptive capacity*^(10, 11).

The most prevalent NDs for potential organ donors or BD patients is related to physiological changes. These patients often have all the NDs cited for this population. However, the NANDA-I does not have a ND addressing this acute condition, because, if a list of NDs is very long, it hinders the prioritization of the interventions required for achieving the desirable results. Among the types of ND from NANDA-I, a syndrome may be present, being defined as "a clinical judgement related to a group of NDs occurring together, being more well-treated together through similar interventions"⁽⁹⁾.

In view of this, the ND whose title is impaired *physiological equilibrium syndrome* is being created. The definition of this ND is: "*State of impaired physiological equilibrium*

syndrome that triggers a set of endocrine-metabolic symptoms, as well as hemodynamic, cardiovascular, ventilatory, nutritional, coagulation, immune and/or inflammatory changes that compromise the health and/or the organ functions".

Thus, the construction of this ND for this specific clinical condition and its future implementation in practice encourages the diagnostic accuracy and consequently the deployment of an adequate care plan that contributes to the improvement of the viability of organs for transplants, decreasing disposals and the use of neighboring organs resulting from failure when managing the potential donor. The decreased organ disposal and the use of neighboring organs reduce unnecessary costs to the public system and health institutions and the waiting list for transplants, improving the transplanted person's quality of life.

OBJECTIVE

To identify possible DCs for the diagnosis of *impaired physiological equilibrium syndrome* for brain death patients and for potential organ donors in the literature.

METHOD

This is an integrative review of the literature (IRL) aimed at identifying the possible DCS of the developing nursing diagnosis. The IRL aims to synthesize and compare the data to develop a more comprehensive explanation of a specific phenomenon. The IRL has five steps: problem formulation, data collection, data evaluation, analysis and interpretation of data, and presentation of results⁽¹²⁾. A protocol for this IRL was created with the five steps to characterize this study. This protocol was evaluated and validated by two nurses (not researchers of this study) with expertise in the subject and methodology of the study. Nurses assessed the steps of the IRL and gave suggestions concerning them.

Through the problem formulation the most important aspects to be considered in the study are defined⁽¹²⁾. The problem of this study is: "How do we do to establish the DCs of the proposal of *ND impaired physiological equilibrium syndrome*?". Based on the problem formulation, the leading question was: "Which conditions/clinical events determine the physiological change in BD patients and potential organ donors?".

Data were collected through the search of articles published in the last 20 years (from 1997 to 2017) in Portuguese, Spanish and English. The time frame was set based on the publication of the organ transplant law in 1997⁽¹³⁾. Web of Science, PubMed and LILACS were the electronic databases consulted using the Health Sciences Descriptors (DeCs) and Medical Subject Headings (MeSH) with Boolean operators. "Brain death" OR "tissue donors" OR "tissue and organ procurement" OR "tissue and organ harvesting" AND "nursing diagnosis" OR "signs and symptoms" OR "hemodynamics" OR "monitoring physiologic" OR "endocrine metabolic management" were the descriptors/MeSh used. To preserve the accuracy in the collection and evaluation of data, these steps were performed independently by two researchers. When the results diverged, a third researcher evaluated these data.

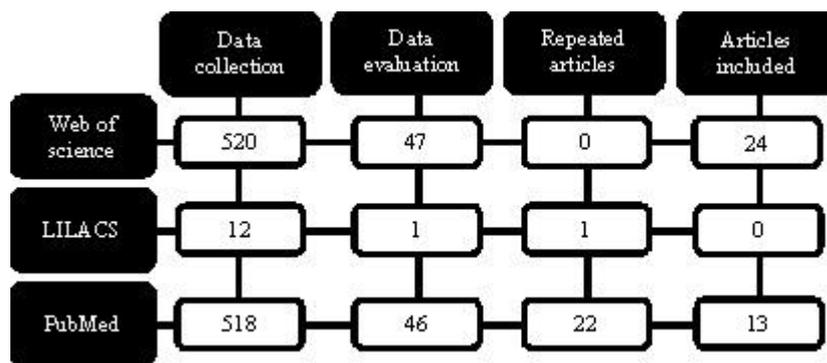
In the data evaluation step, articles were selected based on their title and abstract, and then fully analyzed to answer the leading question of this study. Inclusion criteria were: studies that answer the leading question and full availability online. Exclusion criteria

were: graduation work and monographs, dissertations and theses; format of publication such as research reports, letters, editorials, books, reviews, government publications (ordinances, laws and others); experimental studies with animals; publications in journals whose impact factor (IF) is lower than 0.5; and non-systematic literature reviews published in journals whose IF is lower than 1.0. Articles found in more than one database were analyzed only once. In this step, a data collection form was filled. The variables database, journal and country, impact factor, year of publication, authors and country, title, objective, method, and conditions/clinical events determining the physiological change were in the form.

In the analysis and interpretation of data, the information from the data collection form were synthesized in a summary table. Through the summary table, the data were evaluated critically to answer the leading question of this study. In addition, the convergences or divergences were highlighted, allowing discussing the results of the studies selected for the sample⁽¹²⁾. The conditions/clinical events found in the IRL were related to possible DCs of the ND proposed.

Figure 1 outlines the process of selection of articles in the databases consulted, the number of articles that responded to the leading question and the number of items selected according to the criteria for inclusion and exclusion.

Figure 1: The selection of the articles in databases. Porto Alegre, RS, Brazil, 2017.



RESULTS

The sample of IRL consisted of 37 articles that answered the leading question and met the criteria for inclusion and exclusion of the study. **Box 1** shows the sample characterization.

Box 1: Sample characterization. Porto Alegre, RS, 2017.

Author/ Year of publication	Authors and origin	IF	Title	Objective	Study design
Intensive Care Med. 2015	Al-Khafaji A, et al. USA	12.015	Protocolized fluid therapy in brain-dead donors: the multicenter randomized MOnIToR trial	To determine whether fluid protocolized therapy would increase organs transplanted and improve survival in the recipients compared with usual care.	Randomized controlled clinical trial
Eur J Cardiothorac Surg 2015	Abuanzeh R, et al. United Kingdom	3.759	Early donor management increases the retrieval rate of hearts for transplantation in	To investigate whether early donor management of marginal donor hearts can increase the retrieval rate without affecting the	Retrospective observational study

			marginal donors	posttransplantation outcome for the recipients.	
Br J Anaesth. 2014	Dupuis S, et al. Canada	6.238	Corticosteroids in the management of brain-dead potential organ donors: a systematic review	To assess the clinical efficacy and safety of corticosteroids in brain-dead potential organ donors.	Systematic review
Crit Care 2014	Pinsard M, et al. France	5.358	Interest of low-dose hydrocortisone therapy during brain-dead organ donor resuscitation: the CORTICOME study	To demonstrate that systemic administration of low-dose steroids during resuscitation of brain-dead donors makes vasopressor weaning possible in 25% of patients and decreases by more than 15% of the quantity of vasopressors needed to control circulatory failure.	Case-control
Transplant 2014	Kotfis K, et al. Poland	0.908.	Influence of the hemodynamic status of donors dysregulation on long-term kidney graft survival: The multivariable analysis	To evaluate the influence of the cardiovascular dysregulation donors on the status of long-term kidney graft survival over a 15-year observation period.	Retrospective observational study
Transplantation 2013	Rech TH Brazil	3.678	Management of the brain-dead organ donor: A systematic review and meta-analysis.	To assess the efficacy of interventions to stabilize hemodynamics in brain-dead donors or to improve organ function and outcomes of transplantation.	Systematic review and meta-analysis
Int J Organ Transplant Med 2013	Nozary Heshmati B, et al. Iran	0.980.	Hemodynamic factors affecting the suitability of the donated heart and kidney for transplantation	To investigate the suitability of hemodynamic factors affecting the heart and kidney donated for transplantation.	Retrospective observational study
Crit Care Med 2012	Malinoski DJ, et al. USA	7.050	The impact of meeting donor management goals on the number of organs transplanted per donor: results from the United Network for Organ Sharing Region 5 prospective study of donor management goals	To evaluate the impact of donor meeting management goals at several time points during the organ donation on the number of organs transplanted per donor and to identify any additional factors that may significantly impact organ utilization rates.	Randomized controlled clinical trial
Transplant Rev 2012	Floerchinger B, et al. USA and Germany	3.113	Effects of brain death on organ quality and transplant outcome	This overview presents the current understanding of the pathophysiology and consequences of brain death on organ injury, and summarizes available therapeutic interventions.	Literature review
Clin Transplant 2012	Piazza O, et al. Italy	1.865	Terlipressin in brain-death donors	Pharmacology and literature about the use of	Case study

				terlipressin in shock and particularly in neurogenic shock following brain death is summarized, and our personal experience is reported.	
Clin Transplant 2012	Yang HY, et al. China	1.865	Experience of heart transplantation from hemodynamically unstable brain-dead donors with extracorporeal support	To review the medical records of five brain-dead potential donors who presented hemodynamic instability despite maximal medical management supported by extracorporeal circulation membrane oxygenation (ECMO). The outcomes of heart recipients were reviewed.	Case study
Crit Care Res Pract 2012	Rzheutskaya RE. Belarus	0.710	Characteristics of hemodynamic disorders in patients with severe traumatic brain injury	To define specific features of central hemodynamic parameter changes in patients with isolated severe traumatic brain injury and in patients with isolated severe traumatic brain injury and clinically established brain death, and to determine the required course of treatment for their correction.	Case-control
J Clin Anesth 2011	Nakawaga K, Tang JF. USA	1.677	Physiological response of human brain death and the use of vasopressin for successful organ transplantation	To describe the human physiology of the cushing reflex after severe traumatic brain injury followed by progressive refractory hypotension to phenylephrine, which was responsive to vasopressin during the wait for organ procurement.	Case study
J Crit Care 2010	Robert R, et al. France	2.648	The pair analysis of the delayed graft function in kidney recipient: the critical role of the donor	To analyze the importance of donor factors and especially the potential role of hemodynamic management regarding delayed graft function in kidney recipient paired patients after renal transplantation and to analyze the urine of organ donors by proton nuclear magnetic resonance spectroscopy to identify urine markers potentially correlated with delayed graft function in recipient patients.	Prospective observational study
Transplant Proc 2010	Grigoras I, et al. Romania	0.908.	Functional improvement	The time frame between brain death (BD)	Retrospective observational

			between brain death declaration and organ harvesting	declaration and organ harvesting (BD duration) varies widely with conflicting data reported about functional evolution during BD duration. We investigated the evolution of the functional status of BD patients during this interval.	study
Transplant Proc 2010	Vecchiarelli P, Ricci F. Riccini T. Italy	0.908.	Terlipressin as rescue therapy in catecholamine-resistant hypotension in solid organ donors: a case report	To report the effects of terlipressin treatment in 2 potential organ donors with intractable, catecholamine-resistant hypotension.	Case study
Anesthesiology 2010	Nicolas-Robin A, et al. France	5.660	Hydrocortisone supplementation enhances hemodynamic stability in brain-dead patients	To investigate the benefit of supplementary-dose hydrocortisone in brain-dead patients in hemodynamic instability and decreasing norepinephrine requirements.	Prospective observational study
Clin Transplant 2009	Dictus C, et al. Germany	1.865	Critical care management of potential organ donors: our current standard	In this review, we discuss the pathophysiological functions changes associated with brain death and present the current guidelines at our department, which are optimized based on the literature available.	Literature review
Acta Anaesthesiol Scand 2009	Bugge JF. Norway	2.438.	Brain death and its implications for management of the potential organ donor	This review elucidates these physiological changes and their consequences, and based on these consequences the rationale behind current medical management of brain-dead organ donors is discussed.	Literature review
European Heart Journal 2009	Venkateswaran RV, et al. United Kingdom	20.212	The hemodynamic effects of adjunctive hormone therapy in potential heart donors: a prospective randomized double-blind factorially-designed controlled trial	To assess the hemodynamic effects of triiodothyronine (T3) and methylprednisolone in potential heart donors.	Randomized controlled clinical trial
Acta Anaesthesiol Scand 2009	Barklin A. Denmark	2.438.	Systemic inflammation in the brain-dead organ donor	To discuss the risk factors associated with brain death in general and the inflammatory response in specific organs.	Literature review
Kidney International 2006	Dahmane D, et al. France	8.395	Retrospective follow-up of transplantation of kidneys from	To compare the fate of transplants performed with kidneys, defined by their	Case-control

			'marginal' donors	secondary acceptance by centers after primary refusal by two or more other transplant centers, with the outcome of transplantation performed with 'optimal kidneys' directly accepted by centers.	
Crit Care Med 2006	Mascia L, et al. Italy	7.050	Ventilatory and hemodynamic management of potential organ donors: an observational survey	To determine the current ventilatory and cardiovascular management standard in potential organ donors.	Prospective observational study
Intensive Care Med 2005	Pérez-Blanco A, et al. Spain	12.015	Efficiency of triiodothyronine treatment on organ donor management and adenine nucleotide concentration hemodynamic	We compared hemodynamic values, oxygen utilization, and adenine nucleotide concentration in the extracted organs of brain-dead donors treated with triiodothyronine vs. standard support treatment.	Randomized controlled clinical trial
J Heart Lung Transplant 2004	de Perrot M, et al. Canada, Australia and USA	7.114	Strategies to optimize the use of currently available lung donors	To review the current approach to optimize lung donor management, and to present the potential expansion capacity of the lung donor pool if the donor selection criteria are revised.	Literature review
Clinical Nutrition 2004	Singer P, et al. Israel	4.548	Effect of triiodothyronine replacement therapy on maintenance characteristics and organ availability in hemodynamically unstable donors	To determine the safety and tolerance of intravenous administration of fish-oil emulsion to heart-beating brain-dead donors and, subsequently, to the kidney recipients, and to assess its effects on renal function.	Case-control
N Engl J Med 2004	Wood KE, et al. USA	72.406	Care of the potential organ donor	To present a structured approach to the key issues for the clinicians involved in the care of the brain-dead organ donor.	Literature review
Transplant Proc 2003	Grauhan O. Germany	1.024	Criteria for the assessment of the donor heart	To report factors from donor in brain death that can initiate about poor prognosis to the receiver.	Literature review
Curr Probl Surg 2003	Tuttle-Newhall JE, et al. USA	2.955	Organ donation and treatment of the multi-organ donor.	To report pathophysiological changes of potential donor organs in brain death.	Literature review
J Heart Lung Transplant 2002	Stoica SC, et al. United Kingdom	7.114	Swan-Ganz catheter assessment of donor hearts: outcome of organs with borderline	To determine the outcomes of patients who received borderline and sub-optimal donor hearts in recent years at our institution.	Case-control

			hemodynamics		
Transplant Proc 2001	Della Rocca G, et al. Italy	0.908.	Volumetric monitoring in donor and related dysregulation lung transplant recipients	The study aimed at the optimization of ITBVI (800 to 1000 mL/m ²) with preservation of lung function (.10 EVLWI mL/kg) in the donor dysregulation, investigating the correlation between donors' and recipients' EVLWI and PaO ₂ /FiO ₂ .	Randomized controlled clinical trial
Transplant Proc 2000	Roels L, et al. Belgium	0.908.	Effect of triiodothyronine replacement therapy on maintenance characteristics and organ availability in hemodynamically unstable donors	To report our experience with the effect of hormonal substitution therapy in hemodynamically unstable donors on their hemodynamic changes, their need for inotropic support, and the ultimate organ yield from these donors.	Retrospective observational study
World J Surg 1999	Jenkins DH, Reilly PM, Schwab CW USA	2.673	Improving the approach to organ donation: a review	To report improvement on the approach in the organ donation	Literature review
Circulation 1999	Chen JM, et al. USA	13.965	Vasopressin deficiency and pressor hypersensitivity in hemodynamically unstable organ donors	To assess the shortcoming of vasopressin exogenous at low concentration to avoid the inappropriate use of catecholamines.	Cohort study
Transplant Proc 1997	Szostek M, et al. Poland	0.908.	Influence of thyroid function in brain stem death donors on kidney allograft function	To correlate the biochemical changes in thyroid hormones with hemodynamic stability of these patients and renal allograft function after transplantation.	Prospective observational study
Transplant Proc 1997	Bohatyrewicz FL, et al. Poland	0.908.	Hemodynamic heterogeneity of multiorgan donors in Poland	We investigated whether there are any differences in hemodynamic parameters in multiorgan donors referred to the national organization, Poltransplant, from the Cardiac Transplantation Center, experienced in cardiovascular management, and the centers from the rest of Poland.	Case-control
Transplant Proc 1997	delaTorre NA, et al. USA	0.908.	Influence of donor base deficit status on recipient outcomes in liver transplantation	We hypothesized that donor base deficit values, as a measure of end organ perfusion, predict early liver graft function and recipient outcome.	Retrospective observational study

It is observed that 23 articles of the sample (59%) are by authors from Europe, followed by North America with 11 (28%), in which US authors' publications predominate, being almost all of them, with 10 articles. Most of the studies are recent publications, and 12 articles (33%) were published between 2012 and 2017. Five articles (13%) have IF higher than 10.0 and, among them, journals with high IF, being 20.212 and 72.406. Regarding the study design, observing a varied sample was possible, in which studies with strong-evidence design such as systematic review/meta-analysis, randomized controlled clinical trial and cohort study totaled eight articles (22%). However, nine articles (24%) comprising the sample were non-systematic literature reviews.

The result of IRL related to the leading question "Which conditions/clinical events determine the physiological change in BD patients and potential organ donors?" highlights the potential of the possible DCs of the proposed ND *impaired physiological equilibrium syndrome for BD patients and potential organ donors*. They were categorized in five groups of physiological changes, as shown in Box 2.

Box 2: Possible DCs found in the IRL for the developing ND *impaired physiological equilibrium syndrome* for BD patients and potential organ donors (n=37). Porto Alegre, Brazil,

Possible defining characteristics	f (%)
Endocrine-Metabolic changes	
Endocrine regulatory dysfunction (for example: cortisol deficiency, thyroid hormones, vasopressin, insulin)	22 (59)
Diabetes insipidus	20 (54)
Altered diuresis (for example: change in volume, weight, density, sodium concentration and/or osmolarity)	20 (54)
Electrolyte imbalance	16 (43)
Hypothermia (00006)*	12 (32)
Hyperglycemia	9 (24)
Serum creatinine increased	5 (14)
Metabolic acidosis	5 (14)
Hyperthermia (00007) *	3 (8)
Respiratory alkalosis	2 (5)
Change in liver function (for example: change in GOT GPT, GGT, total bilirubin)	2 (5)
Acid-base imbalance	2 (5)
Increased blood lactate level	2 (5)
Hyperosmolarity	1 (3)
Hemodynamic and/or cardiovascular changes	
Altered blood pressure	32 (86)
Deficient fluid volume (00027) *	19 (51)
Change in mean arterial pressure (MAP)	16 (43)
Change in central venous pressure (CVP)	12 (32)
Changed heart rate	9 (24)
Change in cardiac index	6 (16)
Reduced cardiac output (00029)*	6 (16)
Systemic and/or pulmonary vascular resistance index 50% of baseline values	5 (14)
Ineffective peripheral tissue perfusion (00204)*	5 (14)

Changed heart rhythm	5 (14)
Myocardial depression	4 (11)
Decreased ejection fraction	4 (11)
Increased systemic and/or peripheral vascular resistance	3 (8)
Left ventricular stroke work index $< 15 \times g \cdot m / m^2$	2 (5)
Change in pulse pressure variation	1 (3)
Excess fluid volume (00026)*	1 (3)
Ventilatory changes	
Impaired spontaneous ventilation (00033) *	37 (100)
Decreased arterial oxygen saturation (SaO ₂)	6 (16)
Pulmonary capillary wedge pressure > 12 mmHg	6 (16)
Impaired oxygenation (PaO ₂ /FiO ₂ < 300)	5 (14)
Change in breathing pattern	2 (5)
Pulmonary congestion	2 (5)
Low blood oxygen level (PaO ₂)	1 (3)
Low oxygen extraction ratio (TeO ₂)	1 (3)
Impaired gas exchange (00030)*	1 (3)
Nutrition changes	
Anemia	2 (5)
Imbalanced nutrition: less than body requirements (00002)*	1 (3)
Coagulation, immune and/or inflammatory changes	
Inflammatory changes (for example: increase in cytokines, tumor necrosis factor (TNF) and/or $-1\beta e -6$ interleukins)	12 (32)
Coagulation changes (for example: INR, platelets, PT, aPTT)	7 (19)
Immunological changes (for example: neutrophils, T lymphocytes, basophils, macrophages)	3 (8)

* Possible DCs corresponding to NDs from NANDA-I and its respective classification code 2017.

DISCUSSION

The results of the IRL allow support the problem of this study formulated in "How do we do to establish the DCs of the proposal of ND *impaired physiological equilibrium syndrome*?" by answering the leading question "Which conditions/clinical events determine the physiological change in BD patients and potential organ donors?". The 37 articles included in the sample of this study show several physiological changes found in the patient diagnosed with BD. The studies highlight and promote the discussion of physiological and/or organic changes, from the most frequently found to the rarest ones, in BD patients and potential organ donors.

The 44 possible DCs identified in IRL for the developing ND *impaired physiological equilibrium syndrome* were divided into five major groups: Endocrine-metabolic changes, hemodynamic and/or cardiovascular changes, ventilatory changes, nutritional changes, coagulation changes, inflammatory and/ or immune changes. Choosing to categorize the DCs in these five major groups aims to facilitate the visualization of the pathophysiological variations the nursing professional may find in BD patients. The nine DCs with a numeric code on the side are already NDs from NANDA-I, which corroborates the definition of a syndrome for this classification, that is, to be composed of pre-existing NDs and of other DCs⁽⁹⁾.

In the group Endocrine-metabolic changes, the DCs endocrine regulatory dysfunction, diabetes insipidus and altered diuresis were the most frequent in the sample (>50%). Other DCs that also showed significant frequency were electrolyte imbalance (f=16; 43%) and hypothermia (f=12; 32%). BD can impair the pituitary gland, causing hormone deficiencies, and affect the central thermoregulation⁽¹⁴⁾. Thus, the literature points that among the physiological changes caused by BD in the potential organ donor are diabetes insipidus, with occurrence between 37.5 and 78%, and hypothermia, with 75%^(14, 15). Untreated diabetes insipidus causes polyuria and results in hypovolemic shock and hypernatremia⁽¹⁴⁾. Studies highlight that hypernatremia is a frequent metabolic disorder and a failure of maintenance of the potential organ donors contributing to the primary graft failure⁽¹⁶⁾.

In the group Cardiovascular and/or hemodynamic changes, the DCs altered blood pressure and fluid volume deficiency were the most frequent (>50%). Changes in MAP (f=16, 43%) and CVP (f=12; 32%) were also significant in the sample. The "autonomic storm" in BD donors initially causes hypertension, and after the initial autonomic storm, hypotension and hypovolemia are the main problems in the potential organ donor maintenance. Hypotension should be avoided as it can contribute to the rapid deterioration of organ functions. Hypotension can be treated with a combination of intravenous fluids and vasoactive drugs. Cardiovascular instability increases rapidly, after increase in the intracranial pressure, resulting in myocardial injury. Invasive monitoring of PVC and MAP should be suited to age. It also can help the control of excess fluid administration, which should be avoided, since the latter can cause pulmonary edema^(14, 17).

In the group Ventilatory changes, the only significantly frequent DC was *impaired spontaneous ventilation* (f=37; 100%). All the other DCs showed frequency <20%. *Impaired spontaneous ventilation* is a ND from NANDA-I defined as "inability to start and/or maintain independent breathing that can support life."⁽⁹⁾ This definition corroborates the etiology of BD, due to the fact that it causes inability to breathe independently and that all potential donors usually are on mechanical ventilation.

The nutritional changes in potential organ donor were not significant in the sample; however, the DCs anemia (f=2; 5%) and imbalanced nutrition (less than body requirements) (f=1; 3%) were cited. The coagulopathy, fluid administration and bleedings can cause anemia⁽¹⁸⁾. Regarding nutrition below the body's needs, the importance of nutritional evaluation for an appropriate enteral and/or parenteral diet is evident.

Coagulation, immune and/or inflammatory changes were not frequent (≤ 32%) compared with other groups as well. However, the plasminogen activator released by brain injury results in changes in coagulation (activated thromboplastin and prothrombin time and thrombocytopenia). Thus, bleeding complications may occur⁽¹⁴⁾. BD also triggers a systemic and local inflammatory response that consists of complement and endothelium activation, release of cytokines and chemokines, and flow of leukocytes to organs – which can cause tissue damage and ischemia injuries in the organs, contributing to graft rejection. Therefore, BD is similar to systemic inflammatory response syndrome⁽¹⁹⁾. In relation to immunological changes, the number of leukocytes may increase due to brain damage, systemic inflammatory state or nosocomial infection⁽¹⁴⁾.

An exploratory-descriptive qualitative study aimed to understand nursing scholars'

work when organizing the search of organs faced with the potential donor maintenance in a teaching hospital in Northeastern Brazil, promoting visibility and opportunity to evaluate the nursing practice itself. This study pointed out many care provided by these professionals and highlighted the need for specific knowledge for the care of this patient, such as BD physiological manifestations, drug therapy, as well as the need for understanding the normal physiological functioning to notice changes⁽²⁰⁾. The absence of tools and instruments for the potential organ donor maintenance and the non-use of NP and of a standardized language in the practice hinders the clinical reasoning, and may affect significantly the quality of the patient's care due to its complexity.

CONCLUSIONS

The analysis of the articles allowed answering the leading question of this study and identifying possible DCs of the developing ND entitled impaired physiological equilibrium syndrome. Studies from different parts of the world and published in journals of impact were found, which reflects the relevance of the theme.

Performing a concept analysis to increase the level of evidence of the ND is suggested, in addition to content validation by experts and clinical validation to define which are the DCs found in the literature, providing a better support and accuracy for the ND in practice and thus defining which DCs will be part of the ND.

Considering the modifications made in the NANDA-I 2018-2020, the need for analyzing which DCs are considered associated conditions and risk populations will exist. NANDA-I also recommends structuring the new ND into seven axes, including domain and class. Moreover, NANDA-I suggests listing at least two interventions from *Nursing Interventions Classification* and a result from *Nursing Outcomes Classification* linked to the ND. After all these steps, the ND will be sent for analysis of NANDA-I for publication.

A limitation of this study is the fact that the IRL was performed using only the BD as related factor and only in the context of the potential organ donor maintenance. Replication of this study with other factors specified as circulatory death is suggested, for example, with other possible patient populations in which this new proposal can be applied.

The practical use of this proposal can provide a better systematization of care, enabling the proper potential donor maintenance and consequently a better viability of the organs offered for transplantation and contributing to improving posttransplantation survival. In addition, developing this ND can contribute to the taxonomy of NANDA-I and to development of nursing knowledge in the maintenance of potential organ donors, contributing to teaching and research.

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