

Nursing care in the prevention of renal failure caused by post-catheterism contrast

Cuidados de enfermagem na prevenção da insuficiência renal provocada por contraste após cateterismo

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ABSTRACT

The purpose of this study was to identify the nursing scientific production on acute renal failure caused by post-catheterism iodized cardiac contrast, from 2002 to 2007, by analyzing its practical application. A critical analysis was further performed of the selected scientific production outlining nursing care. This study is a literature review of nursing articles, found through computerized search. Out of the 47 articles found, ten were selected because they met the inclusion criteria. After the analysis of the articles, we checked the importance of the nurse's performance in the prevention of acute renal failure caused by contrasts. In addition, we noted the best nursing practices for prevention of acute renal failure caused by contrasts.

Keywords: Nursing care; Renal insufficiency, acute/etiology; Renal insufficiency, acute/prevention & control; Heart catheterization/adverse effects; Contrast media/adverse effects

RESUMO

O estudo teve como objetivo identificar produções científicas de enfermagem sobre insuficiência renal aguda provocada por contraste iodado após cateterismo cardíaco, no período de 2002 a 2007, analisando sua aplicabilidade à prática. Foi realizada ainda uma análise crítica das produções científicas selecionadas, delineando os cuidados de enfermagem. Este estudo é uma pesquisa bibliográfica de artigos de enfermagem, encontrados através de busca computadorizada. Dos 47 artigos encontrados, 10 foram selecionados por terem atendido os critérios de inclusão. Após a análise dos artigos, verificamos a importância da atuação do enfermeiro na prevenção da insuficiência renal aguda provocada por contraste. Além disso, evidenciamos a melhor prática de enfermagem para a prevenção da insuficiência renal aguda provocada por contraste.

Descritores: Cuidados de enfermagem; Insuficiência renal aguda/etiologia; Insuficiência renal aguda/prevenção & controle; Cateterismo cardíaco/efeitos adversos; Meios de contraste/efeitos adversos

RESUMEN

El presente estudio tuvo como objetivo identificar producciones científicas de enfermería sobre la insuficiencia renal aguda provocada por contraste yodado después del cateterismo cardíaco, en el período de 2002 a 2007, analizando su aplicabilidad a la práctica. Se realizó además el análisis crítico de las producciones científicas seleccionadas, delineando los cuidados de enfermería. Este estudio es una investigación bibliográfica de artículos de enfermería, encontrados por medio de búsqueda computarizada. De los 47 artículos encontrados, 10 fueron seleccionados por haber atendido a los criterios de inclusión. Después del análisis de los artículos, verificamos la importancia de la actuación del enfermero en la prevención de la insuficiencia renal aguda provocada por contraste. Además de lo referido, evidenciamos una mejor práctica de enfermería para la prevención de la insuficiencia renal aguda provocada por contraste.

Descriptores: Atención de enfermería; Insuficiencia renal aguda/etiología; Insuficiencia renal aguda/prevenición & control; Cateterismo cardíaco/efectos adversos; Medios de contraste/efectos adversos

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INTRODUCTION

It is estimated that the number of cardiac, diagnostic and therapeutic catheterisms in western countries is 400,000 procedures per year. In Brazil, angioplasty, introduced in 1979, was widely accepted and today it is estimated that 45,000 such procedures are currently performed each year⁽¹⁾.

Heart diseases present a high risk for the development of acute renal failure (ARF), especially due to hemodynamic deterioration, the use of endovenous iodized contrasts, arterial catheterisms with the risk of arteroembolism and the frequent use of angiotensin conversion enzyme inhibitors⁽²⁾.

Several studies have evaluated the risk factors and etiologies for the development of ARF after cardiac catheterism. Behrend and Miller⁽³⁾, while studying 2,392 patients in a cardiac healthcare facility in the United States, showed a 17% incidence of acute renal failure, with the major etiologies being hemodynamic alterations (54%), followed by the use of iodized contrast (11%). Similar studies show that the mortality of patients with ARF was much higher when compared with patients who did not present renal failure⁽²⁻³⁾.

In this regard, that is, which patients can develop ARF due to the use of iodized contrast in cardiac catheterism, Nursing has a fundamental and irreplaceable role in the pre-surgery period, identifying the patients with potential risk to develop ARF, during surgery, managing the contrast with the volume and the correct osmolarity, and in the post-surgery, identifying early signs of declining renal function. This means that the nurse acts in the prevention, detection and treatment of ARF⁽⁴⁾.

As such, the purpose of the study is nursing care of acute renal failure caused by iodized contrast after heart catheterism. Our objectives were the following:

- Identifying scientific nursing production on acute renal failure caused by iodized contrast after heart catheterism between 2002 and 2007 by analyzing its application into practice.

- Perform a critical analysis of the selected scientific productions, outlining nursing care in acute renal failure caused by iodized contrast after cardiac catheterism.

In order to best contextualize the theme, we present a few important concepts aiming at better understanding the study.

Acute renal failure is a syndrome characterized by acute reduction in renal function, in hours or days, with the resulting seric retention of nitrogen products, whose character is reversible. It refers especially to the reduction in the rhythm of glomerular filtration and/or urine volume, but there are also disturbances in the control of the hydro-electrolytic and base-acid balance⁽⁵⁾.

Accordance to Sociedade Brasileira de Nefrologia⁽⁵⁾,

there are more than 30 definitions for ARF in literature. The use of different definitions makes the comparison of studies difficult. Recently, the international multidisciplinary group *Acute Kidney Injury Network (AKIN)* proposed a new definition and classification for ARF, in order to standardize this concept for the purposes of clinical studies and, in particular, prevent and facilitate the diagnosis of this syndrome. *AKIN* proposes the diagnosis and the classification of acute renal failure based on the seric dosage of creatinine and urine volume in a 48-hour period⁽⁶⁾.

Contrast-induced ARF, most of the time, is asymptomatic, non-oliguric and the seric levels usually increase in 24 to 72 hours after exposure, reaching its maximum value in 3 to 5 days^(2,7).

In spite of its reversible characteristics, acute renal failure still presents a prognosis with a mortality rate of approximately 50%. This ARF prognosis has been associated with some factors such as persistent oliguria (refractory to volume), multiple organ failure and septicemia. This high mortality reinforces the need to prevent it and the importance of the nurse's performance in the identification of risk factors and in early detection of ARF⁽⁷⁾.

The iodized contrast is the radiopaque substance employed in radiologic exams, such as heart catheterism, and is widely used for diagnostic and therapeutic purposes. Such a substance, in spite of improving the visualization of arteries and other anatomic structures during the exam, can cause undesirable adverse reactions that are due, mainly, to high osmolarity of the contrast in relation to the blood⁽⁴⁾.

METHODS

The methodology consisted of a computerized bibliographic research, performed from May to October, 2007, using the key words: nursing; acute renal failure; heart catheterism / nursing; acute renal insufficiency; cardiac catheterization, having all possible crossings been performed among the key words.

We decided to access the Virtual Health Library (BVS) available at www.bireme.br where the databases LILACS, Scielo and BDENF were accessed. The CAPES Portal was also accessed, available at www.periodicos.capes.gov.br, where the CINAHL databased (EBSCO host) was accessed.

The following stages were considered: definition of the sample selection criteria, with inclusion and exclusion criteria for articles; definition of the information to be extracted from each article; analysis of the content results of the articles, and highlight to the articles that are related to acute renal failure with iodized contrast.

The selection criteria of the articles were: having been

published between 2002 and 2007; being related to studies performed by nurses; being written in English, Portuguese or Spanish; dealing with acute renal failure as its main focus or a relevant aspect in the research.

Forty-seven articles were identified (24 in LILACS; 13 in BDNF; 4 in Scielo and 6 in CINAHL) from 2002 to 2007, of which 10 were selected (4 in Portuguese and

6 in English) for analysis, in accordance with the inclusion criteria. After reading the articles, its main ideas were highlighted in Chart I and the critical analysis and discussion of the results found in each text were performed, allowing the preparation of the considerations over the topic.

RESULTS

Chart 1 – Located publications, according to theme, renal insufficiency caused by iodized contrast, in the data bases. Niterói, 2007

Author(s), Date & Country	Research objective	Sample size	Type of the study & instruments	Major findings	Conclusions of the author (s)
Henke K, Eigsti J, ElKhart, 2003, Indiana, USA	Describing the anatomy and renal physiology applied to patients with acute and chronic renal failure.	Not applicable.	Bibliographic descriptive study	Describes the anatomy and detailed renal physiology.	Knowing the theory makes it easier to identify and treat patients with renal impairments.
Redmond A, Devitt MM, Barnes S. Kingston, 2004, Ontario, Canada	Performing a review of anatomy and renal physiology in addition to identifying clinical situations that predispose acute renal failure.	Not applicable.	Bibliographic descriptive study	Mentions and describes clinical situations that predispose the development of ARF	Describes the circumstances in which ARF can occur, in addition to describing the strategies for nursing to care for these patients.
Michael RC, Jacobus, 2006, Pennsylvania, USA	Describing safe actions to protect the patient from nephrotoxicity induced by contrast.	Not applicable.	Bibliographic descriptive study	Describes some nursing care for nephroprotection.	Concludes that nephrotoxicity induced by contrast is the major cause of acute renal failure caused by contrast.
Juchem BC, Dall'Agnol CM, 2007, Ribeirão Preto – SP - Brasil	Knowing the adverse reactions to intravenous iodized contrast in hospitalized patients submitted to computerized tomography.	317 patients, being that 161 received ionic iodized contrast and 190 received non-ionic iodized contrast.	Quantitative research, exploratory-descriptive, non-experimental.	Describes the most common adverse reactions to the use of iodized contrast, in addition to describing the most used types of contrasts.	The adverse reactions occurred at a rate of 12.5% among the patients who received ionic contrast and 1% among those who were exposed to non-ionic contrast.
Hamada SM, Brito TE., 2003, Brasília – DF - Brazil	Discussing the major nursing conducts focused on patients submitted to coronary procedures.	Not applicable.	Bibliographic study.	Refers to renal protection as one of the nursing care practices for patients submitted to coronary procedures.	Description of nursing assistance in cardiac pre, trans and post-catheterism. The success of nursing assistance depends on technical and scientific preparation.
Lourenco R, Andrade M., 2006, Niterói – RJ Brazil	Searching for knowledge on the systematization of nursing care for patients submitted to cardiac catheterism.	Not applicable.	Bibliographic exploratory study..	In the systematization of nursing assistance, describes the volume and type of contrast indicated to prevent nephrotoxicity.	It is concluded that incentive is needed for publications in the area. It is observed that the specialized nurse performs interventions in a more effective way.
Lima LR, Pereira SV, Chianca TC. 2006, Belo Horizonte – MG Brazil	Establishing NANDA's nursing diagnosis in cardiac post-catheterism patients.	30 patients Twenty-five nursing diagnoses were established.	Study of multiple cases, trans-sectional.	Mentions and defines diagnoses for cardiac post-catheterism patients.	Out of the diagnoses outlined, all patients in the study presented risk for renal organic injuries.

Author(s), Date & Country	Research objective	Sample size	Type of study & instruments	Major findings	Conclusions of the author(s)
Brener ZR, Myer AS. Brockport, 2004, New York , USA	Describing the action of acetylcysteine in the prevention of nephropathy developed by contrast.	Not applicable.	Bibliographic descriptive study.	Describes the action of N-acetylcysteine in nephroprotection.	Describes the responsibilities of the nurse in the prevention of nephropathy induced by contrast and concludes that although studies show the benefit of acetylcysteine, new studies will be performed to evaluate the cost / benefit ratio of this drug.
Thompson EJ, King SL. Lancaster, 2003, Pennsylvania, USA	Describing the indication, action and adverse effects of fenoldopam and acetylcysteine.	Not applicable.	Bibliographic descriptive study..	Discusses nursing considerations for patients who receive these medications to prevent renal complications induced by contrast.	It describes the pathogenesis of the nephrotoxicity induced by contrast; it describes the types of contrast used in cardiac catheterism; it describes the action mechanism of acetylcysteine and fenoldopam and the interventions in nursing care.
Katz J. Washington, 2005, Pennsylvania, USA	Defining the best evidence for the reduction of nephropathy induced by contrast using N-Acetylcysteine.	Compares 6 randomized, controlled, double-blind studies with similar design.	Qualitative, systematic review.	Notes quantitatively the best substances for renal protection.	The prevention of nephropathy induced by contrast with N-acetylcysteine still presents little evidence.

DISCUSSION

Critical evaluation of the selected articles and implications for the nursing practice with high-complexity clients

The main ideas extracted from each selected article are presented below. The data presented were interpreted and analyzed critically so as to determine their relevance to the topic proposed in this study.

Understanding the renal system may help the nurse decide for the best therapy, in addition to preventing possible renal injuries. A literature review⁽⁸⁾ that brings, renal anatomy and physiology applied directly to the critical patient as its main focus describes the renal vascular system, the glomerular membrane and the tubular segment of the nephron. It concludes that, in order to preserve the renal function, we must always consider that renal perfusion must be maintained and, as such, the average blood pressure must be maintained around 70 mmHg, in addition to avoiding administering medication that might damage the renal function⁽⁸⁾.

Kidney impairment is classified in accordance with the anatomical location of the renal injury, which can be pre-renal (caused by hypoperfusion), intra-renal (caused by the reduction of filtration) and post-renal (caused by

obstruction, preventing elimination). The risk factors for the development of ARF are defined as: age, presence of chronic diseases such as diabetes and vascular diseases; patients making use of non-steroid anti-inflammatories and diuretics, in addition to patients with severe hypotension or patients who have suffered some trauma with excessive bleeding⁽⁹⁾.

In this regard, the ARF caused by contrast is considered an intra-renal ARF. The nephrotoxicity induced by contrast is the main cause of acute renal failure caused by contrast. As such, one author⁽¹⁰⁾ confirms the aforementioned article and describes actions to protect the patient from nephrotoxicity, quoting as examples of good practices: collecting the history of the patient before the procedure, including the medication in use (anti-inflammatory, angiotensin inhibitors, converter inhibitors, diuretics, metformin derivatives, among others that alter kidney function); tracking risk factors, such as diabetes, age over 75 years and previous changes in kidney function; whenever possible, choosing actions that do not need contrast; if the procedure is necessary, using the lowest possible dose of contrast, in addition to performing adequate hydration⁽¹⁰⁾.

In another article analyzed, the adverse reactions immediately after the iodized contrast are described and

defined, such as: anaphylactoids and chemotoxics. The anaphylactoid reactions are not dependent on contrast doses and are similar to allergic reactions (hives, tachycardia, laryngeal edema, among others). Regarding chemotoxic reactions, these are dose-dependent and relate with the physical-chemical characteristics of the contrast (osmolarity and ionicity). Among signs and symptoms, the following are mentioned: cardiac arrhythmia, hypertension and renal insufficiency⁽¹¹⁾.

Kidney impairment, in addition to being among the chemotoxic adverse reactions, is also mentioned as a risk factor associated with the occurrence of adverse reactions of using iodized contrasts. Other studies also mention pre-existing kidney impairment as one of the highest risk factors for the development of nephropathy induced by contrast, along with the presence of diabetes mellitus and cardiac insufficiency⁽¹¹⁻¹²⁾.

The article under analysis⁽¹²⁾ shows the importance of the nursing team in preventive care, early detection and treatment of adverse events caused by the use of iodized contrasts. In another article, the main types of nursing care provided to patients submitted to cardiac catheterism are described, subdivided into prior, during and after surgery⁽¹³⁾. In pre-surgery care, the history, in which the nurse identifies the risk factors to develop ARF, drug, food and iodine allergies, medications being used that might cause nephrotoxicity, among others. Pre-procedure laboratory exams are also highlighted, including the values of renal residues (urea and creatinine). Pre-procedure hydration is started in this period, with the objective of nephroprotection⁽¹³⁾.

In care during catheterism, the anaphylactic reactions immediately after the contrast are also mentioned by Juchem and Dall'Agnol⁽¹¹⁾. In addition, we note the amount of iodized contrast injected, since the higher the amount of contrast, the higher the probability of nephrotoxicity^(11,13).

In post-surgical care, one must observe late reactions to the contrast, monitor urine volume, provide post-procedure laboratory exams, observe early increase of urea and creatinine rates, in addition to stimulate water intake, aiming at the elimination of the infused contrast^(11,13).

In another article, the authors perform a literary review and conclude that, at national and international levels, there are deficiencies regarding the content and the quality of the scientific production, which highlights the relevance of the proposed theme⁽¹⁴⁾.

After the bibliographic search, the authors selected a few texts for analysis, among which they highlight⁽¹⁵⁾ those that corroborate the previous assertions and highlight the importance of the nurses' performance, who carry out routine activities that prevent or detect complications derived from cardiac catheterism, thus being able to

prevent or detect early kidney impairment caused by iodized contrasts.

In another analyzed article⁽⁴⁾ the authors describe 25 different nursing diagnoses for 30 patients that were submitted to cardiac catheterism. Out of the 25 diagnoses presented, we note three that are relevant to the theme of the present study, namely: hampered urinary elimination; reduced heart debt risk and risk of injuries (referring to renal injuries).

Harmed urinary elimination is associated with emotional factors and physical immobility secondary to cardiac catheterism. Reduced cardiac debt risk, related to altered ejection volumes, may lead to changes in renal perfusion and lead the patient to develop ARF due to low debt. On the other hand, the risk of renal injuries is associated with the exposure of the organism, especially the kidney, to the chemical iodized substance of the contrast during the procedure. These authors affirm, in their study, that, according to the manufacturer, the contrast may lead 23% of the patients to osmotic necrosis of the proximal tubular cells, which leads to renal insufficiency. Therefore, they suggest nephroprotection with venous and oral hydration so as to favor the excretion of the contrast and the reduction of blood viscosity⁽⁴⁻¹⁶⁾.

A few specialists have used acetylcysteine as prophylaxis for nephropathy induced by contrast, since it relates with an antioxidant that reduces free radicals by increasing the expression of the nitric oxide synthesis. Therefore, it is capable of reducing damage in the renal tubules, both because it reduces direct oxidative damage and because it improves the hemodynamic conditions in the kidneys^(6,17).

The benefit of the prophylactic use of acetylcysteine in the prevention of nephropathy induced by contrast has already been confirmed in some meta-analyses⁽¹⁷⁾. In addition, characteristics, such as low cost, widespread availability, oral administration and limited adverse effects strengthen its employment with this purpose. However, this process is still being studied and new investigations are needed in order to evaluate the real benefits of this drug⁽¹⁷⁾.

At the end of the article, the authors⁽¹⁷⁾ describe the responsibilities of the nurse in the prevention of nephropathy caused by contrast and highlight the following nursing actions: identifying the patients with risk of developing nephropathy induced by contrast; watching for signs of early renal dysfunction; administering hydration and prophylactic medication, which prevent the malignant effects of the contrast; evaluating the risks and benefits of contrast administration.

In another article, the authors once again bring acetylcysteine and also fenoldpam as a new promising approach to prevent nephrotoxicity caused by contrast and describe the action mechanism of acetylcysteine,

mentioned previously. Regarding fenoldpam, it is a catecholamine derived from dopamine, and it is a selective agonist of dopaminergic DA-1 receptors, approved for the treatment of hypertensive emergencies through endovenous administration. It has a powerful systemic and renal arteriolar vasodilating action, performing peripheral vasodilatation and preserving the renal flow, which would increase the elimination of the contrast⁽¹⁸⁾.

When we observed the action mechanism of fenoldpam, at first sight, we believed it to be a promising drug, due to its selective action. However, because it is a serious vasodilator, nursing has to be careful as about aspects such as: vigilant observation of arterial pressure; not administering it jointly with other anti-hypertensive drugs or α -blockers; not administering it in pregnant patients or patients with glaucoma; not administering it in patients who are allergic to sulphates (fenoldpam derives from sulphate); observing the seric level of potassium (due to the increased urinary volume, which can cause hypokalemia); observing the heart rate (it can cause tachycardia)⁽¹⁸⁾.

Due to the many and important side effects, in addition to the incipience of studies confirming its effectiveness, new studies must be performed until the benefits of fenoldpam and can be used in prevention of nephrotoxicity caused by contrast⁽¹⁹⁾.

Another study⁽¹⁹⁾ makes a systematic revision and corroborates the previous assertions, comparing six randomized, controlled and double-blind studies, evaluating the use of N-acetylcysteine in the prophylaxis of nephropathy induced by contrast in chronic renal patients. All studies divide the patients in two groups: one group receiving N-acetylcysteine and the other group receiving a placebo.

During the comparison of the studies, the author mentions, as a foundation, a study⁽²⁰⁾ revealing that the use of N-acetylcysteine, in some patients, can reduce the nephropathy induced by contrast in up to 90%.

After evaluating the studies, one comes to three definitions: the radiologic contrast is associated with renal deterioration; the only definitively recognized way to reduce the adverse reactions of the contrast is hydration and the use of the low molecular weight contrast; the opinions diverge as to the prophylactic benefits of N-acetylcysteine in association with venous hydration, to reduce the incidence of nephropathy, which concludes that the only answer to question "How can we treat our patient?" is to continue using venous hydration before and after the procedure, since it is the only effective prophylactic treatment for which there is sufficient evidence. In addition, it affirms that the use of N-acetylcysteine with venous hydration is still uncertain⁽¹⁸⁻²⁰⁾.

CONCLUSION

The performance of the nurse in the prevention of ARF caused by contrast is wide and indispensable. In this regard, we consider that our study might support the professionals in the area, because it contains up-to-date information and it encourages nursing care based on the prevention of co-morbidities and complications, leading to safer, better quality nursing practices.

Regarding what has been studied, we recommend the nurses working in cardiac pre, trans and post-catheterism with iodized contrast to focus on the following objectives: identifying the risk factors for nephrotoxicity and participating in the selection of the ideal contrast for each patient, in addition to preventing adverse effects, especially the ARF induced by contrast.

Keeping these objectives in mind, which seem to be clear and measurable, the nurse must perform a thorough and detailed anamnesis, select the ideal contrast for the patient, administer the lowest necessary amount of contrast for anatomic visualization of the arteries, quantify the post-catheterism urinary volume, collect and evaluate laboratory exams (especially renal residues), perform venous hydration before and after the procedure. In addition to the nursing history, nursing diagnoses must consequently be prepared for the patients and his relatives experiencing ARF. With the identification of the nursing diagnoses, the ethical commitment to establish nursing therapies in the form of a healthcare plan emerge, as well as the evaluation of the results of these actions until the diagnoses are resolved or replaced by diagnoses of well-being.

Since literature has shown that the predominance of nephrotoxicity after administering of contrast is growing, we must reinforce the nursing actions mentioned above with the purpose of minimizing adverse reactions. There are many promising drugs for preventing ARF caused by contrast; however, the only evidence (class IA) confirmed and disseminated as prophylactic and effective measure for the prevention of ARF is venous hydration before and after the procedure. The effectiveness of acetylcysteine, fenoldopam and other therapies still accounts for future studies to define the best evidence and establish the most effective nursing practices.

Finally, we highlight as limitations for this study: our choice for the data collection methodology through virtual libraries, which has certainly restricted the results obtained, in addition to the low presence of articles describing nursing care for these clients, which limited our discussion. We note that new studies must be made within the same perspective. We hope that our results, although underestimated, may contribute to nursing assistance with the compilation of data about the topic.

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