

Contrast-Induced Nephropathy in patients submitted to percutaneous coronary intervention: an integrative review

Nefropatia induzida por contraste em pacientes submetidos à intervenção coronária percutânea: revisão integrativa
Nefropatía Inducida por Contraste en pacientes sujetos al intervención coronaria percutánea: revisión integrativa

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ABSTRACT

Objective: to demonstrate scientific evidence on incidence and factors associated with contrast-induced nephropathy in patients undergoing percutaneous coronary intervention.

Methods: an integrative review carried out in the VHL, PubMed, VHL Regional Portal and SciELO databases, of articles published between 2014 and 2019. **Results:** the sample consisted of five original articles, two cohorts, two control cases and a clinical trial. The incidence of contrast-induced nephropathy ranged from 6% to 24%. It stands out among patients with advanced age, male gender, diabetes mellitus, systemic arterial hypertension, volume of contrast infused and osmolarity. Intravenous hydration, sodium bicarbonate, ascorbic acid and statin were important prophylactic agents. **Conclusion:** this study envisioned the main risk factors for contrast-induced nephropathy in patients undergoing percutaneous coronary intervention and elucidated preventive measures that guide multidisciplinary health care aiming at a quality and safe care.

Descriptors: Acute Kidney Injury; Contrast Media; Balloon Coronary Angioplasty; Nursing; Review.

RESUMO

Objetivo: demonstrar evidências científicas sobre incidência e fatores associados à nefropatia induzida por contraste em pacientes submetidos à intervenção coronária percutânea.

Métodos: revisão integrativa, realizada nas bases de dados BVS, PubMed, Portal Regional da BVS e SciELO, de artigos publicados entre 2014 e 2019. **Resultados:** a amostra foi composta por cinco artigos originais, duas coortes, dois caso-controle e um ensaio clínico. A incidência da nefropatia induzida por contraste variou de 6% a 24%. Destaca-se entre os pacientes idade avançada, sexo masculino, diabetes mellitus, hipertensão arterial sistêmica, volume do contraste infundido e osmolaridade. Hidratação endovenosa, bicarbonato de sódio, ácido ascórbico e estatina foram importantes agentes profiláticos. **Conclusão:** este estudo vislumbrou os principais fatores de risco para a nefropatia induzida por contraste em pacientes submetidos à intervenção coronária percutânea, elucidando medidas preventivas que orientam o cuidado multiprofissional em saúde visando uma assistência de qualidade e segura.

Descritores: Lesão Renal Aguda; Meios de Contraste; Angioplastia Coronária com Balão; Enfermagem; Revisão.

RESUMEN

Objetivo: demostrar evidencia científica sobre la incidencia y factores asociados a la nefropatía inducida por contraste en pacientes sometidos a intervención coronaria percutánea. **Métodos:** revisión integrativa, realizada en las bases de datos BVS, PubMed, Portal Regional BVS y SciELO, de artículos publicados entre 2014 y 2019. **Resultados:** la muestra estuvo conformada por cinco artículos originales, dos cohortes, dos casos-controles y un ensayo clínico. La incidencia de nefropatía inducida por contraste osciló entre el 6% y el 24%. Destaca entre los pacientes con edad avanzada, sexo masculino, diabetes mellitus, hipertensión arterial sistémica, volumen de contraste infundido y osmolaridad. La hidratación intravenosa, el bicarbonato de sodio, el ácido ascórbico y las estatinas fueron importantes agentes profiláticos. **Conclusión:** este estudio visualizó los principales factores de riesgo de nefropatía inducida por contraste en pacientes sometidos a intervención coronaria percutánea, dilucidando las medidas preventivas que orientan la atención de salud multiprofesional con el objetivo de una atención de calidad y segura.

Descriptor: Lesión Renal Aguda; Medios de Contraste; Angioplastia Coronaria con Balón; Enfermería; Revisión.

INTRODUCTION

With the advancement of Western medicine and the technological contributions of recent decades, percutaneous coronary intervention (PCI) has spread, a therapeutic model about treatment of chronic arterial diseases. This intervention model has become widely used and alternative to drug therapies and surgical procedures, due to its ability to significantly reduce mortality, its low cost and its less invasive character. It is considered a standard method and highly recommended for the management of some cases of coronary artery disease, constituting the gold standard for the treatment of acute myocardial infarction with or without ST-segment elevation⁽¹⁾. However, despite PCI, also known as coronary angioplasty, presenting itself as an excellent therapeutic model, this procedure offers risks associated mainly with the necessary exposure to iodinated contrast medium⁽²⁾.

It is well known that iodine, as well as other agents of contrasting function, is able to provide a better response to the definition of tomographic images, leading to medical diagnoses and interventions⁽³⁾. Its use is highly widespread in daily clinical-hospital practice. However, endovascular contrasting agents are potentially responsible for contrast-induced nephropathy (CIN)⁽⁴⁾.

CIN is defined by an iatrogenic complication that causes an absolute increase in serum creatinine equal to or greater than 0.5 mg/dl or a relative increase of 25% or more after 48 or 72 hours of the iodinated contrast endovascular infusion and which lasts for 2 to 5 days in the absence of other identifiable causes, according to the Clinical Practice Guideline for Acute Kidney Injury (KDIGO)⁽⁵⁾. It is the third leading cause of acute intrahospital kidney injury⁽⁶⁾, which can result in severe and permanent sequelae, sequential morbidity and significant increase in mortality rates for patients^(4,7-9).

The pathogenesis of CIN is not entirely clear; however, experimental studies suggest that the contrast acts on renal vascular tonicity, inducing an endothelial vasodilator effect, followed by a vasoconstrictor effect induced by the vasoactive agents adenosine and endothelin. CIN subsequently causes endothelial dysfunction, inflammation, cell toxicity and apoptosis, resulting in hemodynamic changes, hypoxia and oxidative damage^(6,8,10).

Additionally, the development of CIN depends on osmolarity, viscosity and the infused volume of iodinated contrast. High concentration of these agents can stimulate their deposit in the renal tubules and increase tubular pressures, decreasing the glomerular filtration rate and renal blood flow. In order to reduce the contrast's "osmotoxicity", using an iso or low osmolarity agent is recommended, especially in patients with underlying diseases that constitute a greater risk for kidney injury^(8,10).

In Brazil, the prevalence rate of patients undergoing dialysis is 596 patients per million of the population (pmp), individuals with hypertension is 24.3% and with diabetes mellitus is 6.9%⁽¹¹⁻¹³⁾. This panorama of chronic non-communicable diseases corresponds to 70% of health care expenses⁽¹⁴⁾. Acute myocardial infarction is a cardiovascular complication associated with these pre-existing chronic diseases and results in high rates of morbidity and mortality⁽¹⁵⁾. Individuals who have these comorbidities are 50% more likely to develop CIN⁽⁸⁾.

Considering the unfavorable epidemiological scenario regarding risk factors for developing CIN and that these may increase with age, it reaches more than 60% among elderly individuals⁽¹¹⁾. Studies that elucidate iatrogenic kidney damage resulting from the intervention in patients undergoing iodinated contrast can support prevention and treatment of adverse events.

Thus, investigations that elucidate CIN incidence in hospital environments, associated factors and prophylactic clinical management can contribute to the development of preventive protocols that favor comprehensive and multidisciplinary health care aiming at safety and the best therapy for patients.

OBJECTIVE

To demonstrate scientific evidence on incidence and factors associated with CIN in patients undergoing PCI.

METHOD

This is an integrative review with search in the VHL, PubMed, VHL Regional Portal and SciELO virtual library databases, of articles published between 2014 and 2019, with the adoption of the descriptors (DeCS/MeSH) Acute Kidney Injury, Contrast Media and Balloon Coronary Angioplasty.

As a way to guide the search for scientific studies and in order to find the best scientific evidence, a variation of PICO strategy was used. This strategy symbolizes an acronym for Patient or Problem, Intervention, Comparison or Control and Outcomes⁽¹⁶⁾. The search strategy took place in four steps: (1) identification of a clinical problem; (2) formulation of a relevant and specific clinical question; (3) search for scientific evidence; (4) available evidence assessment. Thus, the classification and analysis of the four parameters of problem identification followed. The first criterion (Patient) was the identification of the group to be studied, i.e., patients with CIN; the second (Intervention) was a PCI procedure; in relation to the third party (Comparison), this study did not cover a comparison group; the fourth parameter (Outcomes) includes analysis of incidence, risk factors and prevention of patients with CIN.

The guiding question to develop the integrative review was: what is the incidence, associated factors and clinical management of CIN in patients undergoing PCI? The articles found were analyzed according to the order of selection, and the data were analyzed according to their contents, through the investigation of two researchers. The search criteria are described in Chart 1 and Figure 1.

Original studies on the proposed theme, in Spanish, Portuguese and English, available for free in full for reading were included. Other reviews and studies that did not mention CIN and/or did not contain any incidence data were excluded. Following the search criteria, the following flow diagram (according to PRISMA) was elaborated in the database search.

The articles found were classified according to the type of research and of evidence: Level 1 - evidence from a systematic review or meta-analysis; Level 2 - evidence derived from at least one well-designed randomized controlled clinical trial;

Chart 1 - Search results in databases for analysis of records found in articles, Brazil, 2020

Search strategy	VHL	PubMed	SciELO	VHL Regional Portal
"Lesão Renal Aguda" AND "Meios de Contraste" AND "Angioplastia Coronária com Balão" (in Portuguese)	Results: 82 Full text and filter of the last 6 years: 4 Selected: 4 Included: 4			Results: 5 Full text and filter of the last 6 years: 5 Selected: 1 Repeated: 4 Included: 1
"Acute Kidney Injury" AND "Contrast Media" AND "Angioplasty, Balloon, Coronary"		Results: 82 Full text and filter of the last 6 years: 4 Selected: 4 Repeated: 3 Included: 1	Results: 1 Full text and filter of the last 6 years: 1 Selected: 1 Repeated: 1 Included: 0	

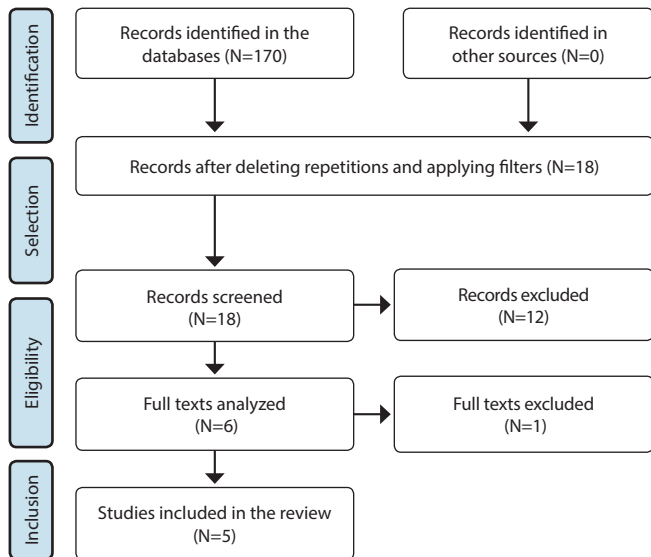


Figure 1 - Flowchart of the steps regarding search for evidence in databases, Brazil, 2020

Level 3 - evidence from well-designed clinical trials without randomization; Level 4 - evidence from well-designed cohort and case-control studies; Level 5 - evidence from systematic review of descriptive and qualitative studies; Level 6 - evidence from a single descriptive or qualitative study; Level 7 - evidence from the opinion of authorities and/or reports of expert committee⁽¹⁷⁾.

RESULTS

Number of articles

A total of 170 articles were found. Then, after excluding repetitions and applying filters, 18 studies were selected from which, after reading abstracts in full, six articles were selected whose content included the descriptors and the research question. At the end of an analytical reading of all articles in full, the sample consisted of five articles that met all inclusion criteria.

Synoptic table (Chart 2)

Chart 2 - Synoptic table containing reference, level of evidence, study design, objective, results and conclusion, of the articles in this integrative review, Brazil, 2020

Title/author/year/country/journal	Type of study/level of evidence	Objective	Main results	Conclusion
Analysis of Biomarkers for Risk of Acute Kidney Injury After Primary Angioplasty for Acute ST-Segment Elevation Myocardial Infarction: Results of the HORIZONS-AMI Trial/Guerchicoff et al./2015/United States of America/Catheter Cardiovasc Interv ⁽¹⁸⁾ .	Cohort/Level 4.	To analyze whether contrast-induced acute kidney injury (AKI) can occur after percutaneous coronary intervention.	Analyzing 390 patients 14.3% developed CIN In this group, the levels of type B natriuretic peptide were higher than in the group without AKI at the beginning of the study (P <0.03), hospital discharge (P <0.001), follow-up 30 days (P <0.01) and 1 year follow-up (P <0.03). At hospital discharge, there was an increase in D-dimer (P <0.01), C-reactive protein (P <0.04), selective adhesion molecule of endothelial cells (P <0.01), adiponectin (P <0.03) and von Willebrand factor (P <0.01), compared to the group without AKI.	The risk of CIN after primary percutaneous coronary intervention for acute myocardial infarction with ST-segment elevation may be associated with hemostatic imbalances, activation of pro coagulants, decreased endogenous anticoagulants, inflammation, platelet activation or reduced fibrinolytic activity.
Contrast-induced nephropathy after primary angioplasty for acute myocardial infarction/Santos et al./2015/Brazil/ J Bras Nefrol ⁽¹⁹⁾ .	Cohort/Level 4.	To determine the incidence and factors associated with CIN in patients with acute myocardial infarction undergoing angioplasty in the first 12 hours after the onset of symptoms.	The total sample was 201 patients. CIN incidence was 23.8%. In the univariate analysis, patients with CIN were older and with a higher frequency of left ventricular ejection fraction=40% and Killip classification=2.	CIN affects a quarter of patients with acute myocardial infarction undergoing angioplasty without predictive variables.

To be continued

Chart 2 (concluded)

Title/author/year/ country/journal	Type of study/level of evidence	Objective	Main results	Conclusion
One-year results of the ICON (Ionic versus non-Ionic Contrast to Obviate worsening Nephropathy after angioplasty in chronic renal failure patients) Study/Giustino et al./2016/United States of America/J Catheter Cardiovasc Interv ⁽²⁰⁾ .	Randomized, double-blind, multicenter clinical trial/ Level 2.	To assess differences in mortality, acute myocardial infarction or PCI, at 1 year after exposure to non-ionic iso-osmolar contrast medium (IOCM) or low-osmolar ion contrast medium (LOCM) in patients with chronic kidney disease undergoing angiography coronary.	The total sample was 146 patients. In 1 year, three deaths (4.1%) occurred in the LOCM group and nine deaths in the IOCM group (13.6%, P <0.07). The 1-year cardiac mortality rate was 2.7% in the LOCM group and 9.1% in the IOCM group (P <0.07). There were no significant differences in the rates of myocardial infarction (1.4% vs. 1.5%; P=1.00) and repeated revascularization (6.8% vs. 9.1%; P=0.75).	Using ionic ioxaglate (LOCM) has been associated with numerically lower mortality in 1 year compared to iodixanol (IOCM) in patients undergoing cardiac catheterization.
Off-Hour Primary Percutaneous Coronary Angioplasty Does Not Affect Contrast Induced Nephropathy in Patients With ST-Segment Elevation Myocardial Infarction/Velibey et al./2017/Turkey/J Angiology ⁽²¹⁾ .	Retrospective control case/ Level 6.	To assess whether primary PCI outside working hours (weekdays from 17:01 to 19:00) is related to an increased incidence of CIN.	The total sample was 2556 patients. The group outside working hours was more often admitted with acute symptoms of heart failure (16.4% vs 7.8%, P <0.001) and more contrast was injected (235.2 ± 82.3 vs 248.9 ± 87.1 ml, P <0.002). There was a trend towards higher hospital mortality when PCI was performed outside working hours (1.9% vs 0.7%, P=0.081). There was no significance with increased risk for CIN (Odds Ratio: 1.051, P=0.833).	CIN incidence did not increase during non-working hours, and PCI outside working hours is not a risk factor for CIN, despite an apparent increase in the use of contrast medium during off-hour PCI.
Preventive effect of statin pretreatment on contrast-induced acute kidney injury in patients undergoing coronary angioplasty propensity score analysis from a multicenter registry/Hoshi et al./2014/Japan/Int J Cardiol ⁽²²⁾ .	Retrospective and multicenter control case/ Level 6.	To investigate whether statin pretreatment prevents CIN in patients with coronary artery disease undergoing PCI.	Of 2,198 patients, a total of 8.7% developed CIN. In the propensity-resected groups, the incidence of CIN was significantly lower in patients with pretreatment with statin than in those without pretreatment (3.5% vs. 10.6%, odds ratio [OR]: 0.31, 95% confidence interval (P <0.001). Multivariate logistic regression analysis showed that the pre-treatment group remained a negative predictor independent of CIN (OR: 0.31, 95% CI, P <0.001) among subjects with propensity.	Pre-treatment with statin has been associated with a significant decrease in the risk of CIN in patients with coronary artery disease undergoing PCI.

Countries

Of the works found, four countries contributed to the studies: two from the United States^(18,20), one from Brazil⁽¹⁹⁾, one from Turkey⁽²¹⁾ and one from Japan⁽²²⁾. All articles present were in English.

Journals and type of study

The analyzed studies were published in different journals. The research originated from four distinct journals, three of which were in the medical field (75%) and one unspecified (for all health fields) (25%). Concerning research design, it was observed that the five studies are original, being four observational and one experimental. Among these studies there are two case-control studies (40%), two cohort studies (40%) and a randomized clinical trial (20%). Among the studies, two articles are multicentric analyzes (40%).

Level of evidence

Of the five selected articles, all made reference to NIC, risk factors and data on sample incidence. The studies covered levels 2, 4 and 6 of evidence, with levels 4 (40%) and 6 (40%) predominating. The results are summarized in Chart 2.

DISCUSSION

Epidemiology

Only one study outlined the clinical and sociodemographic profile of patients who developed CIN⁽¹⁸⁾; however, CIN incidence varied between 6% to 24%⁽¹⁸⁻²²⁾. It was observed that the study samples vary from 135 to 2552 people⁽¹⁸⁻²²⁾. Analyzing the publications that make up this review, it can be seen that, in general, there was a difference in renal involvement according to the social indicators of sex and age. The patients in whom CIN developed were significantly older (64.3 ± 12.5 P <0.005 and predominantly female (32.1% (18/56) P <0.03)⁽¹⁸⁾. Although some studies bring the association between the use of intra-arterial contrast, CIN incidence and sociodemographic factors such as advanced age and female gender, although the age aspect presents itself, in several studies, as a risk factor for kidney injury due to contrast, there is no clear relationship between females and the sudden increase in creatinine, although females are also more prevalent in other studies^(6,23-24).

Scientific evidence reveals that the diagnosis of CIN through creatinine levels, when considering sex, age and ethnicity, may differ in the values of renal laboratory tests. This fact can be justified by the muscle mass index, body surface and creatinine

production among these different groups, in addition to the difference in hormonal levels between both sexes⁽²⁵⁾.

The development of CIN after PCI procedures is multifactorial in nature; however, in four studies reviewed, males were the majority, ranging from 67% to 87%⁽¹⁹⁻²²⁾. These data are consistent with the greater need for cardiovascular intervention in the male population, due to data from epidemiological indexes about Acute Coronary Syndrome and other cardiovascular diseases⁽²⁶⁾. The average age ranged from 57.7 to 71.4 years. Most studies only addressed sex and age as the main sociodemographic data, even though they know that non-communicable diseases and other underlying diseases are often affected and determined by social indicators.

Risk factors

The risk factors most cited in the studies in this review were diabetes mellitus, pre-existing kidney disease, advanced age, heart failure, hypertension, dyslipidemia, obesity and type of contrast⁽¹⁸⁻²²⁾.

The results of this review confirmed the main factors associated with CIN listed by Mehran et al.⁽²⁷⁾. These factors today translate into a risk classification for the development of this syndrome, as age > 75 years, systemic arterial hypertension, dyslipidemia, diabetes mellitus, severe heart failure of functional class III/IV, acute coronary syndrome, chronic kidney disease, anemia, multi-arterial disease, hypotension, use of intra-aortic balloon, type of contrast medium and volume of contrast infused⁽²⁸⁾.

The main results of the studies in this review demonstrate that some clinical features communicate mathematically with CIN development, as seen by significantly higher rates of angina, slightly higher heart failure rates, higher frequency of left ventricular ejection fraction=40% and higher occurrence of the Killip classification=2⁽¹⁸⁻²²⁾.

Velibey et al.⁽²¹⁾ considered age, use of angiotensin-converting enzyme inhibitor/angiotensin receptor blocker before the procedure, baseline creatinine, contrast, hypertension and left ventricular systolic dysfunction as independent predictors of CIN. In addition, According to Hoshi et al.⁽²²⁾ CIN incidence increased gradually with an increase in the risk score of Mehran et al (2004)⁽²⁷⁾. Statin pretreatment has been shown to be an independent predictor of CIN development after PCI⁽²¹⁻²²⁾.

Additionally, the study by Guerchicoff et al.⁽¹⁸⁾ presented an analysis of biomarkers that pointed to a significant association between CIN and imbalance of hemostatic, inflammatory factors, proteins and glycoproteins⁽¹⁸⁾. Appropriating the knowledge of the biochemical elements involved in CIN can clarify the understanding about the guiding questions in spite of CIN pathophysiology, incidence and prevention. Moreover, it may, in the future, contribute to the advancement in the management and combat of this undesired clinical outcome.

CIN prevention

The main preventive measures observed in this review were chemoprophylaxis with ascorbic acid⁽²¹⁾; intravenous hydration with NaCl 0.9%⁽²⁰⁻²¹⁾ and sodium bicarbonate NaHCO₃⁽²¹⁾; contrast volume and the osmolarity of the infused contrast⁽²⁰⁾; pharmacological prophylactic agents such as acetylcysteine⁽²¹⁾ and statin⁽²²⁾; process-admissions such as hours and staff responsible for PCI⁽²¹⁾.

Hydration

Isotonic intravenous hydration (NaCl 0.9%) was present in only two articles in this review⁽²⁰⁻²¹⁾. However, this practice constitutes one of the most widespread methods in clinical practice for patients with risk factors for CIN or with adequate renal function; in these cases, hydration works as a prophylactic with great cost benefit⁽²⁸⁾. Its inexpensive character and simple implementation characterizes it as a method usually implemented.

Studies in patients undergoing PCI, comparing a group with hydration with isotonic saline and another with only unrestricted fluids orally revealed an important difference for CIN in those who received hydration with saline (4%) compared to the group with oral fluids (35%)⁽²⁹⁾. Another study that compared hydration, 0.45% saline with 0.9% saline, which included mostly patients with normal kidney function (79.3%), made isotonic solution the best type of hydration⁽³⁰⁾.

The mechanism of expansion of the intravascular volume can be an important measure of renal protection for patients without previous renal changes, with better results when using isotonic saline solution that ensures greater volume of distribution in the intravascular space⁽²⁸⁻³⁰⁾.

Osmolarity and contrast volume

One of the most important ways to preserve the kidneys from injuries resulting from the use of contrast is the adequacy of the type of contrast and volume of infusion used. The contrast induces, by osmotic diuresis, an increase in oxygen consumption and metabolic activity. Consequently, the increased osmolarity of these agents in the intravascular environment increases their nephrotoxic potential⁽²⁰⁾.

Using low osmolarity contrast was recorded in four articles in this review, one of which also used an iso-osmolar agent. The contrasts identified were ioxaglate 320 mg/ml⁽¹⁹⁻²⁰⁾, iopromide 370 mg of iodine⁽²¹⁾, and iodixanol with an unspecified dose⁽²⁰⁾. In several studies and meta-analyzes, the use of a low-osmolar contrasted agent is considered to reduce the chances of developing CIN, especially in high-risk patients (diabetics and those with pre-existing kidney injury)⁽³¹⁻³⁴⁾. Giustino et al.⁽²⁰⁾ in their double-blind, randomized control group study, found in this review, analyzed that non-ionic and iso-osmolar contrast (iodixanol), despite being demonstrated, in other studies, to be less toxic than low osmolarity (ioxaglate), it was numerically related to higher mortality in 1 year, compared to ioxaglate, which had a lower number of deaths (13.6% vs. 4.6%; P=0.07)^(20,27). The contrast infusion volume was not recorded in some of the selected studies; however, among those who registered, the average contrast volume used ranged between 174 ml and 248.9⁽²⁰⁻²²⁾.

Acetylcysteine

The acetylcysteine referred to in one of the studies analyzed⁽²¹⁾ has the "sequestration" of circulating free radicals as a mechanism of action, reducing the direct damage of these molecules to cells and tissues. Furthermore, it can also exert a protective effect of CIN due to angiotensin-converting enzyme inhibition, promoting endothelial vasodilation in order to reestablish renal blood flow⁽²⁹⁾.

It was once believed that the use of acetylcysteine could provide renal protection, especially when manipulated in conjunction with other elements such as hydration, patients with mild kidney injury and the type and volume of contrast used⁽³⁵⁾; however, current randomized and well-designed studies, guidelines and meta-analyses have shown that acetylcysteine does not decrease CIN incidence in patients with glomerular filtration rate <60 ml/min undergoing percutaneous coronary procedures^(28,36-37). It can be said, therefore, that there is not enough clear evidence to recommend the routine use of acetylcysteine as prophylaxis for CIN^(28,36,38-39).

Sodium bicarbonate

Prophylactic use of sodium bicarbonate was also present in a single study⁽²¹⁾. Sodium bicarbonate works by inhibiting the production of free radical molecules, preventing excessive glomerular damage managed by these radicals. The evidence regarding the direct and real effectiveness of this prophylactic means is still not clear and conclusive. Large metanalytical studies and systematic reviews are found, suggesting significant validity in decreasing CIN rates when sodium bicarbonate is used compared to isotonic saline (5.96% in NaHCO₃ vs 17.23% saline, OR: 0.37, 95% CI 0.18-0.714, P <0.005)^(30,40-41). However, some other studies have not found the benefits of this intervention to prevent CIN so clearly⁽⁴¹⁾, either way it is a valid alternative, especially for patients with ventricular dysfunction or heart failure^(40,42).

Ascorbic acid

The strategy for using vitamin C was identified in one of the studies analyzed; although it is a little used strategy and with little literature on it, some authors classify ascorbic acid as a valid strategy for preventing CIN and that good results can be generated⁽²¹⁾.

Statins

Using statin was highlighted in a Japanese, control, retrospective and multicenter study by Hoshi et al.⁽²²⁾, present in this review, which analyzed 2198 patients undergoing PCI who were divided into a statin pretreatment group (n=839) and another pretreatment without a statin (n=1359). With adjustment for propensity score: pre-treatment statin (n=565) and pre-treatment without statin (n=565). In all patients, CIN incidence was observed less frequently in those with statin pretreatment than in those without statin pretreatment (3.9% vs. 11.7%, respectively, [OR]: 0.31, 95% CI: 0.21-0.45, P <0.001). Even in the group with adjustment of the

propensity score, a similar benefit was confirmed in patients with pretreatment with statin (OR: 0.31, 95% CI: 0.18-0.52, P <0.001)⁽²²⁾.

Using statins as a prophylactic for CIN is increasingly present in the current clinical picture. The characteristic statins of reducing contrast-induced inflammation and improving renal tubular endothelial function, providing protective effects against CIN, contribute to progressive adherence^(22,38). Despite recent discoveries about the benefits of statin pretreatment, its use, before PCI, to prevent CIN is not yet a routine⁽³⁸⁾.

Study limitations

The main limitation found is due to the scarcity of updated and freely available articles that answered the guiding question of this study. Moreover, most of the studies identified tend to investigate possible new associations between CIN and procedural, biochemical factors, due to the current clinical approach necessary to care for patients at risk or already affected by CIN, providing few or even insufficient parameters to subsidize specific NIC management.

Contributions to nursing, health, and public policies

This is one of the most comprehensive reviews of CIN in patients undergoing PCI. As it is considered the third tail of acute in-hospital kidney injury, CIN is characterized as an adverse event that can be prevented and that requires clinical care with a multidisciplinary approach. Nurses play an important role in identifying the risk factors for CIN through the recognition of clinical priorities and specific prophylactic actions, subsidizing safe nursing care. In care plan development, attention to patients with comorbidities such as diabetes mellitus, systemic arterial hypertension, advanced age and previous renal function stands out, in addition to prioritizing urinary output control, which is considered an important clinical parameter for kidney failure assessment.

CONCLUSION

This study envisioned the main risk factors for CIN in patients undergoing PCI and elucidated preventive measures that guide multidisciplinary health care aiming at a quality and safe care. Thus, this review realizes the need for research to develop prophylactic and therapeutic care protocols aiming at alluding to care for patients with CIN.

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