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Original article

Prevalence and Prognosis of Percutaneous Coronary Intervention-associated Nephropathy in Patients With Acute Coronary Syndrome and Normal Kidney Function

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ABSTRACT

Introduction and objectives: The aim of this study was to analyze the prevalence, risk factors, and short- and long-term prognosis of patients with acute coronary syndrome and normal renal function who developed percutaneous coronary intervention-associated nephropathy.
Methods: This was an observational, retrospective, single-center study with a prospective follow-up of 470 consecutive patients hospitalized for acute coronary syndrome (not in cardiogenic shock) who underwent percutaneous coronary intervention, with no preexisting renal failure (admission creatinine $\leq$ 1.3 mg/dL). Percutaneous coronary intervention-associated was defined as an increase in baseline creatinine $\geq$ 0.5 mg/dL or $\geq$ 25% baseline. The mean follow-up was 26.7 (14) months.
Results: Of the 470 patients, 30 (6.4%) developed percutaneous coronary intervention-associated nepfhropathy. The independent predictors for acute renal failure were admission hemoglobin level (odds ratio = 0.71) and maximum troponin I level prior to the procedure (odds ratio = 1.02). During the long-term follow-up, the patients whose renal function deteriorated had a higher incidence of total mortality (5 [16.7%] vs 27 [6.1%]; *P* = .027). In the Cox regression analysis, percutaneous coronary intervention-associated nepfhropathy was not an independent predictor for total mortality, but could be a predictor for cardiac mortality (hazard ratio = 5.4; 95% confidence interval 1.35-21.3; *P* = .017).
Conclusions: Percutaneous coronary intervention-associated nephropathy in patients with acute coronary syndrome and normal preexisting renal function is not uncommon and influences long-term survival.

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Prevalencia y pronóstico de la nefropatía tras intervencionismo coronario percutáneo de pacientes con síndrome coronario agudo y función renal normal

Palabras clave:
Riñón
Síndrome coronario agudo
Intervencionismo coronario percutáneo

RESUMEN

Introducción y objetivos: El objetivo de este estudio es analizar la prevalencia, los factores de riesgo y el pronóstico hospitalario y a largo plazo de los pacientes con síndrome coronario agudo y función renal normal que presentan nefropatía tras intervencionismo coronario percutáneo.
Métodos: Estudio observacional, retrospectivo y unicéntrico con seguimiento prospectivo de 470 pacientes consecutivos ingresados por síndrome coronario agudo sin *shock* cardiogénico y sometidos a intervencionismo coronario percutáneo sin insuficiencia renal preexistente (creatinina al ingreso $\leq$ 1,3 mg/dl). La nefropatía tras intervencionismo coronario percutáneo se ha definido como un incremento de la creatinina basal $\geq$ 0,5 mg/dl o $\geq$ 25% del valor basal. La media de seguimiento fue 26,7 $\pm$ 14 meses.
Resultados: De los 470 pacientes, 30 (6,4%) presentaron nefropatía tras intervencionismo coronario percutáneo. Los factores independientes predictores de insuficiencia renal aguda fueron la hemoglobina al ingreso (*odds ratio* = 0,71) y la troponina I máxima previa al intervencionismo (*odds ratio* = 1,02). En el seguimiento a largo plazo, los pacientes cuya función renal se deterioró presentaron mayor incidencia de mortalidad total (5 [16,7%] frente a 27 [6,1%]; p = 0,027). En el análisis de regresión de Cox, la nefropatía tras intervencionismo coronario percutáneo no resultó predictora independiente de la mortalidad total, pero podría ser predictora de la mortalidad cardiaca (*hazard ratio* = 5,4; intervalo de confianza del 95%, 1,35-21,3; p = 0,017).

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Conclusiones: La nefropatía tras intervencionismo coronario percutáneo en pacientes con síndrome coronario agudo y función renal preexistente normal no es infrecuente e influye en la supervivencia a largo plazo.

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Abbreviations

LVEF: left ventricular ejection fraction
PCI: percutaneous coronary intervention
ACS: acute coronary syndrome

INTRODUCTION

Increased plasma creatinine levels after percutaneous coronary intervention (PCI) are not uncommon and have been associated with adverse prognoses.[1] The development of PCI-associated nephropathy is associated with a substantial increase in morbidity and mortality, prolonged hospital stays, and higher hospital costs.[2–4] The causes of acute renal failure after a percutaneous coronary revascularization procedure vary greatly and include contrast-induced nephrotoxicity, hemodynamic alterations, drug-induced toxicity and atheroembolism. The greatest risk factor for PCI-associated nephropathy is the degree of preexisting renal insufficiency; therefore, nephroprotective measures usually center on this patient subgroup.[3,5,6] Nonetheless, patients with acute coronary syndrome (ACS) treated with PCI are also a population with a higher risk for subsequent nephropathy.[4,7] Few studies have specifically evaluated the long-term prognosis and prevalence of PCI-associated nephropathy in patients with ACS and normal renal function. While the best treatment for this serious complication is prevention, the current guidelines of the European Society of Cardiology for the management of patients with ACS without persistent ST-segment elevation only recommend nephroprotective measures for patients with ACS and chronic renal failure.[8] Therefore, studies including patients with normal renal function could identify a subgroup of patients who would also benefit from these preventative measures.

The aim of this study was to analyze the prevalence, risk factors, and in-hospital and long-term prognoses of patients with ACS without preexisting renal insufficiency who experienced a decline in renal function after a percutaneous coronary revascularization procedure.

METHODS

From 2007-2011, a total of 602 consecutive patients underwent PCI due to ACS either with or without ST-segment elevation. Excluded from the analysis were those patients with renal insufficiency detected at admission (admission creatinine level > 1.3 mg/dL, n = 126) and those with cardiogenic shock (n = 6). The study group included 470 patients (mean age 65 [12]; women, 89 [18.9%]) with ACS and without preexisting renal insufficiency or cardiogenic shock who underwent percutaneous revascularization.

This was an observational, retrospective, single-center study with prospective collection of the variables. Several clinical and epidemiological variables were recorded in the department database, including age, sex, cardiovascular risk factors, other comorbidities, and previous treatment. On admission, a full work-up with complete blood count and biochemical profile was done, with myocardial necrosis marker measurements (6 h and 12 h) and complete analysis at 8 am on the day after admission. After the PCI, and as part of the standard protocol at our hospital, new myocardial necrosis marker curves were calculated 6 h and 12 h later. Renal function was also assessed on the following day. The quantity and the timing of further bloodwork and analyses were determined according to the criteria of the treating physician. Creatinine levels were recorded at admission and during hospitalization. Creatinine clearance was estimated with the simplified Modification of Diet in Renal Disease formula.[9,10]

Catheterization and Treatment

The PCI was performed in accordance with the standard technique, usually using radial access (394 [83.8%]). In all cases, the contrast media used were iohexol (Omnipaque 350® and Omnipaque 300®) and iodixanol (Visipaque 320®). We recorded the number of main vessels affected in the coronary arteriography, type of access, contrast dose, fluoroscopy time, number of stents used, and their type. We also took note of the antithrombotic treatment used, hemorrhagic complications according to the route of access, angiographic success, and the presence of complications during the procedure. The decision to establish a hydration regime through catheterization, the type and dosage of fluid therapy, and the need for renal replacement therapy was left to the discretion of the treating physician.

Follow-up and Objectives

At our hospital, all the patients who underwent PCI were prospectively followed up for a minimum of 12 months (mean follow-up: 26.7 [14.0] months). The follow-up data were compiled from a review of the electronic case files at our hospital and standardized telephone interviews were systematically performed after 1 month, 1 year, and at the end of the follow-up period. The objectives analyzed included mortality and in-hospital complications, cardiovascular events, and long-term cardiac mortality and total mortality.

Definitions

Percutaneous coronary intervention-associated nephropathy was defined as an increase of $\geq$ 25% or $\geq$ 0.5 mg/dL in serum creatinine levels in the 72 h following the procedure.[6,11,12] Acute myocardial infarction was defined as troponin I elevation due to acute myocardial ischemia, and post-PCI infarction was defined according to the criteria of the latest universal classification of myocardial infarction (troponin I elevation $>$ 1 ng/mL in patients with normal baseline levels or an increase of $>$ 20% in patients with elevated troponin in a situation of stability or decrease, associated with clinical data, electrocardiographic data, images of ischemia or angiographic findings compatible with some type of complication).[13] Left ventricular ejection fraction (LVEF) was estimated by echocardiogram. Cardiogenic shock was defined as systolic blood pressure $<$ 90 mmHg for $\geq$ 1 h accompanied by tissue hypoperfusion requiring inotropic support and/or implantation of an intra-aortic balloon pump. Cardiac mortality was that resulting from ACS, heart failure, or ventricular arrhythmia. Angiographic success

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