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Incidence, morbidity, and mortality of contrast-induced acute kidney injury in a surgical intensive care unit: A prospective cohort study☆,☆☆,★

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Abstract

Purpose: Data on contrast-induced acute kidney injury (CI-AKI) in intensive care unit (ICU) are scarce and controversial. The objectives of the study were to evaluate the incidence and characteristics of CI-AKI in a surgical ICU.

Materials and Methods: We conducted a 13-month prospective observational study. Three definitions were compared to characterize CI-AKI: Barrett and Parfrey criteria; Risk of renal dysfunction, Injury to the kidney, Failure of kidney function, Loss of kidney function and End stage renal disease (RIFLE) classification; and Acute Kidney Injury Network (AKIN) criteria. Patients hospitalized in surgical ICU who had received an injection of contrast medium, who were not on renal replacement therapy, who had stable serum creatinine before injection, and no other etiology for new acute kidney injury were included.

Results: One hundred one patients were included. The frequency of CI-AKI was 17%, 19%, and 19% according to Barrett and Parfrey criteria; RIFLE classification; and AKIN criteria, respectively. Diabetes mellitus, creatinine clearance less than 60 mL/min, and concomitant aminoglycoside administration were associated with CI-AKI. Statistically significant associations were found between CI-AKI and renal replacement therapy with all 3 definitions and between CI-AKI and mortality when AKIN criteria were used.

Conclusions: These results show that CI-AKI is not inconsequential in critically ill patients. In the present study, AKIN criteria appear to be most relevant to define CI-AKI. Further studies are required to explore CI-AKI prevention in ICU.

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1. Introduction

The incidence, risk factors, morbidity, and mortality of contrast-induced acute kidney injury (CI-AKI) have been studied, mainly after percutaneous coronary interventions [1-4]. In the intensive care unit (ICU), several radiologic procedures, including computed tomography (CT) and angiography, are widely performed for diagnosis and treatment of critically ill patients. Consequently, ICU patients are exposed to repetitive contrast medium (CM) administration and are at risk for CI-AKI. Up to the present time, a few studies have reported disparate results regarding CI-AKI epidemiology in ICU patients. Contrast-induced acute kidney injury frequency in critically ill patients varied between less than 2% and 18%, depending on the study populations and CI-AKI definitions used [5-9].

The definition of CI-AKI commonly used in non-ICU patients is that proposed by Barrett and Parfrey [10]. Clearly, CI-AKI has never been prospectively evaluated in ICU patients in whom specific definitions of acute kidney injury (AKI) are already used. Indeed, risk of renal dysfunction, injury to the kidney, failure of kidney function, loss of kidney function and end stage renal disease classification (RIFLE) and Acute Kidney Injury Network (AKIN) criteria are validated for AKI diagnosis in ICU patients, using both serum creatinine value and urine output criteria [11-14]. AKIN criteria for CI-AKI diagnosis, first proposed by McCullough [15], had already been used in non-ICU patients [16].

The aims of the present study were to evaluate CI-AKI incidence and characteristics in a surgical ICU and to compare Barrett and Parfrey, AKIN, and RIFLE criteria for CI-AKI diagnosis.

2. Materials and methods

This was a prospective observational study conducted in a 30-bed surgical ICU during a predefined 13 months period from May 2007 to June 2008. The study was approved by an independent ethics committee (*Comité de protection des personnes nord ouest III*). Because there was no randomization or change in patient management, no written informed consent from patients or their relatives was required.

We included patients in whom imaging procedures with intravenous CM administration were performed. Exclusion criteria were chronic or acute renal replacement therapy (RRT); an increase in plasma creatinine of more than 0.5 mg/dL within 48 hours before CM injection; and other etiologies for AKI such as new shock, cardiac arrest, or surgical procedures after CM injection.

Contrast-induced AKI was defined within 72 hours after CM administration using Barrett and Parfrey criteria [10], a change in 1 or more levels of RIFLE classification [11] or according to AKIN criteria [12] (Table 1).

Table 1 RIFLE classification, AKIN, and Barrett and Parfrey criteria for CI-AKI diagnosis

	Criteria within 72 h after CM injection	
	Creatinine	Urine output
RIFLE—stages		
Risk of renal dysfunction	>50%	<0.5 mL/kg per hour × 6 h
Injury to the kidney	>100%	<0.5 mL/kg per hour × 12 h
Failure of kidney function	>200% or plasma value >4 mg/dL (350 μmol/L) in the setting of an acute increase of at least 0.5 mg/dL (44 μmol/L)	<0.3 mL/kg per hour ×24 h or anuria × 12 h
AKIN	≥0.3 mg/dL (26 μmol/L) or 50%	<0.5 mL/kg per hour × 6 h
Barrett and Parfrey	>0.5 mg/dL (44 μmol/L) or 25%	–

For RIFLE classification, when creatinine value before admission in the ICU was not known, baseline creatinine was estimated assuming a glomerular filtration rate of 75 mL/min per 1.73 m^2 using the modification of diet in renal disease equation [11]. Contrast-induced AKI was defined with a change in RIFLE stage.
For AKIN and Barrett and Parfrey definitions, baseline creatinine value was the plasma creatinine measured just before CM injection.

Demographic data, simplified acute physiologic score (SAPS), main admission diagnosis, and mortality were recorded. Any history of diabetes mellitus, arterial hypertension, chronic kidney disease, chronic heart failure, and myeloma were noted. In addition, we recorded the presence of renal insufficiency defined as creatinine clearance of less than 60 mL/min calculated using the Modification of Diet in Renal Disease study equation or any level of RIFLE classification. We also recorded the presence of sepsis, catecholamine administration, hemoglobin level, nephrotoxic drug administration, and CM injection in the previous 72 hours.

Qualitative data were expressed as percentages with a 95% confidence interval (CI) and were compared using Fisher exact test. Quantitative data were expressed as means and SDs or medians (minimum-maximum) if the distribution was not normal. Multivariate analyses were not conducted because of the small sample size. The statistical analysis was performed with EPI INFO software (version 6.04d, Paris, France).

3. Results

One hundred one consecutive patients were included during the study period. The main characteristics of patients are reported in Table 2. Ten patients (10%) had an history of diabetes mellitus, and 2 patients (2%), of chronic kidney disease. Four patients with diabetes had renal insufficiency but with a plasma creatinine value less than 1.5 mg/dL. No

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