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Prognostic Factors of Acute Kidney Failure in Surgical Intensive Care Patients

Facteurs pronostiques de l'insuffisance rénale aiguë en réanimation chirurgicale

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ABSTRACT

Context. Acute Kidney Failure (AKF) is one of the most frequently encountered organ failures in intensive care. It is, in the short and long term, the cause of underestimated complications. The aim of this work is to identify the poor prognostic factors of patients presenting with ARF admitted to surgical intensive care. **Methods.** This was a cross-sectional study with an analytical aim, relating to the future of patients with ARI and admitted to surgical intensive care at the Groupe Hospitalier de la Région de Mulhouse et du Sud-Alsace (GHRMSA) from July 2020 to September 2020. **Results.** A total of 99 patients were recruited. The proportion of ARF in surgical intensive care was 37%. The age group of 60 to 89 years was the most represented (83.78%). A male predominance was observed, with a sex ratio of 6.4. The main antecedents found in our patients with ARF were hypertension (59.46%), heart disease (45.95%) and dyslipidemia (32.43%). The main clinical manifestations were oliguria (62.16%) and hemodynamic instability (56.76%). The most common biological abnormalities were hypoalbuminemia (83.78%) and anemia (64.86%). The course was pejorative in a high proportion of patients (mortality rate: 32.43%). **Conclusion.** The prevalence of ARF in intensive care is high and the prognosis is globally poor. The high rate is due to modifiable factors such as hypertension, the occurrence of septic shock, hemodynamic instability, the use of certain drugs (aminoglycosides, glycopeptides) and non-modifiable factors marked by advanced age and sex. Prevention measures are indicated towards modifiable factors.

RÉSUMÉ

Contexte. L'insuffisance rénale aiguë (IRA) est l'une des défaillances organiques les plus fréquemment rencontrées en soins intensifs. Elle est, à court et à long terme, à l'origine de complications sous-estimées. Le but de ce travail est d'identifier les facteurs de mauvais pronostiques des patients présentant une IRA admis en réanimation chirurgicale. **Méthodes.** Il s'agissait d'une étude transversale à visée analytique, portant sur le devenir des patients atteints d'une IRA et admis en réanimation chirurgicale au Groupe Hospitalier de la Région de Mulhouse et du Sud-Alsace (GHRMSA) de juillet 2020 à septembre 2020. **Résultats.** Au total 99 patients ont été colligés. La proportion de l'IRA en réanimation chirurgicale était de 37%. La tranche d'âge de 60 à 89 ans était la plus représentée (83,78%). Une prédominance masculine a été observée, avec un sex ratio de 6,4. Les principaux antécédents retrouvés chez nos patients atteints d'IRA étaient l'HTA (59,46%), la cardiopathie (45,95%) et la dyslipidémie (32,43%). Leurs principales manifestations cliniques étaient l'oligurie (62,16%) et l'instabilité hémodynamique (56,76%). Les anomalies biologiques les plus fréquentes étaient l'hypoalbuminémie (83,78%) et l'anémie (64,86%). L'évolution de l'IRA a été globalement péjorative, avec une mortalité de 32,43%. **Conclusion.** La prévalence de l'IRA en réanimation est élevée et le pronostic sévère. Cette sévérité est en rapport avec des facteurs modifiables comme l'HTA, la survenue de choc septique, l'instabilité hémodynamique, l'utilisation de certains médicaments (aminosides, glycopeptides) et des facteurs non modifiables comme l'âge avancé et le sexe. Des mesures préventives sont nécessaires.

INTRODUCTION

Acute renal failure (ARF) is a common complication in most hospitalized patients, especially in the intensive care unit. Its occurrence is often associated with high rates of mortality and morbidity [1].

Its incidence has increased in recent decades, especially with the aging of the population [3,4].

Indeed, in intensive care units, the incidence of AKI varies from 3.2% to 78% [5]. Despite significant progress in basic research, in understanding and management of AKI, patient mortality remains too high, especially when AKI

is severe enough and requires continuous renal replacement in intensive care. Our study aims to analyse the prognostic factors of AKI in patients admitted to the surgical intensive care unit of the Groupe Hospitalier de la Région de Mulhouse et du Sud Alsace (GHRMSA).

PATIENTS AND METHODS

It was an analytic retrospective study from July 2020 to September 2020, i.e. three months in the surgical intensive care unit of the GHRMSA.

All patients aged over 15 admitted to the service during the study period were included. The non-inclusion criteria were patients known to have chronic renal failure treated or not by haemodialysis as well as those whose records were incomplete.

The patients included were divided into two groups: group 1 consisted of patients with ARI (37 patients) and group 2 consisted of patients without ARI (62 patients). For each patient, socio-demographic, clinical, paraclinical, therapeutic and evolutionary data were collected using a standardized survey form.

The diagnosis of ARI was selected:

- On the criteria of Kidney Disease Improvement Global Outcomes (KDIGO) with the elevation of serum creatinine baseline or greater than 14 mg/l
- Quantitative change in diuresis such as anuria (diuresis $\leq$ 100 cc/day), oliguria (diuresis $\leq$ 500 cc/day).
- The existence of kidneys of normal size (10-12 cm) or increased ($\geq$ 12 cm).

AKI has been classified according to the mechanism of occurrence:

Functional or pre-renal ARI: presence of diarrhea, vomiting, hemorrhage, heart failure, cirrhosis, Urea (mmol/l)/creatinine (µmol/l) ratio greater than 100.
Organic or parenchymal ARI: defines by the presence of sepsis or a notion of drug intoxication. Intra-hospital mortality was defined as death occurring during hospitalization. Data analysis was performed using Epi info version 7 software. Quantitative variables were presented as mean $\pm$ standard deviation. The comparison of these variables was made using the reduced difference test if the sample size is greater than or equal to 30 or to the t Student test otherwise. The qualitative parameters

were described in terms of number and percentage. The Chi-square test was used for the comparison of proportions. All these statistical tests were carried out at the significance level of 5% ($p \leq 0.05$) on groups I and II.

RESULTS

Epidemiological data

We identified 99 patients. The average age of the patients in group 2 was 61 ± 16.8 years with extremes of 18 and 69 years. And that of group 1 was 69 ± 12.54 years with extremes of 25 and 75 years. The subjects of group 1 were older than group 2 (69 versus 61) with a value of $p\leq0.05$. (Figure 1)
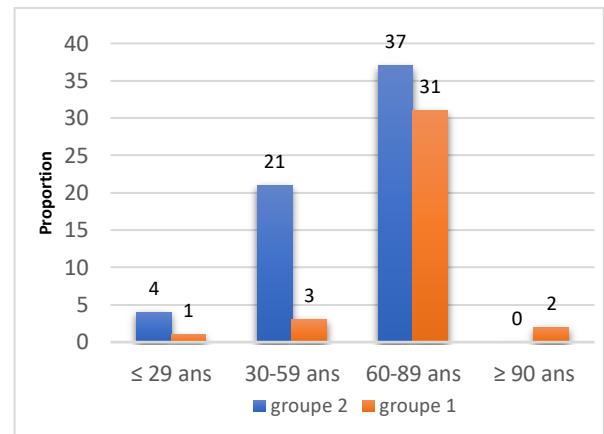

Figure 1: Distribution of patients in groups 1 and 2

Clinical data

The reasons for admission were represented by septic shock, i.e. 18.18%, followed by postoperative monitoring in 34.34% of cases (Table 1).

In our series, the clinical manifestations were more marked by oliguria (62.16%) and hemodynamic instability (56.76%) in patients in group 1. More than 76% were organic ARI.

The etiologies of the ARF were in particular septic shock at 43.24%, hypovolemia at 24.32% and toxic at 13.52% (Table 2).

Biological data

In our study, patients in group 1 had hypoalbuminemia (83.78%), myoglobin (56.76%) and anemia (64.86%) (Table 3).

Regarding the severity of the ARI, 18.92% of the patients were at stage 3 according to the KDIGO classification.

Therapeutic data

Regarding the therapeutic means, rehydration has been used in 32.43% of patients in group 1 versus 9.68% in group 2. The patients all received antibiotic therapy, dominated by glycopeptides (18.92%) in group 1 patients and 1.61% in group 2 patients (Table 4). Vasoactive amines were administered in 41.70% of patients. In addition, 12.27% of patients in group 1 benefited from dialysis.

Evolution

The mortality rate in our study was 32.43% in ARI and 3.23% in non-ARI (Table 5).

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Table 1: Breakdown by reason for admission

Reason for admission	Group1 n(%)	Group2 n(%)	Total	P-value
Diabetic ketosis acidosis	0(0.00)	1(1.61)	1(1.01)	1.00
RCA	3(8.11)	2(3.23)	5(5.05)	0.55
cardiogenic shock	2(5.41)	0(0.00)	2(2.02)	0.26
hemorrhagic shock	1(2.70)	0(0.00)	1(1.01)	0.79
hypovolemic shock	1(2.70)	3(4.84)	4(4.04)	1.00
septic shock	15(40.54)	3(4.84)	18(18,18)	0.00
Coma of undetermined etiology	0(0.00)	1(1.61)	1(1.01)	1.00
Cardiac decompensation	1(2.70)	0(0.00)	1(1.01)	0.79
Acute respiratory distress	6(16.22)	9(14.52)	15(15,15)	1.00
pulmonary embolism	0(0.00)	1(1.61)	1(1.01)	1.00
Status epilepticus	1(2.70)	0(0.00)	1(1.01)	0.79
Post caesarean hemorrhage	0(0.00)	1(1.61)	1(1.01)	1.00
Acute alcohol poisoning	0(0.00)	1(1.61)	1(1.01)	1.00
Polytrauma	0(0.00)	12(19.35)	12(12,12)	0.01
Postoperative monitoring	7(18.92)	27(43.55)	34(34,34)	0.02
Ionic disorders (hypokalemia and hyponatremia)	0(0.00)	1(1.61)	1(1.01)	1.00
Total	37(100)	62(100)	99(100)	0.47

Table 2: Breakdown by etiology

ARI etiologies	Workforce (n)	Proportion (%)
Hemodynamics	9	24.32
Rhabdomyolysis	7	18.92
Septic	16	43.24
Toxic	5	13.52
Total	37	100

Table 3: Distribution according to biology

	Group1 n(%)	Group 2 n(%)	Total n (%)	P-value
Hyperkalemia	8(21.62)	1(1.61)	9 (9.09)	0.002
Hyponatremia	14(37.84)	12(19.35)	26(26,26)	0.074
Anemia	24(64.86)	39(62.90)	63 (63.64)	1.000
High NTprobnp	25(67.57)	18(29.03)	43 (43.43)	0.22
Liver disturbance	16(43.24)	18(29.03)	34 (34.34)	0.29
cpk elevation	7(18.92)	19(30.65)	26 (26.26)	0.295
Myoglobin elevation	21(56.76)	22(35.48)	43 (43.43)	0.063
Lactate elevation	5(13.51)	4 (6.45)	9 (9.09)	0.411
Hypoalbuminemia	31(83.78)	32(52.46)	63(64.29)	0.002
Total	37 (100.00)	62(100)	99(100.00)	0.473

Group 1 consisted of patients with ARI (37 patients) and group 2 consisted of patients without ARI (62 patients).

Table 4: Breakdown by therapeutic means

Medications	Group 2 (n=62)	Group 1 (n=37)	Total(n=99)
Aminosides	2(3.23%)	3(8.11%)	5(5.05%)
Vasoactive amines	4(6.45%)	13(35.14%)	17(17.17%)
Glycopeptides	1 (1.61%)	7(18.92%)	8(20.53%)
Furosemides	12(19.35%)	25(67.57)	37(37.37%)
Blood transfusion	2(3.23%)	6(16.22%)	8(8.08%)
Antihypertensives	12(19.35%)	5(13.51%)	17(17.17%)
Crystalloids/ Gelatins	6 (9.68%)	12 (32.43%)	18(18,18)
EER	0	10(27.03)	10(10.10%)

Table 5: Breakdown by exit mode

Output mode	Group2 n(%)	Group1 n(%)	Total n(%)
Exeat	60 (96.77)	25 (67.57)	85 (85.86)
Deceased	2 (3.23)	12 (32.43)	14 (14.14)
Total	62 (100.00)	37 (100.00)	99 (100.00)

DISCUSSION

AKI was diagnosed in 37 of the patients according to the KDIGO classification (stage1: 43.24%; stage2: 37.84%; stage3: 18.92%). This prevalence is approximately comparable to that in the literature concerning intensive care units; it varies from 2 to 30% [3]. Studies by Case J and Khan S found 20% to 50%, with a lower incidence observed in patients undergoing elective surgery and a higher incidence in patients with sepsis. Several studies have found the high rate of ARI in intensive care [5]. According to several studies, AKI is the prerogative of elderly subjects given the effect of age on renal function and the associated comorbidities.

In our study, there was a male predominance with a sex ratio of 6.4 and a marked increase in the incidence of ARF was observed in patients with an age group between 60-89 years, i.e. 83.78 % with an average age of 69 years. This average age is similar to those reported by some authors in the literature. Our figures join those of Piccinni P. who found an average age of 66 years with more than 59.4% of men[6].

All of the studies linking advanced age and male gender, thus confirmed; their predictive effects on ARI. However, a slight female predominance was reported by Vincent et al [7]. This female predominance remains poorly explained.

Septic shock accounted for 43.24% of reasons for admission and may be attributable to multi-visceral failure in patients in group 1 followed by postoperative monitoring, i.e. 43.55% in patients in group 2. Oliguria was found in 62.16% of patients unlike patients without ARF who had preserved diuresis.Regarding risk factors, all patients with ARI were exposed to at least one.The risk factors were those classically described in the literature: septic shock, hypovolaemia, nephrotoxic products according to Lameire et al [8]. Patients in group 1 had a high proportion of hypertension, 59.46%, and heart disease in 45.95%.These results were similar to those of Susantitaphong P et al who respectively found 61.60% and 39% of their patients exposed to one or more risk factors and a history of high blood pressure 48.60% and diabetes 18.10 %[2].

In our study, like that of Valette et al, AKI was most often observed during hospitalization [10]. It most often fitted into a picture of multivisceral failure encountered in 94% by Erdbruegger [11].

The causes of renal failure in intensive care are most often multiple and associated [12]. Sepsis, cardiogenic and hypovolemic shock represent the main causes of AKI in the literature [13]. In our study, the causes were very varied but there was a high proportion of hypovolemic patients. This could be explained by the frequency of pathologies exposing to hypovolemia such as: haemodynamic instability (24.32%), septic shock (43.24%). Acute organic renal failure is the most frequent entity in intensive care with a frequency ranging from 56 to 81% of cases according to the studies [14]. In a prospective, multicentre and multinational epidemiological study conducted by Uchino et al severe sepsis / septic shock (43.8%), major surgery (39.1%), low cardiac output (29.7) and hypovolemia (28. 2%) were the most common conditions linked to the development of acute renal failure in surgical intensive care patients. A toxic cause was found in 20 to 30% of cases. Obstructive ARIs were rare (0.5 to 5%) [15]. The results of our study showed that the organic AKI (75.68%) was more frequent followed by the functional type (24.32%) and we had no cases of the obstructive type. Acute tubular necrosis is the most common cause of organic renal failure [16]. In our study, we could not accurately tell the rate of acute tubular necrosis; but this rate could be high given the high frequency of certain etiopathogenic factors, namely septic shock and rhabdomyolysis.

The prognosis of ARI depends on age, male sex, previous state of health. Acute renal failure occurred in 50% of patients in the post-surgical intensive care unit, with reported mortality rates of 15% to 80%, with more than 50% of cases being secondary to sepsis [17]. In our series, the mortality rate of ARI patients was32.43% against3.23% in patients without renal impairment.This rate falls within the range usually reported in intensive care units, which varies between 37.10% and 79% [18]. This significant mortality in ARI could be explained essentially by two factors: namely the greater frequency of tubular necrosis in intensive care considered as a factor multiplying mortality by 2 to 7 times and the severity of the initial clinical picture of intensive care patients. The main causes of death were shock, infection, cardiac and respiratory failure [19]. Generally death occurred in a serious infectious picture complicated by several visceral failures 55% in our study, and 32% for Mehta et al [15]. Previous state of health, state of shock, respiratory distress, septic shock, poor neurological state, the association with other visceral failures, the organic nature of the renal insufficiency, the anuria and the advanced age of the patients were correlated in our study with a poor prognosis. Age is known as a risk factor for the development of acute organic kidney failure, but also a risk factor for mortality in several studies [20].

Renal recovery is influenced by the mechanism of the AKI, the stage of KDIGO, and the therapeutic means including extrarenal purification.

According to a French multicenter study [21], the survival rate at discharge from the service and at 6 months was respectively 47% and 29% of cases. Thus a complete recovery of renal function was observed in 81% of cases. Gaudry reported complete recovery of renal function in 96% of cases 12 months after the acute episode [22]. Complete recovery of renal function has been observed in59.46% of cases in our study. However, this frequency was certainly underestimated since we had no idea about the state of renal function in some patients after our study.

CONCLUSION

ARI is a serious complication that occurs most often in patients hospitalized in intensive care. The objective of our work was to contribute to the management of patients in surgical intensive care presenting with ARF. Poor prognostic factors were more related to advanced age, male sex and comorbidities. There was a high mortality rate in patients with group 1 ARF.

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Conflict of interest

The authors declare that they have no conflicts of interest in relation to this article.

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