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Description and predictive factors of infection in patients with chronic kidney disease admitted to the critical care unit

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Summary *Objectives:* To describe the spectrum of infection and multidrug-resistant bacterial colonization, and to identify early predictors of infection in patients with chronic kidney disease (CKD) admitted to the critical care unit (CCU).
Methods: A 7-month observational prospective single-centre study in a French university hospital.
Results: 791 patients were admitted to the CCU, 135 of whom (17%) had severe CKD. Among these, 41 (30%) were infected on admission. Infection was microbiologically documented in 32 patients (78%), of which 7 (22%) were related to *Pseudomonas aeruginosa*. There was no infection related to extended-spectrum β-lactamase-producing enterobacteriaceae despite a 12% carriage rate on admission. A temperature ≥37.6 °C and a leukocyte count >12.000/mm^3 were specific but poorly sensitive of infection (91% and 80%, and 45% and 39%, respectively). Using the threshold of 0.85 ng/ml, procalcitonin was a strong independent predictor of infection on admission (OR 12.8, 95% CI 4.4—37.3). Age (≥60 years) and the cause of CKD were two other predictors.
Conclusions: Infection accounts for one-third of CCU admissions in CKD patients, with a high prevalence of *P. aeruginosa*. The usual diagnostic criteria are inaccurate for diagnosing infection in this population. A procalcitonin ≥0.85 ng/ml might be helpful for early identifying CKD patients with infection.

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Introduction

Chronic kidney disease (CKD) is an important public health issue[1] with an increasing number of patients requiring dialysis every year. The high risk for infection in CKD patients has been well documented,[2,3] particularly in those receiving chronic haemodialysis.[4] Risk factors that potentially predispose this population to infection are numerous, including uraemia-induced leukocyte dysfunction,[5–8] coexisting illnesses such as diabetes, immunosuppressive therapy for the underlying kidney disease, malnutrition, advanced age, vaccine hyporesponsiveness, and haemodialysis procedure with repeated disruptions of the skin barrier. For all these reasons, CKD may be considered as a state of acquired immunodeficiency.[6] Furthermore, it has been demonstrated that, once infected, CKD patients had a much higher risk of death than the general population,[9,10] so that infectious diseases are the second leading cause of death after cardiovascular diseases.[4] Moreover, infection is a major reason for intensive care unit (ICU) admission and accounts for 15—25% of all the ICU admissions in CKD patients.[11–14]

It is well recognized that the clinical suspicion of infection may be particularly difficult in CKD patients, who likely exhibit attenuated symptoms with a trend not to develop fever while infected, due to the classic hypothermia in uraemia.[15,16] In addition, the conventional laboratory parameters of inflammation may be lacking, because of uraemia or haemodialysis process. Some of these inflammatory parameters may decrease, such as white blood cells,[17,18] while others may increase such as C-reactive protein,[19–22] procalcitonin (PCT)[21–25] or other acute-phase proteins.[26,27] This complexity in diagnosing infection in CKD patients may lead to a delayed initiation of antimicrobial agents, a well-known factor of worsened prognosis in patients admitted to the ICU.[28] Early predictive factors of infection are needed to improve the clinical estimate of infection in CKD patients and help physicians' decision-making. However, the clinical and microbiological spectrum of infection in this population has received little attention in the literature, and data about multidrug-resistant (MDR) bacterial colonization are scarce in this highly medicalized population.

In this study, we analyse a cohort of consecutive patients with severe CKD admitted to the critical care units (CCUs) of a single tertiary university hospital and referral center for CKD. Our first objective was to describe the spectrum of infection, and to determine the admission carriage rate of MDR bacteria. The secondary objective was to identify the early clinical and biological predictors of infection.

Patients and methods

Patient's selection

The study was conducted in two CCUs of Tenon Hospital, Paris, France, a 700-bed teaching hospital and referral center for CKD and kidney transplantation. All consecutive patients with severe CKD admitted to the 14-bed medical ICU and the 14-bed specialised kidney acute care unit (KCU) from April 2011 to November 2011 were included. Severe CKD was defined as a glomerular filtration rate (GFR) lower than 30 ml/min/m^2 (estimated either with the Cockcroft and Gault[29] or the Modification of Diet in Renal Disease[30] equation) for at least 3 months, whether long-term haemodialysis was administered or not. Patients with a GFR higher than 30 ml/min/m^2, kidney transplant recipients, pregnant women and patients younger than 18 years old were not included in the study. The two units were located in separate buildings and the policy of admission to one or another unit was based on the presence of associated organ failures, with patients having multiple organ failures being admitted to the ICU.

Data collection

The following data were recorded: (i) demographic characteristics: age, gender, ethnicity, lifestyle, smoking and alcohol status; (ii) reason for ICU or KCU admission; (iii) characteristics of the CKD: cause (diabetes mellitus, hypertensive kidney disease, primitive glomerulonephritis, urologic and others); basal GFR and serum creatinine; long-term haemodialysis and type of vascular access; duration of dialysis dependence; preserved diuresis; (iv) main extra-renal coexisting comorbid conditions: diabetes mellitus (glucose intolerance and treatment with oral antidiabetics or insulin), obesity (Body Mass Index greater than or equal to 30 kg/m^2), HIV infection, pulmonary disease (treatment for asthma or chronic obstructive pulmonary disease or presence of interstitial lung disorders), haematologic malignancy, solid cancer, sickle cell disease, cardiac illness (treatment for arterial hypertension, coronary artery disease or congestive heart failure or presence of valvular heart disease), hepatic disease (preexisting viral or toxic liver disease) and central nervous system disorder (acute or chronic vascular or non-vascular

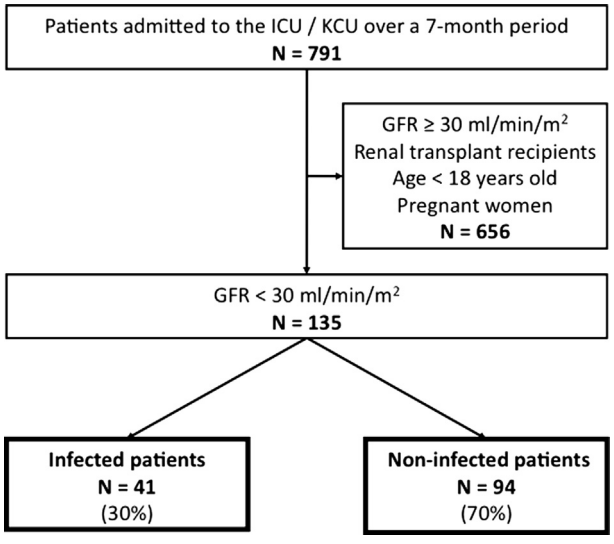

Figure 1 Selection of the patients. Among the 791 patients admitted to the ICU/KCU during the study period, 135 had a glomerular filtration rate lower than 30 ml/min/m^2, of whom 41 (30%) were diagnosed with infection on admission.