Epidemiology of acute renal failure in hospitalized patients: experience from southern Saudi Arabia

M. Al-Homrany¹

ABSTRACT Despite advances in health care, morbidity and mortality associated with acute renal failure (ARF) remain high. This study determined the frequency and etiology of ARF in hospitalized patients in Saudi Arabia over 2 years. Of the 150 cases of ARF, 38.0% were community-acquired and 62.0% hospital-acquired. The main cause was acute tubular necrosis (ATN) in 93 patients, due to sepsis (24.7%), ischaemia (12.7%), rhabdomyolysis (mainly from road traffic accidents) (10.7%), drugs (7.3%) and malaria and snake-bites (4.6%). Overall, 40% died, 48% made a full recovery and 1 patient (0.7%) became dialysis-dependent. Factors associated with poor prognosis were: age 60+ years, community-acquired ARF, peak blood urea nitrogen > 160 mg/dL, duration of ARF > 1 week, need for dialysis and associated chronic liver disease.

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Introduction

Acute renal failure (ARF) is a frequent complication in hospitalized patients. Despite substantial advances in renal replacement therapy and health care delivery, morbidity and mortality rates associated with ARF have remained high [1–3]. Although reliable statistics on the prevalence of ARF among different tropical countries are not available, statistics based on referrals to dialysis units suggest that the condition is more common in the tropics. Earlier reports from the Middle East have indicated that the incidence of ARF is several times higher in the region than elsewhere [4–6].

Snakebite, malaria, liver diseases and road traffic accidents are common health problems in Saudi Arabia [7–9], and the contribution of these conditions to the development of ARF have not been studied before. This report was undertaken to study the pattern of ARF in hospitalized patients in southern Saudi Arabia.

Methods

A prospective study was made of all adult patients (15 years and over) with ARF during a 2-year period (January 1999 to December 2000) attending Asir Central Hospital, southern Saudi Arabia. Children were not included.

The diagnosis of ARF was based on history, physical examination, laboratory data and clinical course. To select cases for the study, ARF was defined as a sudden deterioration in renal function presenting either as oliguria (urine volume ≤ 400 mL/day) for at least 48 hours or as a rise in serum creatinine level of more than 50% and ≥ 2 mg/dL. To ensure accurate diagnosis all cases were evaluated and followed up by a nephrologist until their renal functions normalized, they were discharged from the hospital or they died (average period 3 weeks). Consent was obtained from patients who required kidney biopsy.

Cases were divided into community-acquired ARF, defined as renal failure developing outside the hospital, and hospital-acquired ARF, defined as renal failure that developed during hospitalization for non-renal-related problems in patients whose serum creatinine level on admission was normal.

The data were studied and coded. Analysis was carried out using SPSS, version 10. The chi-squared test, Student t-test and Fisher exact test were used as tests of significance at the 5% level of significance. Multivariate logistic regression analysis was carried out to study potential factors that might affect survival of acute renal failure. Age, peak blood urea nitrogen (BUN), acquiring ARF during hospitalization, duration of renal failure and having concomitant liver disease were included in the logistic regression model. Serum plasma urea was tested using enzymatic methods and serum creatinine using spectrophotometry.

Results

There were 150 patients with ARF in this study: 58.7% males and 41.3% females. The mean age of patients was 58.9 ± 22.5 years and 57.3% were 60 years or over (Table 1). Total admissions to the hospital during the study period were 26,000 patients, giving an incidence of ARF among hospitalized patients of 0.6%.

The mean duration of ARF was 10.7 ± 9.2 days (range 1–46 days). One-fifth of patients (21.3%) required dialysis while 78.7% did not require dialysis intervention. The mean duration of dialysis treatment was 6.1 ± 6.9 days (range 1–40 days).

Table 1: Characteristics of patients with ARF

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>58.9 ± 22.5</td>
<td>57.3 ± 22.5</td>
<td>58.9 ± 22.5</td>
</tr>
<tr>
<td>Sex</td>
<td>58.7%</td>
<td>41.3%</td>
<td>58.7%</td>
</tr>
<tr>
<td>Incidence</td>
<td>0.6%</td>
<td>0.6%</td>
<td>0.6%</td>
</tr>
<tr>
<td>Duration</td>
<td>10.7 ± 9.2</td>
<td>9.2 ± 9.2</td>
<td>10.7 ± 9.2</td>
</tr>
<tr>
<td>Hemodialysis</td>
<td>21.3%</td>
<td>21.3%</td>
<td>21.3%</td>
</tr>
</tbody>
</table>
A majority of patients (93, 62.0%) acquired ARF in hospital after admission for other reasons, while the other 57 patients (38.0%) were admitted primarily due to ARF (Table 2). Associated medical diseases were cardiac problems in 16.0% of patients, diabetes in 15.3% and hepatic problems in 10.7% (Table 2).

The commonest cause of ARF was acute tubular necrosis (ATN) in 93 (62.5%) of the patients (Table 2). Sepsis was the leading cause of ATN (37/93 cases), followed by ischaemia (19/93) and rhabdomyolysis of different etiologies (16/93); 10 of the rhabdomyolysis cases were traumatic following road traffic accidents. ARF was drug-induced in 11 cases due to aminoglycoside antibacterials. Snakebite and malaria comprised 7 cases.

The outcome of renal failure is seen in Table 3. Overall, 60 (40.0%) ARF patients died, 72 (48.0%) achieved full recovery and only 1 patient (0.7%) became dialysis-dependant. Uncontrolled sepsis and multi-organ failure was the leading cause of death (39/60 cases); other major causes of death were hepatic failure (6/60) and myocardial infarction (6/60). All patients with chronic liver diseases who developed ARF during hospitalization died.

Table 4 shows a comparison of hospital- and community-acquired ARF cases. Mortality was significantly more frequent in hospital-acquired ARF than community-acquired ARF. On the other hand, full recovery was significantly more frequent in community-acquired ARF than hospital-acquired ARF.
Factors that determined the survival of our study population are shown in Table 5. Age less than 60 years, low peak BUN, hospital-acquired ARF, short duration of ARF, no concomitant liver disease and no intervention with dialysis were good prognostic factors for better patient survival.

**Discussion**

In recent years, improvements in socioeconomic conditions, rapid industrialization, expanding medical facilities and developments in prevention have led to a near eradication of ARF due to infection and obstetric accident. ARF in industrialized societies is now largely a consequence of road traffic and industrial accidents, cardiovascular surgery, drugs, multi-organ failure and renal transplant rejection [10]. The patterns of ARF encountered in the tropics have shown changes similar to those in the industrialized countries, although at a slower pace [11]. Among the medical causes of ARF, etiological factors leading to ARF in tropical countries are different from those seen in the industrialized world. Diarrhoeal diseases, intravascular haemolysis due to glucose-6-phosphate de-
hydrogenase (G6PD) deficiency, copper sulphate poisoning, snakebite and insect stings together constitute over 40% of all cases of ARF in India, problems that are rarely encountered in western Europe and the USA [12,13].

The incidence of ARF among our hospitalized patients was 0.6%. This is in agreement with reports from the Middle East and industrialized countries where the incidence of ARF was reported to be between 0.1%–1.5% [14–16]. Although the spectrum of the different etiological factors for ARF was not different from previous reports from the region, there were, however, 2 new factors contributing to the cause of ARF in this study, namely snakebite and malaria. Although these 2 tropical problems contributed only to 4.6% of the causes of ARF, they have not been reported previously in other studies. Snakebite and malaria are common health problems in southern Arabia [7,9] and ARF is a common complication of these conditions. The overall prevalence of ARF in Plasmodium falciparum malaria can reach up to 60% of inpatients with heavy parasitaemia [17,18]. The incidence of ARF following snakebite is reported to be 13%–32% in India and snakebite contributes to 3% of the causes of ARF [12]. Although it is a common health problem, particularly in southern Arabia, the true incidence of ARF following snakebite is not known and few case reports have been published [19,20].

ATN was the commonest reason for ARF seen in our hospitalized patients. Septis and ischaemic causes were the commonest causes of ATN in this study, and this is similar to other reports [3–5]. Rhabdomyolysis of different etiologies contributed to 10.7% of ARF cases in our study. This finding is also unique to our study and has not been seen in previous reports from neighbouring countries [4–6,10]. Rhabdomyolysis is defined as injury to skeletal muscle cell of such severity that their contents are released into the circulation. Myoglobinuria is a consequence of rhabdomyolysis. Rhabdomyolysis is caused by either traumatic or non-traumatic factors. In the tropics, the common causes of non-traumatic rhabdomyolysis leading to myoglobinuric ARF include: eclampsia, prolonged labour, poisoning with mercuric chloride or zinc phosphide, status epilepticus, viral myositis, burns and electrical injury [21]. The incidence of post-traumatic ARF has been reported to be 3%–12% [22,23]. Two-thirds of rhabdomyolysis cases in our study were the result of road traffic accidents. Based on this study it is difficult to estimate the risk of ARF following road traffic accidents and further studies are needed.

Nephrotoxicity from drugs remains an important cause of ARF, both in nephrology units and intensive care units as well as in general surgical and medical wards. Drug-induced ARF comprised 7.3% of

Table 5 Multivariate logistic regression model: adjusted odds ratio (OR) and 95% confidence intervals (CI) of potential determinants of survival in cases of acute renal failure

<table>
<thead>
<tr>
<th>Factor</th>
<th>Adjusted OR</th>
<th>95% CI</th>
<th>P-value</th>
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<tbody>
<tr>
<td>Age &lt; 60 years</td>
<td>3.2</td>
<td>1.3–8.2</td>
<td>0.014</td>
</tr>
<tr>
<td>Peak BUN (&lt; 160 mg/dL)</td>
<td>3.1</td>
<td>1.2–8.2</td>
<td>0.018</td>
</tr>
<tr>
<td>Hospital-acquired renal failure</td>
<td>5.0</td>
<td>1.9–12.5</td>
<td>0.001</td>
</tr>
<tr>
<td>No liver disease</td>
<td>5.1</td>
<td>1.2–21.3</td>
<td>0.025</td>
</tr>
<tr>
<td>Duration of renal failure (&lt; 1 week)</td>
<td>3.9</td>
<td>1.5–11.1</td>
<td>0.004</td>
</tr>
<tr>
<td>No dialysis</td>
<td>10.7</td>
<td>3.0–37.5</td>
<td>0.000</td>
</tr>
</tbody>
</table>

BUN = blood urea nitrogen.
cases in our study. In a North American
general hospital the incidence of drug-
induced ARF was estimated to be 20% [24]. Different studies from the Middle
East have reported higher incidences of
drug-induced ARF, up to 24% reported
from Kuwait [4]. Our data showed a lower
incidence than previously reported [4,24].

The mortality rate in this study was
40.0%. This is in agreement with the gen-
eral impression that, despite impressive ad-
vances in the management of patients with
ARF, there has been little improvement in
survival rates [25]. The main causes of
death in our population were uncontrolled
sepsis and multi-organ failure in 39 cases
(26.0%). All patients with chronic liver dis-
ease who developed ARF during hospital-
ization died. ARF complicating chronic
liver diseases is not infrequent in this region
where there is high prevalence of chronic
carrier state for viral hepatitis [8]. In one
study from Saudi Arabia 4 out of 18 deaths
in ARF were caused by hepatic failure [21].

In our study, hepatic failure was the main
cause of death in 4.0% of cases.

Patients who developed ARF in hospital
show a higher mortality rate and less
chance of their renal function recovering to
normal. This can be explained by the fact
that those patients who acquired renal fail-
ure during hospitalization are already ill and
have concomitant medical problems such
as chronic liver disease. A better survival
rate was observed in younger patients, low
peak BUN, short duration of ARF (< 1
week) and in those patients who did not re-
quire dialysis treatment.

In summary, ARF remains one of the
major medical problems that require special
attention in hospitalized patients. Despite
the developments in diagnostic techniques
and the availability of dialysis in most re-
ferral hospitals, the morbidity and mortality
associated with ARF remains high. Approp-
riate treatment and avoidance of toxic
agents in hospitalized patients may help to
reduce the mortality in those at high risk.

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