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Acute Kidney Injury: It's not just the 'big' burns☆

L.A. Kimmel[a,b,*], S. Wilson[c,d,e], R.G. Walker[c,e], Y. Singer[f], H. Cleland[f,g]

[a] Department of Physiotherapy, The Alfred, Melbourne, Australia
[b] Department of Epidemiology and Preventive Medicine, Monash University, Melbourne, Australia
[c] Department of Renal Medicine, The Alfred, Melbourne, Australia
[d] Baker IDI, Melbourne, Australia
[e] Department of Medicine, Monash University, Melbourne, Australia
[f] Victorian Adult Burns Service, The Alfred, Melbourne, Australia
[g] Department of Surgery, Central Clinical School, Monash University, Melbourne, Australia

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ABSTRACT

Background: Acute Kidney Injury (AKI) complicates the management of at least 25% of patients with severe burns and is associated with long term complications. Most research focuses on the patients with more severe burns, and whether the same factors are associated with the development of AKI in patients with burns between 10 and 19% total body surface area (TBSA) is unknown. The aims of this study were to examine the incidence of, and factors associated with, the development of AKI in patients with%TBSA ≥ 10, as well as the relationship with hospital metrics such as length of stay (LOS).
Methods: Retrospective medical record review of consecutive burns patients admitted to The Alfred Hospital, the major adult burns centre in Victoria, Australia. Demographic and injury details were recorded. Factors associated with AKI were determined using multiple logistic regression.
Results: Between 2010 and June 2014, 300 patients were admitted with burn injury and data on 267 patients was available for analysis. Median age was 54.5 years with 78% being male. Median%TBSA was 15 (IQR 12, 20). The AKI incidence, as measured by the RIFLE criteria, was 22.5%, including 15% (27/184) in patients with%TBSA 10–19. Factors associated with AKI included increasing age and%TBSA (OR 1.05 $p < 0.001$) as well as increased surgeries ($p < 0.041$) and a cardiac comorbidity ($p < 0.01$). All patients with renal comorbidity developed AKI. In the%TBSA 10–19 cohort, only increasing age (OR 1.05 $p < 0.001$) was associated with AKI. After accounting for confounding factors, the probability of discharge from hospital in Non-AKI group was greater than for the AKI patients at all time points ($P < 0.001$).
Conclusion: This is the first study to show an association between patients with%TBSA 10–19 and AKI. Given the association between AKI and complications, prospective research is needed to further understand AKI in burns with the aim of risk reduction.

Introduction

Acute Kidney Injury (AKI) complicates the management of at least one in four patients with severe burns [1]. Observational cohort analyses in patients with greater than 10% total body surface area (TBSA) have identified inhalational injury, catheter infection, restrictive resuscitation volumes [2] and sepsis as associated risk factors though the epidemiology across the spectrum of burn severity is unclear [3]. A recent systematic review found the pooled incidence of AKI in all patients admitted to hospital with a severe burn injury was nearly 40% [4]. Factors associated with AKI in this analysis included increasing age and TBSA, inhalation and flame injury, sequential organ failure assessment score, baseline blood urea nitrogen, creatinine and sepsis [4].

Acute kidney injury in the burns population is associated with increased mortality [3–7] with some studies also reporting increased morbidity leading to chronic and end stage renal disease [5,6]. Furthermore, the development of AKI may negatively influence hospital metrics including increased length of stay (LOS) and readmission [5]. Even a single episode of non-dialysis requiring AKI (irrespective of severity) may be associated with mortality and long term renal dysfunction [8,9], making assessment of this complication paramount in all patients who sustain burns, not only those at the more severe end of the spectrum.

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* Corresponding author at: Department of Physiotherapy, The Alfred, Melbourne, Australia.
E-mail address: l.kimmel@alfred.org.au (L.A. Kimmel).

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The present study examines the incidence, associated clinical factors and hospital LOS outcomes of AKI using the RIFLE criteria (a classification tool to measure AKI) [10] in all patients with%TBSA >10 from an Australian tertiary burns centre. Stratification across severity of 'major burn' was undertaken by sub analysis comparing %TBSA involvement between 10 and 19 compared with ≥ 20 to determine if the factors related to AKI are different across the spectrum of severity.

Methods

Design and data collection

This study was approved by The Alfred Research and Ethics Committee (project number 356/16). From the Victorian Adult Burns Service registry, all consecutive patients admitted to The Alfred Hospital, the adult burns referral centre Victoria, Australia, with %TBSA >10 between January 2010 and December 2014 were included. Patients were excluded if they died within 48 h of admission as they either did not have any blood tests or did not have significant time to develop AKI or show the effects of any AKI episode.

Demographic, comorbidity and hospitalisation data were collected by direct case review.

Renal outcome measures

The primary outcome was incidence of AKI as measured by the RIFLE criteria [10] which classifies patients according to stages of (i) Risk: estimated glomerular filtration rate (eGFR) decrease $>25\%$/serum creatinine increased 1.5 times (ii) Injury: eGFR decrease $>50\%$/doubling of creatinine; (iii) Failure: eGFR decrease $>75\%$, tripling of creatinine or creatinine >355 μmol/L (with a rise of >44 μmol/L) (>4 mg/dL) (iv) Loss: persistent AKI or complete loss of kidney function for more than 4 weeks and (v) End-stage renal disease: need for renal replacement therapy for >3 months. Biochemical markers of the RIFLE criteria were applied in isolation as urine output was not consistently available for analysis. In the absence of consensus as to the most representative means of assessing baseline eGFR [11,12] the baseline (pre-existing level of renal function) was assumed at the maximum eGFR achieved at least twice throughout hospitalisation. Determining AKI relies on a patient having two or more renal function tests taken at different time points. A patient was classified as having AKI if they achieved a RIFLE criteria of "risk" or greater.

Statistical analysis

Descriptive analysis was used to outline patient demographics with univariate analysis reporting the difference between those who developed AKI and those who did not (Non-AKI). Continuous variables were expressed by median and interquartile range and categorical variables by raw numbers and percentages. A backwards stepwise logistic regression was performed to determine those factors associated with AKI, and their adjusted odds in (i) the entire population and (ii) those patients with%TBSA 10–19 alone. All factors with a univariate association >0.2 were included in the analysis. These included age, gender, %TBSA, comorbidities (renal, cardiac, diabetes), full or deep thickness burns, referral source (direct admission from scene/other), time to admission (hours), inhalational injury, number of surgeries, ventilation hours, and positive blood culture results.

The effect of AKI on length of hospital stay (acute and inpatient rehabilitation) was evaluated using a Cox proportional hazards regression, taking into account the confounders to this relationship including age, %TBSA, gender, hours ventilated and blood culture positivity. Kaplan-Meier survival curves were constructed taking into account these factors and a log rank test was performed.

A P-value of 0.05 was used to determine statistical significance. All analyses were completed using STATA Version13.2 (StataCorp, College Station,TX,USA).

Results

Three hundred consecutive patients with%TBSA >10 were included from The Alfred Hospital database during the study period and, of these, 267 were included in the final analysis (Fig. 1). Twenty three patients were excluded as they died within 48 h of admission. A further 10 patients did not have two blood tests and therefore a change in renal function could not be calculated in these cases.

The description of the patient cohort is shown in Table 1. The median age was 54.5 years with the majority of the population being male (78%). The median%TBSA was 15 (IQR 12, 20). Half of the population had a%TBSA injury <20. The incidence of AKI in the study population was 22.5% with over 2.5 times the frequency associated with%TBSA ≥ 20 as opposed to the%TBSA 10–19 cohort (AKI incidence 33/83 (40%) and 27/184 (15%) respectively). Median time from admission to the development of AKI was 1 day (IQR 0, 7) with 39 patients (68%) manifesting AKI within 24 h.

When reviewing AKI based on the RIFLE criteria for the entire cohort, 34 patients had category 1 (risk), 15 had RIFLE category 2 (injury) and 11 had RIFLE category 3 (failure). For those patients with a%TBSA <20, the severity of AKI was lower with 21 patients in RIFLE category 1, five with category 2 and one in RIFLE category 3.

The in-hospital mortality rate for the entire study cohort was 2.6% (7 patients), with 3 of these having%TBSA 20. Five of the patients who died had developed AKI as opposed to 2 who had not ($p < 0.001$). None of these had a RIFLE category of "Failure".

Of the 260 patients who survived to discharge, only 45 patients (17%) had follow-up blood tests recorded by the burns service in the year following their discharge, including 20 of those who experienced AKI. This represents a follow-up rate of 36.4% of those patients who survived to discharge and experienced an episode of AKI. The median eGFR at follow-up for this group was 84 mL/min/1.73 m^2 (IQR 68–90) compared to 90 mL/min/1.73 m^2 (IQR 90-90) for those without AKI.

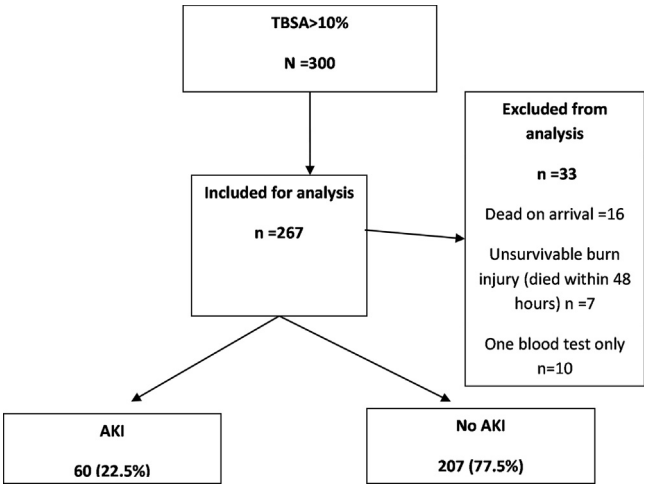

Fig. 1. Flow of patients.

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