Acute renal dysfunction following hip fracture

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ABSTRACT

We investigated the incidence, risk factors and outcome of acute renal dysfunction (ARD) in patients with a fractured neck of femur.

170 consecutive patients were prospectively included in the Scottish Hip Fracture Audit database and retrospectively analysed. Historically, lack of consensus definition has hindered accurate reporting of ARD. ARD was defined using the 'RIFLE' criteria.

27 patients (16%) developed ARD. Risk factors were male sex, vascular disease, hypertension, diabetes, chronic kidney disease and pre-morbid use of nephrotoxic medications ($p < 0.01$). Inpatient, 30- and 120-day mortality was higher in the ARD group 19%, 22% and 41% respectively, versus 0%, 4% and 13% in the non-ARD group ($p < 0.01$). Length of hospital stay was significantly longer in the ARD group. Pre- and post-operative complications were 12 and 5 times more frequent respectively in the ARD group ($p < 0.01$).

Awareness of risk factors and serial measurements of renal function allow early identification and focused monitoring of these patients.

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Introduction

Hip fractures are a common injury of the elderly and have increased in frequency by 40% in Scotland between 1982 and 1998.[6] These patients are a high risk surgical population with considerable rates of post-operative mortality, morbidity and protracted length of hospital stay. Post-operative renal dysfunction has also been shown to increase in-hospital mortality, length of hospitalisation and risk of discharge to an extended care facility in certain patient populations.[9,3] The Scottish Intercollegiate Guideline Group published guidelines on hip fracture management in 2002 targeting preadmission dehydration, renal dysfunction, pre- and post-operative fluid balance management as areas requiring further research.[6]

Little is known about the incidence of acute renal dysfunction (ARD) in these patients, or indeed other surgical populations. The inherent problem, until recently, was the lack of consensus definition of acute renal dysfunction. A systematic review of 28 studies looking at pre-operative risk factors for ARD performed in 1994[10] struggled to draw any meaningful conclusions because no two studies used the same diagnostic criteria. In 2004, the Acute Dialysis Quality Initiative (ADQI) Group published recommendations[1] covering diagnosis, monitoring and the choice of physiological and clinical end points for trials. They developed the RIFLE classification system for patients with acute renal dysfunction that allows categorisation of patients into well-defined groups. This is now well-accepted in the renal literature as a reliable classification system for patients with ARD.

This study used the RIFLE classification to categorise patients with acute renal dysfunction (Table 1).

Each letter in 'RIFLE' corresponds to a progressive level of dysfunction; **R**isk of renal dysfunction (RIFLE 1), **I**njury to the kidney (RIFLE 2) and **F**ailure of kidney function (RIFLE 3) reflected by acute deterioration in function. **L**oss of kidney function and **E**nd stage kidney disease reflect persisting loss of function at >4 weeks and >3 months respectively.

A patient can be classified based on either biochemical changes or urine output. The glomerular filtration rate (GFR) criteria uses either an increase in serum creatinine or fall in estimated GFR (eGFR)—whichever parameter is most abnormal. The eGFR is used in addition to serum creatinine, as the latter can underestimate renal impairment. The urine output criteria uses both the duration and severity of oliguria. The advantage of the classification is that it encompasses both acute and acute-on-chronic renal failure.

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Table 1
RIFLE classification for acute renal failure[5].

	Glomerular filtration rate (GFR) criteria	Urine output (UO) criteria
Risk	↑serum creatinine × 1.5 or ↓eGFR >25%	UO < 0.5 ml/kg/h × 6 h
Injury	↑serum creatinine × 2 or ↓eGFR >50%	UO < 0.5 ml/kg/h × 12 h
Failure	↑serum creatinine × 3, ↓eGFR >75% or serum creatinine >400 mg/dl	UO < 0.3 ml/kg/h × 24 h
Loss	Persistent ARD = complete loss of kidney function >4 weeks	
ESKD	End stage kidney disease (>3 months)	

The aim of this study was to define the incidence of, risk factors for and outcome of acute renal dysfunction in patients presenting to our hospital with a fractured neck of femur.

Materials and methods

We performed a retrospective analysis of patients selected from the Scottish Hip Fracture Audit database.[15] We identified 177 consecutive patients who presented with a hip fracture to a single orthopaedic trauma unit during a 10-week period between August and October 2005. In total 7 patients were excluded from the study; 5 because of missing data and 2 because they had suffered multiple injuries.

Case notes and blood results were reviewed. Basic demographics, time from admission to surgery, length of hospital stay and inpatient mortality were recorded. The 30- and 120-day mortality figures were obtained by linking the Scottish Hip Fracture Audit[15] database to the ISD Scotland linked data set (including SMR01 records and GROS dates of death). All relevant medical co-morbidities were recorded. These were categorised as vascular disease (which included ischaemic heart disease, cerebral vascular disease and peripheral vascular disease), hypertension, diabetes mellitus and pre-existing chronic kidney disease. Medications known to affect renal function were recorded, including angiotensin converting enzyme inhibitors (ACE-I), angiotensin-II receptor antagonists, non-steroidal anti-inflammatory (NSAID), diuretics and opiates.

Pre-operative acute medical problems were recorded. Urinary tract infection was defined as a suggestive clinical picture with >10^5 organisms/ml found in the urine. Lower respiratory tract infection was diagnosed by the presence of new or changing pulmonary infiltrates on chest X-ray and/or purulent sputum production. Gastrointestinal bleeding was defined as haematemesis or melaena requiring endoscopic investigation.

The intra-operative period was assessed for the presence of hypotension (systolic blood pressure <90 mm Hg), total blood loss and any other complications that occurred.

Post-operative complications were recorded using the same criteria as for the pre-operative complications as described above. In addition, wound infection was considered present if diagnosed clinically and confirmed by bacteriology. Atrial fibrillation was considered a complication if it was of new onset and confirmed by ECG.

Acute renal dysfunction cannot be routinely defined by a single blood test on admission to a trauma unit because in most cases no reliable comparison can be made with previous renal function tests. Thus we compared a patient's worst serum creatinine and eGFR (this could be on admission or post-operatively) with their discharge values to give us their RIFLE status, on the basis that the lowest creatinine (highest GFR) would be the closest representation of true baseline renal function. For example, a patient presenting to hospital with a creatinine of 200 μmol/l was placed in the 'Injury' category if their creatinine fell to below 100 μmol/l and eGFR had doubled by discharge.

We used the serum creatinine and eGFR only to categorise patients in this study as urinary output was not consistently measured in all hip fracture patients.

Statistical methods

Inpatient mortality, independent co-morbidities and pre- and post-operative medical complications were compared between the groups by using two-by-two contingency tables with chi-squared analysis and Fischer's exact test for categorical variables. The Student's t-test was used to compare parametric data and the Mann–Whitney U-test was used on non-parametric data. The paired t-test was used to compare changes in eGFR. Two-tailed p-values were calculated on each variable between groups. A p-value of less than 0.05 was considered significant.

Results

Of 170 patients, 27 (16%) developed acute renal dysfunction. These were subdivided as having either RIFLE 1 (19/27 patients, 11%) or RIFLE 2 (8/27 patients, 5%) during their admission. No patients progressed to RIFLE 3. 3 patients developed ARD pre-operatively and 24 post-operatively.

The demographics of patients with acute renal dysfunction (ARD group) and those without acute renal dysfunction (non-ARD group) are shown in Table 2. The ARD group were older, had significantly more medical co-morbidities and were receiving greater numbers of nephrotoxic medications, compared to the non-ARD group. 1 in 3 men with a hip fracture developed ARD.

Inpatient mortality within the ARD group was 5/27 patients (19%) and there were no inpatient deaths in the non-ARD group. Of the 22/27 patients who survived, renal function had improved, with the median eGFR closer to normal (60 ml/min/1.73 m²) by the date of discharge. The 30-day mortality was 22% (6/27 patients) in the ARD group, compared to 4% (5/143 patients) in the non-ARD group. The 120-day mortality was 41% (11/27 patients) in the ARD group compared to 13% (19/143 patients) in the non-ARD group. There was a significant difference between the length of time from admission to surgery between groups; 48% of patients in the ARD group had their surgery within 2 days compared to 70% in the non-ARD group ($p < 0.03$). Additionally, the length of hospital stay differed between the two groups. The median length of stay of patients in the ARD group was 20 days compared to 13 days for patients in the non-ARD group (Table 3).

In the ARD group, the admission eGFR was lower (median 47 ml/min/1.73 m², interquartile range 38–60 ml/min/1.73 m²),

Table 2
Patient demographics, co-morbidities and medications.

	ARD ($n = 27$)	Non-ARD ($n = 143$)	p-Value
Age (range)	85 (63–97)	81 (51–99)	
Sex (M:F)	13:14	27:116	<0.001
Vascular disease	14 (52%)	31 (13%)	<0.001
Diabetes mellitus	11 (41%)	8 (6%)	<0.001
Hypertension	16 (59%)	45 (32%)	<0.002
CKD	3 (11%)	2 (1%)	<0.001
ACE-I	9 (33%)	22 (15%)	
Diuretic	22 (82%)	41 (29%)	
NSAID	8 (30%)	37 (26%)	
Opiates	12 (44%)	30 (21%)	