

ACUTE KIDNEY INJURY FOLLOWING SURGERY FOR HIP FRACTURE

LESÃO RENAL AGUDA APÓS CIRURGIA DE FRATURA DE QUADRIL

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ABSTRACT

Objective: An observational study was carried out to determine the rate of acute kidney injury (AKI) following surgery for hip fracture at our institution and to look for factors associated with AKI. **Methods:** Preoperative creatinine values were compared to post-operative results for all patients who underwent surgery for hip fracture at our institution between 1st January 2015 and 30th September 2016. AKI was defined as an increase in postoperative creatinine, greater than or equal to 1.5 times the preoperative value within 7 days. Chi-squared test and Student's t-test were used to look for factors associated with AKI. **Results:** Out of 500 patients, 96 developed an AKI (19.2%). Patients with chronic kidney disease (CKD) were more likely to develop AKI (30.8%) than those without it (17.2%, $p = 0.018$). Similarly, patients with 2 or more comorbidities were more likely to develop AKI (22.0%) than those without it (12.4%, $p = 0.009$). No statistically significant association was observed between type of surgery and AKI. **Conclusion:** A large proportion of patients following surgery for hip fracture developed AKI. Patients with CKD and the presence of 2 or more comorbidities had significantly higher rates of AKI. **Level III evidence, Retrospective comparative study.**

Keywords: Hip Fractures. Acute Kidney Injury. Hip. Hemiarthroplasty. Fracture Fixation. Arthroplasty, Replacement.

RESUMO

Objetivo: Estudo observacional realizado no Altnagelvin Hospital para determinar a taxa de lesão renal aguda (LRA) após a cirurgia de fratura de quadril e procurar fatores associados à LRA. **Métodos:** Os valores de creatinina pré-operatória foram comparados aos resultados pós-operatórios em todos os pacientes submetidos à cirurgia de fratura de quadril entre 1^o de janeiro de 2015 e 30 de setembro de 2016. A LRA foi definida como aumento da creatinina pós-operatória maior ou igual a 1,5 vezes ao valor pré-operatório dentro de 7 dias. Os testes qui-quadrado e t-Student foram usados para procurar fatores associados à LRA. **Resultados:** Dos 500 pacientes, 96 desenvolveram LRA (19,2%). Pacientes com doença renal crônica (DRC) foram mais propensos a desenvolver LRA (30,8%) do que os pacientes sem a doença (17,2%, $p = 0,018$). Da mesma forma, pacientes com duas ou mais comorbidades foram mais propensos a desenvolver LRA (22,0%) do que os pacientes sem comorbidades (12,4%, $p = 0,009$). Não houve associação estatisticamente significativa entre tipo de cirurgia e LRA. **Conclusão:** Após a cirurgia de fratura de quadril uma grande proporção de pacientes desenvolveu LRA. Pacientes com DRC e duas ou mais comorbidades tiveram taxas significativamente maiores de LRA. **Nível de evidência III, Estudo comparativo retrospectivo.**

Descritores: Fraturas do Quadril. Lesão Renal Aguda. Quadril. Hemiartroroplastia. Fixação de Fratura. Artroplastia de Substituição.

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INTRODUCTION

Hip fracture is a rising epidemic associated with prolonged stay in hospital and reduction in quality of life.¹ Acute kidney injury (AKI) following surgery for hip fracture is common.² Long- and short-term mortality rates are higher for patients who develop AKI following surgery for hip fracture compared to those who do not.^{3,4} This group of patients is aging with more comorbidities.⁵ Recent studies have shown that increasing age and number of

comorbidities are associated with significantly more patients developing AKI following surgery for hip fracture.⁶ Observational studies have shown that up to 21% of patients following surgery for hip fracture can develop AKI; however, results vary among studies.^{6,7} The purpose of this study was to determine how many patients developed AKI following hip fracture in our institution and if previously suggested risk factors for postoperative AKI are true for this patient sample.

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METHODS

All patients aged over 65 years who underwent surgery for hip fracture at Altnagelvin Area Hospital between 01/01/2015 and 09/21/2016 were identified using our hip fracture database.

Baseline serum creatinine concentration (day of hospital admission) and postoperative serum creatinine concentration (day 1 and 4) were recorded at the Northern Ireland Electronic Care Record. Recorded information also included age, sex, type of fracture and surgery, date and duration of surgery, length of stay in hospital and medical comorbidities.

AKI was defined as an increase in postoperative serum creatinine concentration greater than or equal to 1.5 times the baseline value within 7 days.

Statistics

Results are presented as mean and standard deviation (SD) for continuous variables. Binary and categorical variables are summarized by frequency. Chi-squared test and Student's t-test were used to investigate risk factors associated with post-surgical AKI (increasing age, male sex, chronic kidney disease—CKD and 2 or more comorbidities). All analyses were performed with IBM SPSS Statistics version 20 (IBM Corporation, New York, US).

RESULTS

Baseline patient characteristics are summarized in Table 1. The mean age was 81.4 years and most patients were women. Frequent comorbidity included ischaemic heart disease (13%), chronic obstructive pulmonary disease (11.2%) and 14.2% of patients had a history of diabetes mellitus. The most common type of operation performed was hip hemiarthroplasty (46.8%), followed by dynamic hip screw insertion (29.8%) and long intramedullary nail insertion (16.2%). The least common operation performed was total hip replacement (7.2% of patients). The mean preoperative serum creatinine was 90 micromoles per liter.

Out of 500 patients aged over 65 years who underwent surgery for hip fracture, 96 developed AKI (19.2%).

Table 1. Baseline patient characteristics and type of surgery.

	All Patients N = 500
Mean age, years (SD)	81.4 (8.6)
Sex, n (%)	
Male	133 (26.6)
Female	367 (73.4)
Past Medical History, n (%)	
Ischaemic heart disease	65 (13.0)
Chronic obstructive pulmonary disease	56 (11.2)
Cerebrovascular accident	49 (9.8)
Diabetes mellitus	71 (14.2)
Myocardial infarction	31 (6.2)
Type of Surgery, n (%)	
Dynamic hip screw	149 (29.8)
Hip hemiarthroplasty	234 (46.8)
Long intramedullary nail	81 (16.2)
Total hip replacement	36 (7.2)
Mean preoperative creatinine concentration, micromoles/l (SD)	90 (50.0)

Table 2 shows the risk factors known to be associated with AKI following surgery for hip fracture. Patients with chronic kidney disease and the presence of 2 or more comorbidities had significantly higher rates of AKI (p-value = 0.018 and 0.009 respectively).

A significant difference was identified between mean preoperative serum creatinine concentration and development of AKI ($p = < 0.001$). No significant difference was found regarding sex ($p = 0.200$), mean age or type of surgery performed ($p = 0.282$) and development of AKI ($p = 0.459$).

Table 2. Possible factors associated with acute kidney injury following hip fracture.

	Patients with AKI	Patients without AKI	p value
Mean age, years (SD)	82.5 (9.1)	81.1 (8.4)	0.459 Student's t-test
Sex, n (%)			
Male	30 (6.0)	103 (20.6)	0.200 Chi-squared test
Female	66 (13.2)	301 (60.2)	
Type of Surgery, n (%)			
Dynamic hip screw	25 (5.0)	124 (24.8)	0.282 Chi-squared test
Hip hemiarthroplasty	44 (8.8)	190 (38.0)	
Long intramedullary nail	22 (4.4)	59 (11.8)	
Total hip replacement	6 (1.2)	30 (6.0)	
Comorbidities, n (%)*			
≥ 2 comorbidities	78 (15.6)	277 (55.4)	0.009 Chi-squared test
< 2 comorbidities	18 (3.6)	127 (25.4)	
Chronic kidney disease, n (%)	20 (4.0)	45 (9.0)	0.018 Chi-squared test
No chronic kidney disease, n (%)	75 (15.0)	360 (72.0)	
Mean preop creatinine concentration, micromoles/l (SD)	109.0 (80.0)	85.0 (39.0)	< 0.001 Student's t-test

*Cerebrovascular accident, transient ischaemic attack, cardiovascular disease, chronic obstructive pulmonary disease.

DISCUSSION

Recent studies have shown that between 12.7% and 24.0% of patients develop AKI following surgery for hip fracture.^{2-4,6,7} In this study, 19.2% of patients developed AKI within 7 days of surgery for hip fracture. This is comparable to the findings from other recent studies. Variability exists in relation to how AKI is defined, and this may contribute to the differences presented in numbers of patients developing AKI.

In one of the largest studies investigating AKI following surgery for hip fracture, 12.7% of 13,529 patients from hospitals in Denmark developed AKI.⁸ Baseline serum creatinine was estimated using an electronic database of blood results.⁸ The highest serum creatinine value in the first 5 postoperative days was compared to baseline.⁸ AKI was defined according to the criteria in The Kidney Disease Improving Global Outcome (KIDGO) classification.⁹

A similar study included 2,959 patients from UK hospitals.¹⁰ Baseline serum creatinine was estimated using the Modification of Diet and Renal Disease (MDRD) equation.¹⁰ Then this result was compared to the highest postoperative value for the length of hospital stay.¹⁰ AKI was defined again according to the KIDGO classification. A total of 24% of patients developed a post-surgical AKI.¹⁰

One modifiable factor that may affect the development of postoperative AKI is the antibiotic choice for surgical prophylaxis. In this study, all patients received flucloxacillin and gentamicin. Higher rates of AKI among patients receiving flucloxacillin and gentamicin have been seen compared to cephalosporins for elective hip and knee surgery.¹¹

Intraoperative measures also play an important role in preventing postoperative AKI. Hypovolaemia due to intraoperative blood loss will lead to reduced renal perfusion.^{12,13} Even short periods of low mean arterial pressure are poorly tolerated and associated with increased risk of postoperative AKI.^{12,13} This fact highlights the importance of accurate measurement of intraoperative blood loss, recording of blood pressure while the patient is anesthetized and careful assessment of fluid balance in the perioperative period.^{12,13} Another important modifiable risk factor for the development of postoperative AKI is the administration of nephrotoxic or potentially nephrotoxic medications.¹⁴ Drugs associated with an increased risk of AKI in general are non-steroidal anti-inflammatory drugs, angiotensin converting enzyme inhibitors and angiotensin receptor blockers, and mineralocorticoid receptor antagonists.^{14,15} If possible, these drugs should be discontinued preoperatively and held in the perioperative period.^{14,15}

In this study, the proportion of patients developing AKI was significantly higher in those patients with a past history of CKD or the presence of 2 or more comorbidities when compared to those without. This is in keeping with findings from other studies.^{2-5,8} Porter et al.,¹⁰ in a recent observational study, found a significant number of patients who developed AKI following surgery for hip fracture with a history of

CKD or the presence of 2 or more comorbidities. Additional factors known to increase the risk of AKI following surgery for fractured neck of femur include increased age and being men.⁸ In this study, the proportion of patients developing AKI was not significantly different for patients with these risk factors compared to those without. The reason for this is not clear, but one possible explanation is that the study size was insufficient to present a significant difference.

This study has a number of limitations. Firstly, data collection was retrospective, introducing an element of recall bias. Secondly, no information was recorded about patient medication being potentially nephrotoxic, which could have affected the results. Finally, although the proportion of patients developing AKI in this study is in keeping with other recent studies, the sample size is still relatively small. Further studies are required to analyze the type of operation performed for hip fracture and the subsequent development of AKI.

CONCLUSION

In this single-center observational study involving 500 patients, 19.2% developed acute kidney injury within 7 days following surgery for hip fracture. Patients with a medical history of CKD and 2 or more comorbidities were more likely to develop AKI than those without it.

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