Outcomes of major trauma among chronic kidney disease and dialysis patients in Nova Scotia: a retrospective analysis (2006-2017)

Ryan Pratt MD,[1] Mete Erdogan PhD MHI,[2] Robert S. Green MD DABEM FRCPC FRCP(Edin),[2-4] Karthik K. Tennankore MD SM FRCPC[1]

[1]Dept. of Medicine, Division of Nephrology, Dalhousie University, Halifax NS; [2]Trauma Nova Scotia, Nova Scotia Health Authority, Halifax NS; [3]Dept. of Emergency Medicine, Dalhousie University, Halifax NS; [4]Dept. of Critical Care, Dalhousie University, Halifax NS

Introduction

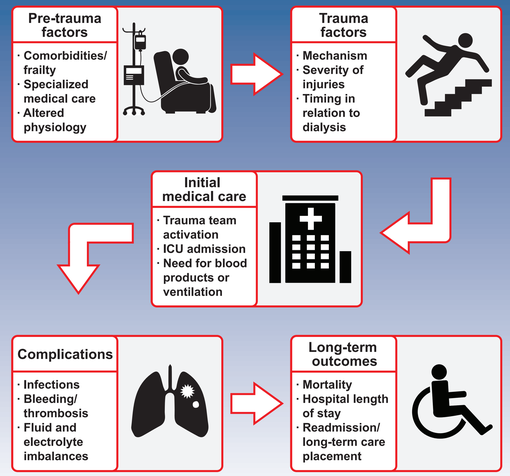
- The survival of major trauma patients can be influenced by subsequent complications that are related to pre-existing comorbidities.
- Patients with renal disease are at higher risk of complications as a direct result of trauma, and are more likely to succumb to these complications compared to patients with other comorbidities (e.g., cardiac disease).
- Chronic kidney disease (CKD) patients treated with renal replacement therapies (RRTs) such as hemodialysis and peritoneal dialysis are at even greater risk of complications following traumatic injury including cardiac events, electrolyte imbalances, fluid overload, infections, and abnormal bleeing and fractures.
- Objective: To identify factors that are predictive of poor patient outcomes following major trauma among CKD/dialysis patients at a level 1 trauma center in Nova Scotia.

Methods

- Retrospective cohort study of all adult major trauma patients (≥18 years) admitted to the Queen Elizabeth II Health Sciences Centre (QEII HSC) in Halifax, Nova Scotia betweem Jan. 1 2006 and Dec. 31 2017.
- Data were collected from the patient chart, a regional dialysis database (MyNephrology), and the Nova Scotia Trauma Registry (NSTR).
- Patients with any degree of CKD (i.e., stage 1-5, including end-stage renal disease [ESRD]) were initially identified from the NSTR based on ICD-10-CA injury codes using the algorithm described by Quan et al.
- All patients assessed in the QEII HSC outpatient nephrology clinic during the study period were identified from the MyNephrology database, and linked with records from the NSTR to identify any major trauma patients.
- A chart review of CKD patients was performed to verify an estimated glomerular filtration rate (GFR) of <60mL/min/1.73m^2 in the 6 months prior to hospital admission to ensure only patients with stage 3 or higher CKD were included in the CKD cohort. We also identified a sub-cohort of major trauma patients who received in-center hemodialysis.

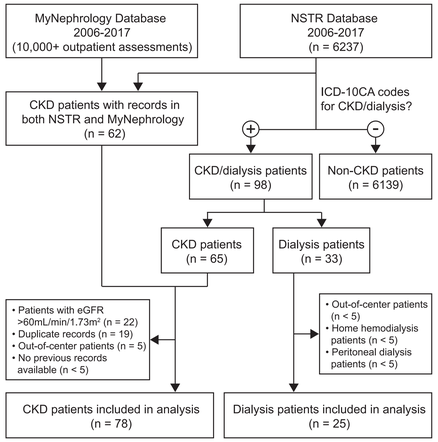
Methods (continued)

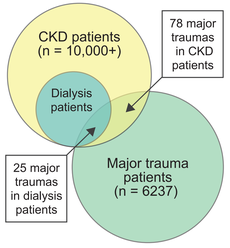
- Outcomes: Intensive care unit (ICU) length of stay (LOS), number of ventilator days, need for blood transfusion, number/type of blood products required, number/type of severe adverse events, in-hospital LOS, and in-hospital mortality
- Univariable statistics were used to compare baseline characteristics and outcomes between CKD patients and dialysis patients, and between dialysis patients who did or did not experience a major trauma.
- The adjusted association between CKD status and in-hospital mortality was analyzed using logistic regression. Age, sex, and Injury Severity Score were included as covariates.
- In a sensitivity analysis, we examined the unadjusted association with mortality comparing non-CKD patients with CKD category 3-5 and dialysis patients, separately.
- Any cell counts less than 5 are suppressed and reported as *n* < *5*.



Results

Figure 1. Flow chart of patient selection





Regression analysis* of association between CKD/dialysis and in-hospital mortality

Compared to non-CKD patients, patients in the CKD/dialysis group were at significantly increased risk of in-hospital death following major trauma:

Relative hazard: 2.41 95% CI: 1.65-3.53

When analyzed separately, dialysis patients were at even higher risk of in-hospital mortality compared to non-CKD patients:

Relative hazard: 3.58, 95% CI: 2.11 - 6.09

*Regression models were adjusted for ISS, age, and sex

Table 1: Characteristics and outcomes of CKD/dialysis patients versus non-CKD patients who sustained major traumatic injury

Characteristic	CKD/dialysis patients (n = 72)	Non-CKD patients (n = 6165)	P-value
Age, mean ± SD	72.0 ± 12.0.5	50.0 ± 22.0	<0.001
Male, %	64%	73%	0.11
ISS, mean ± SD	20 ± 8	18 ± 10	0.091
Hospital LOS, days, median [IQR]	6 [15]	6 [13]	0.87
Ventilation, days, median [IQR]	0	0	1.00
Post-trauma complications, %	18%	11%	0.093
In-hospital mortality	39%	10%	<0.001

CKD = chronic kidney disease; ISS = Injury Severity Scale; LOS = length of stay; SD = standard deviation; IQR = interquartile range.

Table 2: Characteristics of CKD and dialysis patients with major trauma

Characteristic	CKD patients (n = 78)	Dialysis patients (n = 25)
Age, mean ± SD	72.5 ± 13.4	68.4 ± 11.5
Male, %	57.7%	56.0%
Charlson Comorbidity Index, mean ± SD	5.0 ± 2.7	8.0 ± 2.4
Comorbidities, %		
Myocardial infarction	35.9%	32.0%
Congestive heart failure	28.2%	24.0%
Peripheral vascular disease	14.1%	48.0%
Diabetes mellitus	34.6%	44.0%
Cancer	9.0%	12.0%
ESA, monthly mcg of darbepoetin, mean ± SD	0 ± 68	100 ± 135
Receiving IV iron, %	2.6%	80.0%
Receiving phosphate binders	15.4%	76.0%
Receiving vitamin D	21.8%	24.0%
Pre-trauma hemoglobin, g/L, mean ± SD	116 ± 20	109 ± 17
Pre-trauma potassium, mmol/L, mean ± SD	4.5 ± 0.6	5.0± 0.8
Pre-trauma albumin, g/L, mean ± SD	35.7 ± 5.5	33.5 ± 4.4
Pre-trauma calcium, mmol/L, mean ± SD	2.26 ± 0.16	2.22 ± 0.11
Pre-trauma phosphate, mmol/L, mean ± SD	1.27 ± 0.37	2.00 ± 0.73
Pre-trauma PTH, pmol/L, mean ± SD	25 ± 22	61 ± 51
Pre-trauma eGFR, mL/min/1.73m^2, mean ± SD	33.5 ± 14.9	-
AKI or new RRT during hospitalization, %	34.6%	-
Post-trauma eGFR, mL/min/1.73m^2, mean ± SD	33.5 ± 17.2	-
Emergency room visit in previous 30 days, %	11.5%	28.0%

CKD = chronic kidney disease; ESA = erythropoiesis-stimulating agent; IV = intravenous; SD = standard deviation; PTH = parathyroid hormone; eGFR = estimated glomerular filtration rate; AKI = acute kidney injury; RRT = renal replacement therapy.

Discussion

- Our findings suggest CKD/dialysis patients are at considerably increased risk of in-hospital mortality (relative hazard 2.41, 95% CI 1.65-3.53) following major trauma compared to non-CKD patients.
- The risk of in-hospital mortality for dialysis patients alone (vs non-CKD patients) was even greater (relative hazard 3.58, 95% CI: 2.11-6.09).
- This study provides the first detailed analysis of the association between key factors that others have suggested to contribute to poor outcomes in dialysis patients who sustain major trauma (including age, comorbidities, laboratory variables, renal-specific medications, and dialysis modality and vintage) in a contemporary Canadian cohort of CKD/dialysis patients.
- Identifying factors most associated with adverse outcomes in trauma patients with CKD improve recognition of these high-risk patients and help to optimize their care.
- Further research is required to identify specific trauma management strategies that are better suited to patients with CKD in order to improve outcomes in these patients.

Acknowledgements

The authors thank Susan Arklay-Lehman, Niall Sheehy and Karen Ssebazza for assisting with data collection. Data used in this research were made available from the NSTR (Nova Scotia Department of Health and Wellness) by Trauma Nova Scotia (Nova Scotia Health Authority). Any opinions expressed by the authors do not necessarily reflect the opinion of the Nova Scotia Department of Health and Wellness, the Nova Scotia Health Authority, or Trauma Nova Scotia.

References & Contact Information

Quan H, Sundararajan V, Halfon P, et al. Coding Algorithms for Defining Comorbidities in ICD-9-CM and ICD-10 Administrative Data Medical Care, Vol. 43, No. 11 (Nov., 2005), pp. 1130-1139.

Contact Information:
Ryan Pratt, Rm. 5070, Dickson Building, QEII Health Sciences Centre, 1276 South Park St., Halifax, NS, B3H 2Y9.
Email: Ryan.Pratt@nshealth.ca

DALHOUSIE UNIVERSITY

TRAUMA NOVA SCOTIA
TRAUMA. STOPS. HERE.

nova scotia health authority

Outcomes of major trauma among chronic kidney disease and dialysis patients in Nova Sco