



High-grade renal injuries are often isolated in sports-related trauma



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ABSTRACT

Introduction: Most high-grade renal injuries (American Association for Surgery of Trauma (AAST) grades III–V) result from motor vehicle collisions associated with numerous concomitant injuries. Sports-related blunt renal injury tends to have a different mechanism, a solitary blow to the flank. We hypothesized that high-grade renal injury is often isolated in sports-related renal trauma.

Material and methods: We identified patients with AAST grades III–V blunt renal injuries from four level 1 trauma centres across the United States between 1/2005 and 1/2014. Patients were divided into “Sport” or “Non-sport” related groups. Outcomes included rates of hypotension (systolic blood pressure <90 mm Hg), tachycardia (>110 bpm), concomitant abdominal injury, and procedural/surgical intervention between sports and non-sports related injury.

Results: 320 patients met study criteria. 18% (59) were sports-related injuries with the most common mechanisms being skiing, snowboarding and contact sports (25%, 25%, and 24%, respectively). Median age was 24 years for sports and 30 years for non-sports related renal injuries ($p = 0.049$). Males were more commonly involved in sports related injuries (85% vs. 72%, $p = 0.011$). Median injury severity score was lower for sports related injuries (10 vs. 27, $p < 0.001$). There was no difference in renal abbreviated injury scale scores. Sports related trauma was more likely to be isolated without other significant injury (69% vs. 39% ($p < 0.001$)). Haemodynamic instability was present in 40% and 51% of sports and non-sports renal injuries ($p = 0.30$). Sports injuries had lower transfusion (7% vs. 47%, $p < 0.001$) and lower mortality rates (0% vs. 6%, $p = 0.004$). There was no difference in renal-specific procedural interventions between the two groups (17% sports vs. 18% non-sports, $p = 0.95$).

Conclusions: High-grade sports-related blunt renal trauma is more likely to occur in isolation without other abdominal or thoracic injuries and clinicians must have a high suspicion of renal injury with significant blows to the flank during sports activities.

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Introduction

Renal injuries are the most common traumatic genitourinary injury with approximately 245,000 cases worldwide each year [1].

Nearly 82–95% of renal injuries in the United States are caused by blunt trauma. Motor vehicle collisions (MVC) and falls account for most blunt renal injuries and often result in multiple traumatic injuries including other intra-abdominal or thoracic injury [2].

Blows to the flank sustained during sports related activities, such as skiing, contact sports, or biking can result in isolated renal injuries [3]. Most diagnostic and prognostic criteria for blunt renal injury reflect large urban trauma databases with MVC and falls as the predominant mechanisms of blunt renal injury. In these trauma series, injury severity score (ISS), American Association for

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the Surgery of Trauma (AAST) renal injury grade, and presence of haematuria or haemodynamic instability have been shown to be predictive of intervention and nephrectomy rates [1,4–6]. There are limited data regarding specific demographic factors, clinical signs, rates of procedural or surgical interventions, and mortality for less common mechanisms of blunt renal injury, such as sports related activities. Although most sports related renal injuries are low-grade (AAST grades I–II), isolated blows to the flank sustained during sports related activities can also produce high-grade renal injury (AAST grades III–V) [7,8,3,9].

We hypothesize that high-grade renal injury associated with sports related trauma is often isolated without the sequelae of polytrauma associated with non-sports related injury. We evaluated AAST grade III–V blunt renal injuries at four large trauma centres in the United States to determine differences in clinical characteristics and management for these two mechanistic groups of blunt renal trauma.

Materials and methods

We retrospectively reviewed all renal trauma records between January 2005 and January 2014 at four level 1 trauma centres across the United States including the University of Utah Hospital (Salt Lake City, UT), Intermountain Medical Centre (Murray, UT), Ben Taub General Hospital (Houston, TX), and San Francisco General Hospital (San Francisco, CA). Each institution received Institutional Review Board approval prior to this study. The AAST grading system was used to define injury grade (Table 1) [10,11]. We limited our analysis to patients 17 years or older with grades III–V blunt renal injury. The mechanism of injury was identified as sports related or non-sports related. Sports related renal trauma was defined as snow-sport related injury (skiing, snowboarding, sledding), injury sustained during contact sports (contact with another person or object while playing football, soccer, rugby, etc.) and bicycle related injury (mountain or road biking). Sports related injuries excluded any accidents involving motorized vehicles including pedestrian versus motor vehicle, bicyclist versus motor vehicle, all terrain vehicles, motorcycles or dirt bikes, motorized scooters, snowmobiles, or motorized boats or other motorized watercraft.

We collected data on patient age, sex, injury mechanism, ISS, abbreviated injury scale (AIS), AAST renal injury grade,

concomitant injuries, and systolic blood pressure and heart rate measurements before arrival or in the emergency department. Additionally, we gathered information on management and outcomes of blunt renal injury including rate of blood transfusion within 24 h of arrival, endoscopic or surgical intervention, nephrectomy, length of hospital stay, and mortality.

Our primary outcome measures were rates of hypotension and/or tachycardia and haemodynamic instability. Hypotension was defined as systolic blood pressure <90 mm Hg, and tachycardia was defined as heart rate >110 beats/min at any time before arrival or in the emergency department before resuscitation. We defined haemodynamic instability as the presence of either hypotension and/or tachycardia. Secondary outcome measures included differences in ISS scores, rates of transfusion, rates of concomitant abdominal injury, and rates of any intervention between sports and non-sports related grades III–V blunt renal injury.

Demographic and clinical variables were summarized as count (%) or median (inter-quartile range, IQR) by injury mechanism (sports vs. non-sports related). Each variable was compared to injury mechanism controlling for institution using Firth's penalized-likelihood logistic regression [12,13]. Firth's logistic regression was used to overcome sparse institutional and clinical characteristics strata. Firth's penalized logistic regression produces consistent regression estimates when the maximum likelihood parameters do not exist due to sample separation. All analyses were conducted in R[®] v.3.0.3 (<http://cran.us.r-project.org/>) using two-sided tests with a 0.05 significance level.

Results

We identified 320 high-grade (AAST grades III–V) blunt renal injuries between January 2005 and January 2014, including 84 (26%) at the University of Utah, 85 (26%) at Intermountain Medical Centre, 105 (39%) at Ben Taub Hospital, and 46 (17%) at San Francisco General Hospital (SFGH). Two hundred and thirty seven patients (74%) were men. Mean age was 33.9 (SD: 16.0) years and mean ISS was 25.5 (SD: 14.7). The injury mechanism was sports-related in 59 (18%) injuries compared to 261 (82%) non-sports related injuries.

The demographics of high-grade renal injuries grouped by sports or non-sports related are shown in Table 2. Fifty (85%) and 187 (72%) patients were males in sports and non-sports related renal injuries, respectively ($p = 0.011$). AAST grade III injuries were

Table 1
American Association for the surgery of trauma kidney injury scale.^a

Grade ^b	Type of injury	Description of injury
I	Contusion	Microscopic or gross haematuria, urologic studies normal
	Haematoma	Subcapsular, nonexpanding without parenchymal laceration
II	Haematoma	Nonexpanding perirenal hematoma confirmed to renal retroperitoneum
	Laceration	<1.0 cm parenchymal depth of renal cortex without urinary extravagation
III	Laceration	<1.0 cm parenchymal depth of renal cortex without collecting system rupture or urinary extravagation
IV	Laceration	Parenchymal laceration extending through renal cortex, medulla, and collecting system
	Vascular	Main renal artery or vein injury with contained haemorrhage
V	Laceration	Completely shattered kidney
	Vascular	Avulsion of renal hilum which devascularizes kidney

^a <http://www.aast.org/library/traumatools/injuryscoringscales.aspx#kidney>.

^b Advanced one grade for bilateral injuries up to grade III.

Table 2
Demographics of sports vs. non-sports related renal injury.

	Sports related <i>n</i> = 59 (18%)	Non-sports related <i>n</i> = 261 (82%)	<i>p</i> ^a
	Median (IQR)	Median (IQR)	
Age	24.0 (19.5, 33.5)	30.0 (22.0, 46.0)	0.049
ISS	10.0 (8.0, 18.0)	27.0 (17.0, 36.0)	<0.001
AIS kidney	3 (2.0, 3.5)	3 (2.0, 4.0)	0.87
LOS	2.0 (1.0, 3.8)	8.0 (3.0, 17.0)	<0.001
	Sports related <i>n</i> = 59 (18%)	Non-sports related <i>n</i> = 261 (82%)	<i>p</i> ^a
	Median (IQR)	Median (IQR)	
	<i>n</i> (%)	<i>n</i> (%)	
No. of Males	50 (85%)	187 (72%)	0.011
Grade III	32 (54%)	146 (56%)	0.36
Grade IV	22 (37%)	84 (32%)	
Grade V	5 (8%)	31 (12%)	

Bold values indicates statistically significant *p* value (ie *p*-value <0.05).

^a Firth's logistic regression predicting sports vs. non-sports related injury controlling for institution.

ISS, Injury severity score; AIS, abbreviated injury scale, AAST, American Association for the Surgery of Trauma; LOS, length of stay.

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