Resource utilization and secondary overtriage for patients with traumatic renal injuries in a regional trauma system

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AUTHORS/CONTRIBUTORS

Vishnu Iyer, Judith C. Hagedorn, Monica S. Vavilala, Frederick P. Rivara, and Niels V. Johnsen have nothing to disclose.

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BACKGROUND: While renal trauma management has shifted to conservative nonoperative management, insufficient data exist to guide interhospital renal trauma transfer protocols. Secondary overtriage is defined as the potentially avoidable transfer of patients from a lower to a higher-level trauma center despite the lack of need for higher-level care. The goal of this study was to determine the prevalence and predictors of secondary overtriage in renal trauma patients to a level 1 trauma center.

METHODS: A retrospective cohort study was performed of all renal trauma patients transferred to a level 1 institution between 2005 and 2017. Secondary overtriage was defined as a potentially avoidable transfer that consisted of hospital stay <72 hours with survival, no surgical or interventional radiology procedure, and all nonabdominal Abbreviated Injury Scale scores of <3 after transfer. Multivariate logistic regression was performed to estimate odds of secondary overtriage based on predefined clinical criteria.

RESULTS: Of the 612 renal trauma patients transferred between 2005 and 2017, 71 (11.6%) met the criteria for secondary overtriage. Female patients and patients coming from level IV/V trauma centers were more likely to have potentially avoidable transfers ($p = 0.01$ and $p < 0.001$, respectively). Mean (SD) Injury Severity Score was 10 (4.2) and 30.7 (14.3) in overtriaged and appropriately triaged patients, respectively ($p < 0.001$). Of the 71 overtriaged patients, 70.4% had isolated renal injuries. Patients with isolated renal injuries (odds ratio, 39.0; 95% confidence interval, 16.44–105.39) and those transferred from a level IV/V trauma center (odds ratio, 3.85; 95% confidence interval, 1.64–9.61) had a higher likelihood of secondary overtriage.

CONCLUSION: Within our regional trauma system, the majority of secondary overtriage was due to potentially avoidable transfers from level IV/V centers and of patients with isolated renal injuries. By implementing strategies to reduce the secondary overtriage burden on major trauma centers, regional trauma systems can avoid unnecessary costs while maintaining patient safety and ensuring appropriate care. (*J Trauma Acute Care Surg.* 2022;92: 1061–1065. Copyright © 2021 Wolters Kluwer Health, Inc. All rights reserved.)

LEVEL OF EVIDENCE: Therapeutic/care management, Level III.

KEY WORDS: Renal trauma; resource utilization; secondary overtriage.

While renal trauma management has shifted to a more conservative, nonsurgical management strategy over the last few decades, there is a lack of data on interhospital transfer protocols and the impacts of trauma level designation on renal trauma outcomes.[1–4] Emergency departments are required to evaluate and stabilize patients after they present and then can consider transfer to a higher-level center if they lack the expertise or resources necessary to manage the patient.[5] Most regional trauma centers are designed with triage in mind to ensure that patients can be transferred appropriately and in a timely manner, and studies have shown benefit in outcomes and mortality for severely injured patients who are transferred from a lower-level to higher-level trauma center.[6,7] However, there are limited protocols in place to guide providers when assessing individual injury patterns or indications for transfer, and thus, the reason for transfer is based on individual provider clinical judgment, which can be subjective and variable.[6] The lack of clear guidelines increases risk for secondary overtriage or a potentially avoidable transfer of a patient to a higher-level trauma center from a lower-level trauma center when they could have been managed appropriately at the originating lower-level center (Supplemental Digital Content, http://links.lww.com/TA/C294).[8]

However, as trauma systems usually function independently from one another, hospital-level overtriage practices remain unknown. The aim of this study is to evaluate a cohort of renal trauma patients transferred to a level I trauma center to determine the prevalence and predictors of secondary overtriage, with the goal of identifying critical features that could help optimize triage for renal trauma. We hypothesized that patients with isolated and low-grade renal injuries are less likely to benefit from transfer to a higher-level of care because of a low likelihood of requiring specialized interventions.

PATIENTS AND METHODS

After receiving approval from the Institutional Review Board at the University of Washington, a retrospective cohort study was performed analyzing the Harborview Trauma Registry from January 2005 to 2017. Using *International Classification of Disease* version 9 codes, patients with traumatic renal injuries were selected. Patients who were triaged initially at Harborview Medical Center were excluded from the study. Patients were assigned American Association of Surgery for Trauma (AAST) renal trauma scores based on radiographic imaging.[9] Past medical history, demographics, trauma type, and mechanism of injury were obtained via chart review.

The primary outcome of this study was the rate of secondary overtriage of patients transferred to Harborview Medical Center, which is the primary referral center for approximately 214 lower-level trauma centers across the Pacific Northwest. Additional covariates, such as trauma level designation of referring hospital, concurrent nonrenal solid organ injury, isolated renal injury, Injury Severity Score (ISS), and AAST injury grade were assessed to determine impact on odds of potentially avoidable transfer. Hospital-level outcome variables included length of stay and disposition after hospital stay.

Patients were categorized as either necessary transfers or potentially avoidable transfers, termed *secondary overtriage*.[10] Secondary overtriage was defined as a potentially avoidable transfer in which a patient had all nonabdominal Abbreviated Injury Scale (AIS) scores of <3, a hospital length of stay <72 hours with survival, no intensive care unit admission, no operating

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room procedure, and no renal-specific interventional radiologic procedure. Isolated renal injury was defined as no other concurrent abdominal organ injury and all nonabdominal AIS scores of <3. Transfers were termed *potentially avoidable* based on the receiving hospital's characteristics noted previously, as resources, staffing, and capabilities of the transferring hospital were not able to be directly evaluated.

Bivariate analysis using Student's *t* test, χ^2 analysis, and the Mann-Whitney *U* test, where appropriate, was used to compare patients based on necessary transfer versus secondary overtriage. Multivariate logistic regression was then used to identify independent factors associated with likelihood of secondary overtriage. Age, severity of renal injury (AAST grade IV or V vs. grades I–III), presence of isolated renal injury, mechanism of injury, and transferring center American College of Surgeons (ACS) trauma level designation (levels IV and V vs. levels II and III) were all included. Notably, ISS was not included in the model because it is multicollinear with AAST renal injury severity. All statistical analyses were completed using R version 3.5.1 (R Foundation for Statistical Computing, Vienna, Austria; 2018). A p value of <0.05 was considered statistically significant. Multivariate model fit was assessed using the Hosmer-Lemeshow goodness-of-fit test and by calculating the area under the curve for the receiver operating characteristic curve. Results were reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology checklist.

RESULTS

Six hundred twelve patients who had been transferred to our level I trauma center for renal injuries from 2005 to 2017 were identified. Seventy-one patients (11.6%) were found to meet the criteria for secondary overtriage, while 541 (88.4%) were defined as necessary transfers. The overall mean age for the sample was 40.5 years (SD, 18.8 years), with the mean age in the necessary and overtriaged groups being 40.6 years (SD, 18.8 years) and 39.3 years (SD, 19.3 years), respectively ($p = 0.58$). One hundred forty-nine patients (24.3%) identified as female, with 141 (94.6%) being needed transfers. Blunt traumas accounted for 574 renal injuries (93.8%), and penetrating traumas accounted for 38 renal injuries (6.2%). Median hospital length of stay was 9 days (interquartile range [IQR], 4–18 days) for the necessary transfer patients and 2 days (IQR, 1–2 days) for the overtriaged patients ($p < 0.01$). Median intensive care unit length of stay was 2.8 days (IQR, 1.4–8.3) for the necessary transfer patients and 1.0 (IQR, 0–1.4) for the overtriaged patients ($p < 0.01$).

There was no significant difference in likelihood of needed transfer versus secondary overtriage on bivariate analysis based on renal injury grade, mechanism, or patient age (Table 1). However, patients being transferred from lower designation trauma centers (level IV and level V) were more likely to be overtriaged as opposed to those from higher level centers (level II and level III; $p < 0.001$). Similarly, patients who were overtriaged had significantly lower ISS relative to needed transfers (ISS, 10 ± 4.2 vs. 30.7 ± 14.3; $p < 0.001$). Mean abdominal AIS was 3.3 (SD, 0.9) for the necessary transfer patients and 2.8 (SD, 0.7) for the overtriaged patients ($p < 0.01$). Furthermore, 20.3% (110 of 541) of necessary transfers had a head AIS score of ≥3, while only 2.8% (2 of 71) of overtriaged patients had a head AIS score of ≥3 ($p < 0.001$). Presence of isolated renal injury was significantly associated with secondary overtriage ($p < 0.001$). There was a 6.5% mortality rate (n = 35) in the needed transfer group and, by definition, no mortality noted in the overtriaged group.

TABLE 1. Demographics and Injury Details of Patients Transferred With Traumatic Renal Injuries

	Total	Necessary Transfers	Potentially Avoidable Transfers	*p*
Patients (%)	612	541 (88.4)	71 (11.6)	
Age, mean (SD), y	40.5 (18.8)	40.6 (18.8)	39.3 (19.3)	0.58
Female (%)	149 (24.3)	141 (26.1)	8 (11.3)	**0.01**
Transferring hospital trauma designation				**<0.001**
Level II	62 (10.1)	62 (11.5)	0	
Level III	263 (43.0)	253 (46.8)	10 (14.1)	
Level IV	179 (29.2)	143 (26.4)	36 (50.7)	
Level V	14 (2.3)	10 (1.8)	4 (5.6)	
Undesignated	94 (15.4)	73 (13.5)	21 (29.6)	
Mode of transfer				**<0.001**
Ambulance	252 (41.2)	191 (35.3)	61 (85.9)	
Helicopter	171 (27.9)	165 3(0.5)	6 (8.5)	
Fixed wing	179 (29.2)	177 (32.7)	2 (2.8)	
Unspecified	10 (1.6)	8 (1.5)	2 (2.8)	
Injury mechanism				0.12
Blunt	574 (93.8)	504 (93.2)	70 (98.6)	
Penetrating	38 (6.2)	37 (6.8)	1 (1.4)	
ISS, mean (SD)	28.3 (15.1)	30.7 (14.3)	10.0 (4.2)	**<0.001**
Renal injury grade				0.18
I	133	116 (21.4)	17 (23.9)	
II	86	74 (13.7)	12 (16.9)	
III	204	175 (32.3)	29 (40.8)	
IV	130	119 (22.0)	11 (15.5)	
V	25	25 (4.6)	0	
Missing	34	32 (5.9)	2 (2.8)	
Isolated renal injury	127 (20.8)	69 (12.8)	58 (81.7)	**<0.001**
Initial ED SBP <90 mm Hg	31 (5.1)	31 (5.7)	0	0.07
Liver injury				**<0.001**
No liver injury	421 (68.8)	358 (66.2)	63 (88.7)	
Low-grade liver injury (OIS I-II)	84 (13.7)	79 (14.6)	5 (7.0)	
High-grade liver injury (OIS III-V)	107 (17.5)	104 (19.2)	3 (4.2)	
Spleen injury				**<0.001**
No spleen injury	423 (69.1)	358 (66.2)	65 (91.5)	
Low-grade spleen injury (OIS I-II)	64 (10.5)	59 (10.9)	5 (7.0)	
High-grade spleen injury (OIS III-IV)	125 (20.4)	124 (22.9)	1 (1.4)	
Length of stay, median (IQR), d	7 (3,16)	9 (4, 18)	2 (1, 2)	**<0.001**
Disposition				**<0.001**
Home	392 (64.1)	327 (60.4)	65 (91.5)	
SNF	101 (16.5)	100 (18.5)	1 (1.4)	
Rehab	34 (5.6)	34 (6.3)	0	
Morgue	35 (5.7)	35 (6.5)	0	
Other	50 (8.2)	45 (8.3)	5 (7.1)	

Bolded *p*-values indicate statistical significance.

ED, emergency department; OIS, organ injury scale; SBP, systolic blood pressure; SNF, skilled nursing facility.

On multivariate logistic regression analysis assessing for odds of secondary overtriage (Table 2), the presence of high-grade renal injury (odds ratio [OR], 0.26) was independently associated with a decreased odds of inappropriate transfer/secondary overtriage. However, after adjustment for mechanism of injury, patient age, and severity of injury, the presence of isolated renal injury (OR, 39.0) and transfer from a lower ACS trauma designation facility (OR, 3.85) were both significantly associated with increased odds of secondary overtriage. Model fit was deemed appropriate with a Hosmer-Lemeshow of $p = 0.55$ and an area under the curve of 0.91.

DISCUSSION

In this study, we examined the prevalence and predictors of secondary overtriage for renal trauma patients who were transferred to our level I trauma center. We found that patients transferred from lower-level trauma centers (level IV or V) were at increased odds of secondary overtriage, that patients with high-grade renal injury (AAST grade IV or V) were associated with increased odds of necessary transfer, and that patients with isolated renal injuries were very unlikely to require transfer to a higher level of care. This latter finding confirms a recent study from our group that found that patients with isolated renal injury did not require transfer to a level I trauma center and could be safely managed both on the floor and at a lower level facility.[11]

A recent study using the National Trauma Data Bank found that odds of intervention versus nonoperative management for traumatic renal injuries was similar when comparing level I trauma centers to non–level-I trauma centers and that management of these injuries was similar across level designations.[12] Another study analyzing the National Trauma Data Bank showed that more than half of 8,156 patients (53%) transferred to a level I/II trauma center had low-grade renal injuries (AAST I and II) and that 37% of the transferred patients met the criteria for secondary overtriage.[10] Within the group that met the definition for secondary overtriage, 59% had low-grade renal injuries.

These data suggest that, on a national level, secondary overtriage is prevalent and is not isolated to specific trauma systems. However, national database analyses often lack the level of detail necessary to assess reasons for transfer (i.e., insurance status, patient transfer requests, census burden at transferring hospital, or other patient/institution factors driving transfer) and lack the granularity necessary to show whether patients do better in a higher level of care. Therefore, single-institution studies are often needed to develop protocols within systems. While hospital systems want to maximize patient outcomes and ensure best possible care, potentially avoidable transfers have been shown to increase costs, delay definitive care, and cause undue burden on both patients and regional trauma systems.[13] Secondary overtriage can also shift resources away from critically ill patients who would truly benefit from level I trauma center care.[8] Furthermore, prior studies have shown that isolated renal injury can be safely managed at lower-level centers.[11,14] These data highlight the need for appropriate assessment and implementation of transfer guidelines to manage renal trauma patients.

Reducing hospital costs benefits not only hospital systems but also the patients they serve. Estimated costs for overtriaged patients at a level I trauma center, including trauma center charge and emergency department charges, can exceed $60,000 per patient.[15] By analyzing factors that lead to secondary overtriage and implementing protocols to optimize management of renal trauma patients, hospitals can ensure appropriate distribution of resources while reducing the financial burden for patients and payers.

While overtriage is important to monitor for any trauma system, it is also equally important to monitor for undertriage or the lack of transfer to a higher-level care facility when needed. Avoiding undertriage has been shown to reduce trauma-related morbidity and mortality, and as such, the ACS advocates that a <5% undertriage rate is an acceptable limit, while a 25% to 35% overtriage rate is acceptable.[16] In our study, 11.6% of patients met the criteria for secondary overtriage, which is well within the ACS limit. While advocating for the best possible care for patients is the goal, in the face of ever-growing hospital costs and finite resources, it is vital to investigate opportunities to improve both patient care and costs.

There are several limitations of this study. We can only speculate as to the reason patients were transferred and cannot analyze the various factors influencing transferring center decision making, such as hospital resources, physician availability/comfort, hospital census, and patient comorbidities. As such, we chose to evaluate secondary overtriage from the perspective of the receiving center as "potentially avoidable" transfers, where overtriaged patients did not require the higher level of care a level I center can uniquely provide. Furthermore, we do not have access to transfer protocols that might exist at participating transfer centers. Data come from a single regional trauma system of patients transferred to a level I center; thus, we do not capture patients overtriaged within the system to level II or III centers. Lastly, this is a retrospective cohort study based on an institutional trauma registry, the quality of which is dependent on health record abstraction.

TABLE 2. Multivariate Logistic Regression Analysis of Odds for Secondary Overtriage

	OR	95% CI
Age	0.98	0.96–1.00
High-grade renal injury (AAST IV-V)	**0.26**	**0.09–0.66**
Isolated renal injury	**39.0**	**16.44–105.39**
Penetrating trauma	0.32	0.01–2.74
ACS level IV or V transferring hospital	**3.85**	**1.64–9.61**

Bolded *p*-values indicate statistical significance.
CI, confidence interval.

CONCLUSION

Secondary overtriage represents a potential burden to both patients and regional trauma systems. By identifying factors associated with secondary overtriage, hospital systems can more effectively devise plans and protocols to better use health care resources and ensure appropriate care.

AUTHORSHIP

V.I. was part of the literature search, data analysis, data interpretation, writing, and critical revision process. J.C.H. was part of the data collection,

data analysis, and critical review process. M.S.V. was part of the data interpretation and critical revision process. F.P.R. was part of the data interpretation and critical review process. N.V.J. was part of the study design, data collection, data analysis, data interpretation, writing, and critical review process.

DISCLOSURE

The authors declare no conflicts of interest.

REFERENCES

1. Shoobridge JJ, Corcoran NM, Martin KA, Koukounaras J, Royce PL, Bultitude MF. Contemporary management of renal trauma. *Rev Urol*. 2011;13(2):65–72.
2. Hammer CC, Santucci RA. Effect of an institutional policy of nonoperative treatment of grades I to IV renal injuries. *J Urol*. 2003;169(5): 1751–1753.
3. Morey AF, Brandes S, Dugi DD, Armstrong JH, Breyer BN, Broghammer JA, Erickson BA, Holzbeierlein J, Hudak SJ, Pruitt JH, et al. Urotrauma: AUA Guideline. *J Urol*. 2014;192(2):327–335.
4. Keihani S, Xu Y, Presson AP, Hotaling JM, Nirula R, Piotrowski J, Dodgion CM, Black CM, Mukherjee K, Morris BJ, et al. Contemporary management of high-grade renal trauma: results from the American Association for the Surgery of Trauma Genitourinary Trauma study. *J Trauma Acute Care Surg*. 2018; 84(3):418–425.
5. Parikh PP, Parikh P, Mamer L, McCarthy MC, Sakran JV. Association of system-level factors with secondary overtriage in trauma patients. *JAMA Surg*. 2019;154(1):19–25.
6. Adzemovic T, Murray T, Jenkins P, Ottosen J, Iyegha U, Raghavendran K, Napolitano LM, Hemmila MR, Gipson J, Park P, et al. Should they stay or should they go? Who benefits from interfacility transfer to a higher-level trauma center following initial presentation at a lower-level trauma center. *J Trauma Acute Care Surg*. 2019;86(6):952–960.
7. Newgard CD, McConnell KJ, Hedges JR, Mullins RJ. The benefit of higher level of care transfer of injured patients from nontertiary hospital emergency departments. *J Trauma*. 2007;63(5):965–971.
8. Ciesla DJ, Sava JA, Street JH 3rd, Jordan MH. Secondary overtriage: a consequence of an immature trauma system. *J Am Coll Surg*. 2008;206(1): 131–137.
9. Kozar RA, Crandall M, Shanmuganathan K, Zarzaur BL, Coburn M, Cribari C, Kaups K, Schuster K, Tominaga GT. Organ injury scaling 2018 update: spleen, liver, and kidney. *J Trauma Acute Care Surg*. 2018;85(6): 1119–1122.
10. Hagedorn JC, Quistberg DA, Arbabi S, Wessells H, Vavilala MS. Factors associated with secondary overtriage in renal trauma. *Urology*. 2019;130: 175–180.
11. Iyer V, Gause E, Vavilala MS, Hagedorn JC. Resource utilization and outcomes in isolated low-grade renal trauma at a level 1 trauma center. *Urology*. 2021;152:91–95.
12. Bjurlin MA, Renson A, Fantus RJ, Fantus RJ. Impact of trauma center designation and Interfacility transfer on renal trauma outcomes: evidence for universal management. *Eur Urol Focus*. 2019;5(6):1135–1142.
13. Bible JE, Kadakia RJ, Kay HF, Zhang CE, Casimir GE, Devin CJ. How often are interfacility transfers of spine injury patients truly necessary? *Spine J*. 2014;14(12):2877–2884.
14. Freton L, Scailteux LM, Hutin M, Olivier J, Langouet Q, Ruggiero M, Dominique I, Millet C, Bergerat S, Panayatopoulos P, et al. Early discharge in selected patients with low-grade renal trauma. *World J Urol*. 2020;38(4): 1009–1015.
15. Bukur M, Teurel C, Catino J, Kurek S. The price of always saying yes: a cost analysis of secondary overtriage to an urban level I trauma center. *Am Surg*. 2018;84(8):1368–1375.
16. American College of Surgeons, Committee on Trauma (ACS-COT). *Resources for Optimal Care of the Injured Patient*. Chicago, IL: American Collect of Surgeons; 2014.

