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Is There a Difference in the Incidence of Urinary Tract Infection and Outcome between Trauma and Emergency General Surgery (EGS) Patients?

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Abstract

Background: Acute care surgery (ACS) patients represent a population at high risk to develop urinary tract infections (UTIs) and these are associated with significant morbidity and mortality. Lack of substantial data exists regarding the differences in incidence and outcomes of UTIs between trauma and emergency general surgery(EGS) patients.

Methods: A prospectively maintained ACS database was queried for EGS and Trauma patients with a diagnosis of UTI using ICD 9 and 10 codes. Demographics, microbiology data and outcomes were abstracted. Student's T-test and Chi-square were used to evaluate continuous and categorical variables. Binary logistic regression was used to determine the impact of UTI on EGS and Trauma patients' outcomes.

Results: Out of 15,475 EGS and 37,293 Trauma patients, the incidence of UTIs was similar between them (7.6% vs. 7.2% respectively p=0.248). Females in the EGS group had a significantly higher UTI rate (13.66% vs. 9.84% p=<.001). Trauma patients were significantly older (70 ± 20.16 vs. 57.83 ± 18.57 p=<.001) and had a higher Charlson comorbidity index (4.76 ± 2.95 vs. 4.39 ± 3.16 p=0.004). E. coli, Enterococcus sp., *Klebsiella sp*., and Candida sp. represented the most common organisms associated with UTIs. EGS patients had significantly more Foley catheter days (4.86 ± 9.13 vs. 3.43 ± 8.15 p=<0.001), longer hospital length of stay (hLOS) (12.11 ± 13.45 vs. 9.81 ± 12.59 p= <0.001) and higher mortality (6.30 % vs. 4.36% p=0.01) than trauma patients. On binary logistic regression with mortality as outcome, UTI was an independent predictor of increased mortality in EGS patients but not in the trauma group (EGS OR 1.72, p=0.0001 vs. trauma OR 0.55, p=<.0001).

Conclusion: There is a high incidence of UTIs in EGS and trauma patients. Gram-negative rods are the most common organisms associated with these infections. EGS patients that develop a UTI are at increased risk of mortality as compared to trauma patient. Interventions to reduce the number of UTIs in ACS patients, including early Foley catheter removal, should be implemented routinely.

Keywords: Acute care surgery; Trauma; Urinary tract infections; Emergency general surgery; Immunosuppressive diseases

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Introduction

Urinary tract infections (UTIs) represent up to 25% of hospital-acquired infections and are associated with significant morbidity and mortality in hospitalized patients [1-3]. The annual cost for HA-UTI is estimated between $ 424 and $ 451 million [4,5]. Risk factors for UTIs are well established and include female sex, older age, pregnancy, spinal cord injury, diabetes, immunosuppressive diseases and urinary catheter use [3,6-11]. Indwelling urethral catheters represent the most common risk factor for the development of UTIs, associated with an up to 80% of cases, leading to worse outcomes in the inpatient setting, including longer length of stay and higher mortality [3,12-14].

Trauma and Emergency General Surgery (EGS) represent a population at higher risk of UTIs due to their underlying physiologic conditions. The incidence of UTIs in trauma patients has been reported to be from 4.5% to 19% and up to 1.5% in EGS patients [15-17]. Injured patients are at a higher risk of developing an UTI due to prolonged hospital stay and alterations

to their physiology that increase the susceptibility to contracting an UTI [18].

According to Evelyn et al., approximately 70%-80% of HA UTI can be attributed to an indwelling urethral catheter [3]. They state that catheter-associated (CA) UTI causes an increase in mortality and length of stay [19]. Additionally, they posit that catheter useis the most critical risk factor for developing UTI [3]. Other studies concluded that UTI significantly increases mortality rates in hospitalized patients [12-14]. However, there are discrepancies regarding increased mortality in patients with UTI; Laupland et al. and Tambyah et al. concluded that UTI did not increase the risk of mortality in their studied populations [20,21].

To our knowledge, there are no data evaluating whether there is a difference in both incidence of UTIs and the virulence of the causative pathogens and outcome between emergency general surgery (EGS) and trauma patients. We hypothesize that UTIs are more common and are associated with more virulent pathogens in trauma patients due to emergent Foley catheter insertions and the severity of multisystem injury.

Materials and Methods

A prospectively maintained ACS database containing 52,768 patients spanning from 2008 to 2018 was queried for patients with diagnosis of UTI using the International Classification of Diseases (ICD) ninth and tenth revision with either pathologic urine analysis (UA) consistent with an UTI or positive urine cultures that received treatment for it. We included all the patients greater than 18-years-old diagnosed with a UTI developed more than 48 hours upon admission to the hospital. Patients diagnosed with UTI before admission, or those admitted to the hospital with a diagnosis of UTI in less than 48 hours were excluded.

Demographics, microbiology, Charlson comorbidity index (CCI), body mass index (BMI), length of stay, ICU admission, ICU days, ventilator use days, urinary catheter days (UCD), Injury Severity Score for Trauma patients, and mortality data were obtained for trauma and EGS patients that met inclusion criteria [22]. Student's T-test was used for continuous variables and Chi-square test was used for categorical variables. Binary logistic regression using mortality as outcome and adjusting for age, sex, CCI, presence of UTI and ISS for trauma patients was performed to determine possible risk factors. A p value of <0.05 was considered significant.

Results

A total of 15,475 EGS and 37,293 trauma patients were screened from our institutional database. Out of those patients 1,175 (7.6%) EGS and 2,682 (7.2%) trauma patients were diagnosed with UTI during the course of the admission and met inclusion criteria. The average age for EGS patients was 57.83 ± 18.57 and 69.63 ± 20.16 for trauma patients, p=<.0001. Overall, female patients had higher rates of UTI when compared to male patients (4.95% vs. 2.36%, p=<.0001) See **Table 1** for complete demographic and outcome results.

When comparing trauma to EGS patients with UTI, trauma patients had a significantly higher CCI (4.76 ± 2.95 vs. 4.39 ± 3.16 p=0.004) and were more likely to be admitted to the ICU (44.25% vs. 38.21%, p=0.005). No difference was found in ventilator days or ICU LOS between the cohorts. EGS patients had significantly more UCD (4.86 ± 9.13 vs. 3.43 ± 8.15, p=<0.0001), longer LOS (12.11 ± 13.45 vs. 9.81±12.59, p=<0.0001) and higher mortality rates (6.30 % vs. 4.36%, p=0.0107) than trauma patients.

Females in the EGS cohort had a higher LOS (11.48 ± 13.07 vs. 7.81 ± 9.54, p=<.0001), more UCD (4.70 ± 9.10 vs. 2.77 ± 5.59, p=<.0001), ICU LOS (3.48 ± 9.46 vs. 2.27 ± 6.16, p=0.001), ventilator days (1.63 ± 6.41 vs. 0.86 ± 3.83, p=0.0041) and higher mortality (64.86% vs. 52.14%, p=0.001) when compared to females in trauma. Trauma males had a higher ICU LOS (5.98 ± 12.35 vs. 3.86 ± 8.82, p=0.0006) and more ventilator days (3.32 ± 9.58 vs. 1.35 ± 4.45, p=<.0001) than EGS males. No other difference was found between male patients between the cohorts.

UTI was diagnosed using either UA or urine cultures. Out of the urine cultures performed, 48.76% of EGS and 46.92% of trauma patients came back positive for UTI. The most common microorganism isolated in EGS and Trauma patients was *E. Coli*. The incidence of *Candida, Staphylococcus Aureus* and *Acinetobacter* in the urine cultures were significantly higher in EGS patients when compared to trauma patients (Candida: 3.65% vs. 3.24%, p=<.0001; *Staphylococcus Aureus*: 0.93% vs. 0.75%, p=0.0002; *Acinetobacter* 0.45% vs. 0.26%, p=0.0019, respectively). Complete microbiology data is shown in **Table 2**.

Using mortality as the primary outcome in binary logistic regression adjusted for sex, age, CCI, ISS for trauma patients, and UTI presence, CCI is an independent risk factor for increased mortality in EGS and trauma patients (CCI: Trauma OR 1.16 [CI: 1.13-1.19], p <.0001 / EGS OR 1.30, [CI: 1.26-1.34], p=<.0001). ISS is an independent risk factor for increased mortality in Trauma patients with UTI (OR 1.10, p<.0001). The presence of UTI was an independent risk factor associated with increased mortality in EGS patients, but not in Trauma patients EGS OR 1.72 [CI:1.30-2.26], p=0.0001 vs. Trauma OR 0.55 [CI:0.64-0.69], p=0.0001) **(Table 3).**

Variable		Trauma (n=2,682)	EGS (n=1,175)	p value
Age		69.63 ± 20.16	57.83 ± 18.57	<.0001
Gender	Female	1,831 (68.27%)	780 (66.38%)	0.2488
	Male	851 (31.73%)	395 (33.62%)	
Race	Caucasian	1,969 (73.39%)	730 (62.13%)	<.0001
	African American	569 (21.21%)	372 (31.66%)	
	Asian	13 (0.48%)	6 (0.51%)	
	Other	132 (4.92%)	67 (5.70%)	

BMI	27.30 ± 7.83	31.16 ± 12.17	<.0001
Charlson comorbidity index	4.76 ± 2.95	4.39 ± 3.16	0.0004
ICU admission	1,190 (44.25%)	449 (38.21%)	0.0005
ICU Days	3.44 ± 8.79	3.61 ± 9.25	0.6005
Ventilator days	1.16 ± 5.40	1.36 ± 5.49	0.3095
LOS	9.81 ± 12.59	12.11 ± 13.45	<.0001
Urine catheter days	3.43 ± 8.15	4.86 ± 9.13	<.0001
Mortality	117 (4.36%)	74 (6.30%)	0.0107

Table 1: Comparison of demographics and outcomes of patients with UTI between EGS and Trauma cohort.

Culture	Trauma (Frequency, %)	EGS (Frequency, %)	p value
Escherichia coli	525 (19.57)	167 (6.23)	<.0001
Enterococcus sp.	182 (6.79)	90 (3.36)	0.3294
Klebsiella sp.	145 (5.41)	82 (3.06)	0.5618
Candida sp.	87 (3.24)	98 (3.65)	<.0001
Pseudomonas aeruginosa	87 (3.24)	49 (1.83)	0.1511
Proteus mirabilis	66 (2.46)	22 (0.82)	0.2599
Enterobacter sp.	55 (2.05)	12 (0.45)	0.0243
Staphylococcus, coagulase negative	40 (1.49)	11 (0.41)	0.1647
Streptococcus sp.	35 (1.3)	11 (0.41)	0.1647
Aerococcus sp.	27 (1.01)	1 (0.04)	0.0019
Citrobacter sp.	21 (0.78)	9 (0.34)	0.9558
Staphylococcus aureus	20 (0.75)	25 (0.93)	0.0002
Gram-negative bacillus	14 (0.52)	3(0.11)	0.2498
Acinetobacter sp.	7 (0.26)	12 (0.45)	0.0019

Table 2: Culture data and statistical analysis between EGS and Trauma cohorts.

	Logistic regression. Outcome: Mortality				
	Variable	Odd ratio	95% Wald confidence limits confidence limits		p value
Trauma	Gender: female	0.594	0.529	0.666	<.0001
	UTI	0.723	0.584	0.894	0.003
	Age	0.994	0.991	0.997	6E-04
	Charlson comorbidity index	1.171	1.145	1.199	<.0001
	Injury severity score	1.100	1.095	1.105	<.0001
EGS	Gender: female	0.949	0.772	1.166	0.6176
	UTI	1.722	1.308	2.267	0.0001
	Age	1.020	1.012	1.027	<.0001
	Charlson comorbidity index	1.302	1.260	1.346	<.0001

Table 3: Logistic regression adjusted for risk of mortality in EGS and Trauma patients.

Discussion

UTIs affect 150 million people each year worldwide and are the most common bacterial infection [2]. Also, UTIs are the fourth most common type of healthcare-associated infections, with an estimated 93,300 UTIs in acute care hospitals in 2011 [23]. In 2007 there were an estimated 10.5 million office visits in the United States for UTI symptoms (constituting 0.9% of all ambulatory visits) and 2–3 million emergency department visits resulting in 100.000 hospitalizations [24-26]. To our knowledge, this is the first study comparing outcomes between EGS and Trauma patients with a diagnosis of UTI after admission to the hospital.

Our study identified a similar rate of UTIs in EGS and trauma patients (7.59% vs. 7.20%, p=0.2488, respectively). Previous studies by Monaghan et al. in 2011 [15], and Bochicchio et al. in 2004 showed an incidence of UTI in trauma patients between 12% and 19%.[16] We found a higher incidence of UTI in EGS patients when compared to Scarborough et al. in 2016 (1.5%)[17]. Women were more frequently diagnosed with UTIs when compared to men in the EGS and trauma cohorts, which has been shown before by different authors [3,6,15,27].

UTIs are more common among critically ill, and older patients, with an incidence of ICU acquired UTI of 9% [3,20]. The development of a hospital-acquired urinary tract infection is associated with significantly longer ICU LOS [20]. UTIs are independent predictors for increased mortality in critically ill patients with up to three- fold increase [12,28]. Although the mortality rate in these studies was higher than ours, this could be explained because they only included ICU patients in their population.

In our study, EGS patients had a significantly longer LOS (12.11 vs.

9.81 p<0.001) and almost two additional UCD compared to trauma patients (4.86 vs. 3.43 p<0.001). Additionally, the presence of a UTI was found to be an independent risk factor causing increased mortality in EGS, but not trauma patients, as described in other studies [12-14]. The presences of urinary catheters have been identifiedas one of the main risk factors for developing a UTI [3].

Our data show that EGS patients had significantly higher mortality rates (6.30 % vs. 4.36% p=0.0107) despite the similar incidence of UTI between cohorts and that trauma patients with UTIs are older (57.83 vs. 69.63, p<.0001), with higher CCI (4.76 vs. 4.39, p=0.0004) with more admissions to the ICU (44.25% vs. 38.21%, p=0.0005).

Even though Laupland et al. did not find a correlation between UTI and increased mortality, they found that patients with ICU-acquired UTI caused by Candida were more likely to die than patients with ICU-acquired UTI caused by a different pathogen [20]. In our study, we identified that urine culture of EGS patients had more virulent pathogens compared to trauma patients. Staphylococcus *Aureus and Acinetobacter* species were more frequently isolated in urine cultures of EGS patients, who were also found to have higher incidence of Candida colonization than trauma patients. UTIs in EGS patients seem to be caused by more virulent microorganisms, which could explain associated increased mortality in EGS but not Trauma patients.

To our knowledge, there have been studies looking at each group independently but not as part of a big group of patients in the acute care surgery practice who are being treated by the same surgeons. Comparing two different patient populations allows us to better understand the variables associated with UTIs that could impact patient outcomes during their hospital and may help to mitigate these risks going forward. Furthermore, once these variables are identified, alert the treating physicians to see, approach, and treat UTIs in these two populations understanding better their differences.

Our study was limited because of its retrospective nature and because EGS and trauma populations are different in their past medical history, comorbidities, and diagnoses. However, they have two things in common; first, UTIs are the most common infections in both patient populations; and second, they are both treated by the same acute care surgeon, who approaches these infections in both groups the same way. This led us to hypothesize that due to the differences between EGS and trauma patients, UTIs should be treated differently.

Conclusion

Despite the similar incidence of UTI in EGS and Trauma patients, there were significantly greater hospital days, ICU days, and higher mortality in EGS patients. UTI itself was found to be associated with an increased risk of mortality in EGS patients, which we believe could be due to the fact that these UTIs are caused by more virulent pathogens than UTI in trauma patients. Physicians should be aware of the differences between both groups while treating these patients. Further prospective research studies are required to validate these findings.

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