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Clinical Potpourri

Unplanned intensive care unit admission following trauma☆

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ABSTRACT

Background: The prevalence and outcomes of trauma patients requiring an unplanned return to the intensive care unit (ICU) and those initially admitted to a step-down unit or floor and subsequently upgraded to the ICU, collectively termed *unplanned ICU* (UP-ICU) *admission*, are largely unknown.
Methods: A retrospective review of the trauma registry of a suburban regional trauma center was conducted for adult patients who were admitted between 2007 and 2013, focusing on patients requiring ICU admission. Prehospital or emergency department intubations and patients undergoing surgery immediately after emergency room evaluation were excluded.
Results: Of 5411 admissions, there were 212 UP-ICU admissions, 541 planned ICU (PL-ICU) admissions, and 4658 that were never admitted to the ICU (NO-ICU). Of the 212 UP-ICU admits, 19.8% were unplanned readmissions to the ICU. Injury Severity Score was significantly different between PL-ICU (16), UP-ICU (13), and NO-ICU (9) admits. UP-ICU patients had significantly more often major (Abbreviated Injury Score ≥ 3) head/neck injury (46.7%) and abdominal injury (9.0%) than the NO-ICU group (22.5%, 3.4%), but significantly less often head/neck (59.5%) and abdominal injuries (17.9%) than PL-ICU patients. Major chest injury in the UP-ICU group (27.8%) occurred at a statistically comparable rate to PL-ICU group (31.6%) but more often than the NO-ICU group (14.7%). UP-ICU patients also significantly more often underwent major neurosurgical (10.4% vs 0.7%), thoracic (0.9% vs 0.1%), and abdominal surgery (8.5% vs 0.4%) than NO-ICU patients. Meanwhile, the PL-ICU group had statistically comparable rates of neurosurgical (6.8%) and thoracic surgical (0.9%) procedures but lower major abdominal surgery rate (2.0%) than the UP-ICU group. UP-ICU admission occurred at a median of 2 days following admission. UP-ICU median hospital LOS (15 days), need for mechanical ventilation (50.9%), and in-hospital mortality (18.4%) were significantly higher than those in the PL-ICU (9 days, 13.9%, 5.4%) and NO-ICU (5 days, 0%, 0.5%) groups.
Conclusions: UP-ICU admission, although infrequent, was associated with significantly greater hospital length of stay, rate of major abdominal surgery, need for mechanical ventilation, and mortality rates than PL-ICU and NO-ICU admission groups.

1. Introduction

Recently, there has been significant interest placed by various organizations (Committee on Trauma, University Health Consortium, etc) on unplanned intensive care unit (UP-ICU) admission. It is monitored as a quality metric for performance improvement and also used in benchmarking. The literature largely focuses on UP-ICU readmission (ie, "bounce-backs"). In medical-surgical patients, these UP-ICU readmissions have been associated with increased hospital and ICU length of stay (LOS), as well as worse outcomes [1,2]. Predictors of ICU readmission include patient age, number of comorbidities, severity of initial injury, and seriousness of illness, among others [1–8]. Unplanned ICU readmission also has long-term implications, as survivors of critical illness have a higher 6-month mortality rate than those not requiring ICU admission [5]. However, little is known about patients who are initially admitted to the floor or step-down unit and later require upgrade to the ICU. We sought to evaluate the incidence and outcomes of these patients as well as those requiring UP-ICU readmission as well as those who were initially admitted to the wards or step-down units following acute traumatic injury and required subsequent unplanned upgrade to the ICU, collectively termed as *UP-ICU admission* by the National Trauma Data Standard (NTDS) [9].

2. Methods

A retrospective analysis of the trauma registry (Trauma One version 4.1, Lancet Technologies, Boston, MA) at our regional trauma center was

☆ A very early version of a small portion of this work was presented at the 42nd annual Congress of the Society of Critical Care Medicine in San Juan, Puerto Rico, in January 2013. After substantial updating and modification with new data, the additional information was presented at the 10th annual Academic Surgical Congress in Las Vegas, NV, in February 2015.

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performed. The center provides the highest state-designated echelon of trauma care for a suburban county with an approximate 1.5 million population. This study was exempt by our institutional review board. All adult trauma admissions (age ≥ 18 years) from January 2007 through December 2013, with hospital LOS > 2 days, were evaluated. Patients with burns and isolated hip fractures were excluded. Furthermore, in concert with others, emergent intubations in the field or in the emergency department (ED) and patients taken directly to the operating room from the ED were excluded [10]. Patients with no prior ICU admission (ie, those upgraded from regular floor, telemetry, or step-down units) and those with an unplanned return to the ICU (ie, a "bounce-back"), in accordance with current NTDS definitions, were analyzed in detail. Each patient was counted only once. To this end, if a patient was initially admitted to the ICU and then had an unplanned return to the ICU during the same hospitalization, that is, a "bounce-back," that patient was only counted once as a UP-ICU. In addition, there were 54 patients excluded from the planned ICU (PL-ICU) group because they did not go to the ICU, although this was the initial plan. Comorbidities and complications were identified and recorded using the *International Classification of Diseases, Ninth Revision,* and NTDS codes, in accordance with New York State Trauma Registry (NYSTR) definitions. In this regard, the bleeding disorder comorbidity refers to patients on anticoagulants other than aspirin as well as hereditary or other acquired conditions that may increase bleeding tendency.

Univariate statistical analyses were performed by SPSS v. 23.0 for Windows (IBM, Armonk, NY) using χ^2, and Wilcoxon rank-sum tests, with $P \leq .05$ defined as significant. Multivariate forward stepwise logistic regression using SPSS v. 23.0 , with a default predicted probability cutoff of 0.5, was performed for clinically important factors (age, sex, ≥5 comorbidities, bleeding disorder, hypertension [HTN], heart disease, lung disease, renal disease, diabetes mellitus [DM], preadmission do not resuscitate [DNR] advanced directive, low fall, transferred in from outside hospital, Injury Severity Score [ISS], head/neck Abbreviated Injury Score [AIS] ≥ 3, chest AIS ≥ 3, abdomen AIS ≥ 3, extremity AIS ≥ 3, major orthopedic procedures, major thoracic surgery, major abdominal surgery, and neurosurgery). A second stepwise forward logistic regression was performed using these same variables but excluding neurosurgery, major thoracic surgery, major abdominal surgery, and major orthopedic surgery.

Complications were excluded as possible predictors because the registry data do not specify timing of complications, that is, whether the complications occurred during floor/step-down unit admission and thereby prompted ICU admission or if they occurred after the patient had already been admitted to the ICU for another reason.

3. Results

During the study period, 5411 trauma patients, who were not intubated in the field or ED and did not go directly to the operating room from ED, met inclusion criteria. Of these, 4658 (85.2%) patients were never admitted to the ICU (NO-ICU), 212 (3.9%) had UP-ICU admission, and 541 (10.0%) had PL-ICU admission (Table 1). In examining demographics (Table 1), the UP-ICU group was older (73.5 years) as compared with the PL-ICU group (66.0 years, $P < .001$) and NO-ICU group (54.0 years, $P < .001$); had lower ISS (13.0) than PL-ICU group (16.0, $P < .001$) but higher than NO-ICU group (9.0, $P < .001$); more often had 2 or more NTDS comorbidities (65.1%) than PL-ICU (47.1%, $P < .001$) and NO-ICU groups (33.2%, $P < .001$); and more frequently had 5 or more comorbidities (9.0%) than PL-ICU (3.9%, $P < .001$) and NO-ICU groups (4.1%, $P < .001$). Prevalence of several NTDS comorbidities is provided in Table 1. Specifically, the UP-ICU group more frequently had HTN (61.3% vs 48.8%, $P = .002$), heart disease (13.2% vs 7.4%, $P =$

Table 1
Demographic characteristics of admitted adult (age ≥ 18 years) trauma patients who were not intubated in the field or ED and did not go to the operating room directly from the ED

	UP-ICU	PL-ICU	NO-ICU	*P* (UP vs PL-ICU)	*P* (UP vs NO-ICU)
n	212	541	4658	n/a	n/a
Age (y, median, IQR)	73.5 (52-82)	66.0 (45-81)	54.0 (35.0-76.0)	<.001	<.001
Male (%)	68.9%	64.0%	56.4%	.203	<.001
ISS (median, IQR)	13.0 (9.0-18.0)	16.0 (10.0-22.0)	9.0 (4.0-13.0)	.002	<.001
ED GCS	15 (15-15)	15 (14-15)	15 (15-15)	.283	<.001
Transferred in from referral hospital (%)*	42.5%	34.9%	27.0%	.094	.133
1st final ED (h, median, IQR)	4.8 (3.7-6.3)	4.3 (3.4-5.6)	4.9 (3.9-6.4)	.108	.501
NYSTR comorbidities†					
2 or more comorbidities (%)	65.1%	47.1%	33.2%	<.001	<.001
5 or more comorbidities (%)	9.0%	3.9%	4.1%	<.001	<.001
Dementia (%)	9.9%	8.3%	6.2%	.488	.033
Hypertension (%)	61.3%	48.8%	35.0%	.002	<.001
Heart disease (%)	13.2%	7.4%	4.5%	.012	<.001
Respiratory disease (%)	9.0%	5.4%	5.5%	.069	.031
Renal disease (%)	2.4%	1.3%	0.7%	.294	.009
DM (%)	26.9%	18.5%	11.6%	.011	<.001
Bleeding disorder (%)‡	32.1%	20.7%	10.7%	.001	<.001
Preadmission DNR directive	2.8%	2.6%	2.1%	.852	.444
Functional dependence	8.5%	8.3%	5.5%	.939	.062
Mechanism of injury					
Any fall (%)	59.4%	47.8%	53.1%	.004	.069
Fall <3 f. (%)	44.8%	34.2%	37.1%	.007	.023
MVC/MCC/pedestrian/pedal cycle (%)	37.3%	42.9%	33.9%	.159	.318
MVC/MCC (%)	31.6%	35.9%	28.2%	.270	.284
Pedestrian struck/pedal cycle (%)	5.7%	7.0%	5.7%	.499	.965
Penetrating (%)	0%	1.9%	1.9%	.046	.045
Other (%)	3.3%	7.4%	11.1%	.037	.0003

IQR indicates interquartile range; ED GCS, Emergency Department Glasgow Coma Score; h, hours; y, years; MVC, motor vehicle crash; MCC, motorcycle crash; NYST, New York State Trauma Registry.

Percentage calculations are based on number of patients in each category (UP-ICU, PL-ICU, NO-ICU).

* A total of 1257 of 4658 patients in the NO-ICU group were transferred in from an outside hospital (OSH) to our facility; however, the duration of time between facilities was available for only 1118 patients.

† Patients may have more than 1 NYSTR-defined comorbidity.

‡ Bleeding disorder as defined by the NTDS includes patients on anticoagulant or antiplatelet medications other than aspirin as well as those with hereditary or other acquired bleeding disorders.