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Hospital-Acquired Pressure Injury: Clinical Characteristics and Outcomes in Critical Care

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Abstract

Electronic health records (EHRs) enable us to use and re-use electronic data for various multiple purposes, such as public reporting, quality improvement, and patient outcomes research. Current hospital-acquired pressure injury (HAPI) risk assessment instruments have not been specifically developed for intensive care unit (ICU) patients and showed false positive rates in this specific populations. Previous research studies report a number of risk factors; however, it is still not clear what factors influence ICU HAPI in this population. As part of a larger research study, we performed an exploratory analysis by using a large electronic health record data. The aims of this study were to compare characteristics of patients who developed HAPIs during their ICU stay with those who did not, and to determine whether the two groups were different in the aspects of length of ICU stay, discharge disposition, and discharge destinations. We conducted chi-square test and t-test for group comparison. Association was examined by using bivariate analyses. Pearson correlation coefficients were used to examine correlation between LOS and number of medications. Our findings suggest a number of consistent and potentially modifiable risk factors, such as sedation, feeding tubes, and the number of medications administered. The mortality of the HAPI group was significantly higher than the non-HAPI group in our data. Discharge disposition was significantly different between the groups. 67% of the HAPI group transferred to intermediate or long-term care hospitals whereas 57.7% of the non-HAPI group went home after discharge. Awareness of these risk factors can lead to clinical interventions that can be preventative in the ICU setting.

Keywords: *hospital-acquired pressure injury, patient outcomes, intensive care units,*

1. Introduction

Electronic health records (EHRs) enable us to use and re-use electronic data for various multiple purposes, such as public reporting, quality improvement, and patient outcomes research [1]. Hospital-acquired pressure

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injury (HAPI) is a localized skin injury/underlying tissue damage during their hospital stay [2].

Current risk assessment instruments have not been specifically developed for intensive care unit (ICU) patients and showed false positive rates in this specific populations [3]. Previous research studies mentioned risk factors, such as length of ICU stay, vasopressors, mechanical ventilation, comorbidities, type of admission to the ICU (i.e. emergency admission), and time spent in operating room [4-6]; however, it is still not clear what factors influence ICU HAPI in this population.

As part of a larger research study, we performed an exploratory analysis by using a large electronic health record data. The aims of this study were to compare characteristics of patients who developed HAPIs during their ICU stay with those who did not develop and to determine whether the two groups were different in the aspects of length of ICU stay, discharge disposition, and discharge destinations.

2. Methods

The research design was a retrospective cohort study. We conducted an exploratory analysis. We provided specific descriptions in another journal article, including data collection, cleaning, and preparation [7]. The study was approved by the institutional review board. The total number of patient encounters available for this analysis was 12652 in which male patients were 7178 (56.7%). In total, 965 patients developed HAPIs during their ICU hospitalization; thus, they were included in the HAPI group. On the other hand, the rest 11687 patients did not develop HAPIs; therefore, they were included in the non-HAPI group. We performed statistical analyses on these groups of patient data.

Patient characteristics compared between the groups were weight, Glasgow Coma Scale (GCS), Feeding tube, numbers of comorbid conditions, transfusion, numbers of medications, use of continuous sedation medications, use of non-continuous sedation medications, surgery, duration of surgery, and blood transfusion during the surgery. The GCS is an assessment tool to be used to measure the level of consciousness of patients with a brain injury [8]. The GCS ranges from 3-15. The score of 15 indicates the best while 3 indicates the poorest prognoses. Generally, patients with scores of 3-8 are said to be in a coma. Scores of 8 or above have a good chance for recovery. The ICU patients had been administered various types of medications such as vasopressors, diuretics, and antipyretics [9]. We calculated total number of medications administered. Continuous sedation meant continuous intravenous infusion of sedatives whereas non-continuous meant intermittent administration of sedatives.

Patient outcomes were compared in the following 3 aspects: 1) length of ICU stay, 2) discharge disposition (discharge status), and 3) discharge destination. Length of ICU stay (LOS) was measured by days. Discharge disposition was classified into 3 categories; alive, expired, and left against medical advice (AMA). Discharge destination were home, acute care hospitals, intermediate care facilities, long-term care facilities, rehabilitation facilities, hospice centers, and others. Others included prison, unknown, and autopsy. We conducted chi-square test and t-test for group comparison. Association was examined by using bivariate analyses. Pearson correlation coefficients were used to examine correlation between LOS and comorbid conditions and number of medications.

3. Results

The HAPI and non-HAPI groups were significantly different in terms of demographics inclusive of weight, feeding tube, comorbid conditions, number of medications, continuous sedation, non-continuous sedation, and having undergone surgery (Table 1). There was no significant difference between the groups in terms of GCS, transfusion, surgery duration, and blood transfusion during the surgery.

LOS was not significantly different between the groups (Table 2). However, LOS and number of medications were strongly correlated ($r=.73$, $p<.001$). The relative slope of the LOS over number of medications in the HAPI group was greater than the non-HAPI group when we split them into sub-groups by Surgery (Figure 1) and GCS (Figure 2). LOS and comorbid conditions did not appear to be correlated ($r=-.096$,

p<.001).

There was significant difference between the HAPI and non-HAPI groups relative to discharge disposition (Table 2). In the HAPI group, 39.1% were discharged to intermediate care facilities, followed by long-term hospitals (27.9%), home (16.1%). As for the non-HAPI group, 57.7% of the patients were discharged home, followed by intermediate care facilities (21.4%), and long-term care hospitals (7.0%).

Table 1. Comparison of clinical characteristics between the HAPI and non-HAPI groups

Characteristics		HAPIs		Non-HAPIs		P
Weight (lbs) (n=7743)	Mean (SD)	226.9	(56.2)	206.2	(56.9)	<.001
	Median	214.0		198.0		
Glasgow Coma Scale (n=1726)	3-8	63	(35.8)	509	(32.8)	.430
	9-15	113	(64.2)	1041	(67.2)	
Feeding tube (n=12652)	Yes	346	(35.9)	1857	(15.9)	<.001
	No	619	(64.1)	9830	(84.1)	
Comorbid conditions (n=12652)	Mean (SD)	10.4	(4.1)	6.3	(4.0)	<.001
	Median	11.5		6.0		
Transfusion (n=8985)	Yes	134	(14.6)	1014	(12.6)	.076
	No	782	(85.4)	7055	(87.4)	
Number of medications (n=8985)	Mean (SD)	14.5	(8.0)	8.3	(5.1)	<.001
	Median	14.0		7.0		
Sedation: Continuous (n=8069), freq (%)	Yes	512	(55.9)	3815	(47.3)	<.001
	No	404	(44.1)	4254	(52.7)	
Sedation: Non-continuous (n=8069), freq (%)	Yes	169	(14.8)	1187	(14.7)	.003
	No	747	(81.6)	6882	(85.3)	
Surgery (n=11687), freq (%)	Yes	39	(4.0)	1700	(14.5)	<.001
	No	926	(96.0)	9987	(85.5)	
Blood transfusion during Surgery (n=1700),	Yes	37	(94.9)	1494	(87.9)	.184
freq (%)	No	2	(5.1)	206	(12.1)	
Surgery: Duration (min) (n=1739)	Mean (SD)	562.0	(228.9)	510.0	(144.8)	.165
	Median	503.0		469.5		

Table 2. Comparison of outcomes between the HAPI and non-HAPI groups

Patient Outcomes		HAPIs		Non-HAPIs		P
LOS (n=12652)	Mean (SD)	12.3	(13.0)	12.1	(12.5)	.654
	Median	8.0		8.0		
Discharge disposition (n=11635), freq (%)	Alive	792	(82.8)	10090	(86.7)	.001
	Expired	164	(17.1)	1513	(13.0)	
	AMA*	1	(0.1)	32	(0.3)	
Discharge destination (n=10092), freq (%)	Home	128	(16.1)	5828	(57.7)	<.001
	Acute care	26	(3.3)	191	(1.9)	
	Intermediate care	310	(39.1)	2159	(21.4)	
	Long-term care	221	(27.9)	702	(7.0)	
	Rehabilitation	53	(6.7)	693	(6.9)	
	Hospice	27	(3.4)	228	(2.3)	
	Other	28	(3.5)	291	(2.9)	

*=Left Against Medical Advice (AMA)

4. Discussion

As part of a larger and ongoing research project, we conducted a retrospective cohort study using a subset of the collected ICU data [7]. We compared clinical characteristics of the patients who developed HAPIs during ICU hospitalizations relative to the patients who did not develop HAPIs. The patients with HAPIs had

significantly heavier compared to those without HAPIs. The HAPI group had significantly more comorbid conditions and were administered more medications than the non-HAPI group. The HAPI group appeared to have more continuous and non-continuous sedation.

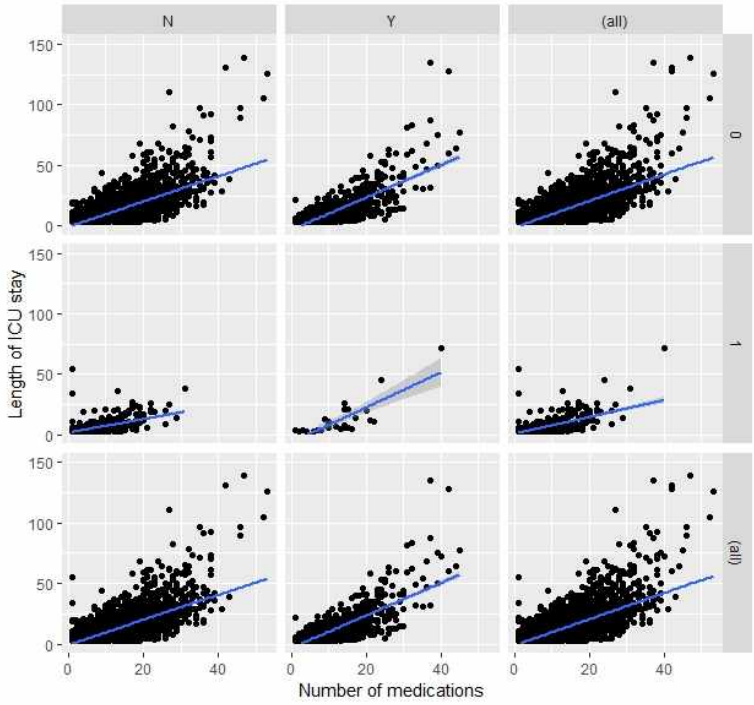

Figure 1. Comparison between HAPIs and non-HAPIs
N=Non-HAPI; Y=HAPI, 0=without surgery; 1= with surgery

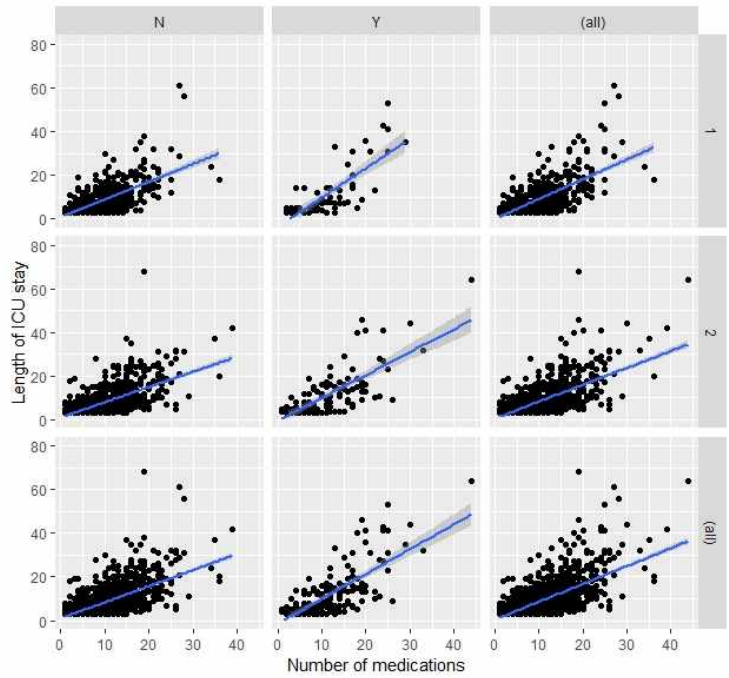

Figure 2. Comparison between HAPIs and non-HAPIs
N=Non-HAPI; Y=HAPI, 1=Glasgow Coma Scale (GCS) from 3-8; 2=GCS from 9-15

On the other hand, the patients in the non-HAPI group had more surgery than the patients in the HAPI group. The non-HAPI group had more blood transfusion both during the ICU stay and during the surgery; however, they were not significant. Interestingly, the surgery duration was not significantly different between the groups.

Patient outcomes were examined by reviewing 3 aspects, LOS, discharge disposition (status), and discharge destination. LOS was strongly correlated with number of medications administered. Interestingly, LOS was not significantly different between the groups at the significance level of 0.05. This finding is conflicting with what have known in the literature [3, 5, 10]. However, when we examined LOS by surgery status (yes/no), the HAPI group showed a greater slope of LOS over number of medications than the non-HAPI group in the patients who had surgeries. In addition, LOS of the HAPI group showed a larger slope over number of medications administered in the both unconscious patients (GCS of 3-8) and those who were conscious.

Previous research reported that prolonged surgical procedure was a risk factor for pressure injury [6]. The HAPI group in our study had longer surgery duration than the non-HAPI group, but it was not significant in our data. A possible explanation may be related to limitations of this study. For instance, our data included medical and surgical ICU patient data. We were unable to distinguish them due to unavailability of relevant data elements. Future research is necessary.

The mortality of the HAPI group (17.1%) was significantly higher than the non-HAPI group (13.0%) in our data. This is consistent with the previous research study [11]. Discharge disposition was significantly different between the groups. 67% of the HAPI group transferred to intermediate or long-term care hospitals whereas 57.7% of the non-HAPI group went home after discharge.

Our findings suggest a number of consistent and potentially modifiable risk factors, such as sedation, feeding tubes and the number of medications administered. A systematic review reported that vasopressor infusion was a risk factor for ICU pressure injury [5]. Continuous sedation appeared to be significantly associated with HAPIs and medical devices were reported as an independent risk factor for ICU HAPI [10]. Awareness of these risk factors can lead to clinical interventions that can be preventative in the ICU setting.

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