HHS Public Access
Author manuscript
Am J Surg. Author manuscript; available in PMC 2017 July 01.

Published in final edited form as:
Am J Surg. 2016 July ; 212(1): 109–115. doi:10.1016/j.amjsurg.2015.06.013.

Hypoalbuminemia at admission is associated with increased incidence of in-hospital complications in geriatric trauma patients

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Abstract

BACKGROUND—Elderly patients are at an increased risk of protein-energy malnutrition (PEM) which increases the risk of morbidity/mortality. We evaluated the association between hypoalbuminemia at the time of emergency department (ED) admission and in-hospital complications among geriatric trauma patients.

METHODS—This was an ambidirectional cohort study of geriatric (≥55 years) trauma patients treated at a Level I trauma center between May 2013 and March 2014. The exposure of interest was albumin level at ED admission (<3.6 g/dL [PEM] or ≥3.6 g/dL (No PEM)]. The outcome of interest was 30-day incidence of complications.

RESULTS—A total of 130 patients met study eligibility. Of these, 85 (65%) patients were in the PEM group. After adjusting for tube feeding and injury severity score, PEM at admission was associated with a 2-fold increase in the risk of 30-day overall hospital complications (hazard ratio 2.1, 95% confidence interval 1.1 to 3.8).

CONCLUSION—Serum albumin level at ED admission, but not prealbumin level, is a significant predictor of inhospital complications in geriatric trauma patients.

Introduction

Protein-energy malnutrition (PEM) is a condition resulting from a pathologic depletion of the body's lean tissues caused by inadequate dietary protein intake (starvation) or a combination of starvation and catabolic stress.[1] It commonly includes deficiencies of many micronutrients. PEM is typically characterized by generalized fat and muscle loss. As such, it is easiest to diagnose PEM when fat stores are depleted, but, it can occur without apparent fat loss in previously obese patients, in chronic protein deficiency without energy deficiency, and in highly protein catabolic states.[1] Severity of PEM ranges from subclinical deficiencies to obvious wasting. Protein-energy malnutrition is associated with impaired wound healing, increased infectious morbidity, multi-organ dysfunction, prolonged hospitalization and disproportionate mortality.[2] **N**o fully satisfactory PEM severity classification method currently exists.[3] However, there are a number of instruments available to measure the concept of protein-energy malnutrition, each with its own limitations. These instruments include dietary assessment methods, anthropometric methods, biochemical indices such as serum albumin, prealbumin, transfrerrin and, functional methods. Unlike subjective nutritional assessments performed by nutritionists, biochemical indices can be quickly and easily evaluated. Although not the only condition that lowers albumin levels, PEM is typically characterized by low (abnormal) albumin levels (hypoalbuminemia). Both serum albumin and prealbumin have been shown to be significant predictors of adverse clinical outcomes in medical and surgical patients.[4–7] However, there is a paucity of information regarding this association in trauma patients, particularly in geriatric trauma patients. A few studies evaluating this association in trauma patients have been primarily restricted to patients with traumatic brain injuries (TBI) or cervical spinal cord injuries.[8–10] One study that included all adult trauma patients 18 years and older, without restriction to a specific anatomic injury site, acknowledged increased age as an effect modifier of low albumin levels on the risk of adverse outcomes. However this study was not designed to focus specifically on geriatric trauma patients.[11]

Compared to their younger counterparts, elderly patients are at higher risk of developing protein-energy malnutrition.[2] Elderly patients represent a group with a high risk of PEM due to presence of chronic, degenerative, and neurological diseases, habitual use of medications, dietary and psychosocial habits, as well as physiologic and anatomic modifications related to the aging processes.[2, 12] Despite a high incidence of multi-system and non-extremity injuries in the elderly, most prior studies on nutritional predictors of outcomes in older injured patients have narrowly focused on elderly patients with hip fractures. A number of studies have reported up to 64% of elderly patients hospitalized with an acute hip fracture are protein-energy undernourished at admission or develop serious nutritional deficits while hospitalized.[13, 14] These patients are at an increased risk of complications and mortality, with this risk increasing exponentially with the severity of nutritional deficits. [13, 14] For elderly patients sustaining severe injuries, the combination of pre-existing PEM and tissue injury-induced hypermetabolism is likely to further exacerbate PEM and disproportionately increase the risk of complications and mortality. Major injury, among other stressors is typically associated with a catabolic stress state, unfortunately right at the time protein needs are increasing; severe tissue injury commonly induces a hypermetabolic response termed the systemic inflammatory response syndrome (SIRS). Prealbumin, one of the visceral proteins used to assess nutritional status, has short half-life of about 2 days and is the first protein to show altered levels under acute malnutrition. [15] On the other hand, because of its long half-life (18–20 days), the sensitivity of albumin can be reduced in acute protein malnutrition; [15] however, this reduced sensitivity can make it a more useful indicator of pre-existing hypoalbuminemia, particularly in trauma patients. This study sought to evaluate the association between hypoalbuminemia at admission (as a surrogate marker of pre-injury PEM) and 30-day incidence of in-hospital infectious and non-infectious complications in geriatric patients sustaining severe injuries. Early identification and nutritional intervention in geriatric trauma patients who have pre-existing PEM will mitigate the poor prognosis typically associated with PEM.

Material and Methods

Study Design and Population

This was an ambi-directional cohort study of geriatric trauma patients 55 years and older consecutively evaluated and treated at a Level I trauma center between May 2013 and March 2014. Eligibility criteria included hospital length of stay of at least 3 days and at least 1 day stay in the intensive care unit. Baseline demographic and clinical information was obtained for all screened patients at admission. The prospective component of the study included obtaining informed consent to monitor the patient's daily caloric intake including timing of feeding, type of feeding (enteral, parenteral, etc), % of caloric needs as well as incidence of in-hospital complications. The nutritional parameters of consenting patients were monitored daily by a registered dietician. Due to low recruitment for the prospective study and the need to validly estimate prevalence of PEM at admission, the study also included a retrospective component. The retrospective component of the study included supplemental retrospective data collection of limited clinical and outcome information on all screened patients who met study criteria after the patients were discharged from the hospital. It should be noted however that, most of the information for patients in the retrospective group was obtained prospectively at baseline as part of the screening process. Data obtained prospectively as part of the screening process included demographics, BMI, initial ED vital signs, pre-existing conditions and medication use, ED admission serum albumin and pre-albumin, ICU admission and tube-feeding status. Eighteen (18) patients from the prospective component of the study and 112 patients from the retrospective component of the study are included in this analysis. This study was approved by the University of Oklahoma Health Sciences Center (OUHSC) Institutional Review Board.

Variables and Statistical Analysis

The primary outcome of interest was 30-day incidence of complications. Two major categories of complications were considered: infectious and non-infectious complications. Infectious complications of interest included pneumonia, sepsis, urinary tract infection, superficial surgical site infection. Non-infectious complications of interest included acute renal failure, acute lung injury /acute respiratory distress syndrome, decubitus ulcer, coagulopathy, myocardial infarction, deep venous thrombosis, pulmonary embolism, stroke or cardiovascular accident. The primary exposure of interest was serum albumin level upon ED arrival dichotomously defined as either PEM (albumin <3.6g/dL) or NO PEM (albumin >=3.6g/dL). Except for 4 patients whose albumin levels were determined a day after admission, all patients' albumin levels were determined based on ED blood draws upon arrival. The cutoff value of 3.6g/dL was determined based on receiver operating characteristic (ROC) curve analysis and this value maximized the sum of sensitivity and specificity in predicting in-hospital complications (AUC=0.66, sensitivity=0.84 and specificity=0.55). A sensitivity analysis that used the conventional cutoff value (3.5g/dL) had minimal effect on either the magnitude of the estimated association or its statistical significance. A secondary analysis also evaluated whether pre-albumin level at ED admission was associated with in-hospital complications after adjusting for potentially confounding variables.

Covariates of interest considered for multivariable adjustment included patient demographics, body mass index (BMI), mechanism of injury, initial emergency department (ED) vital signs (systolic blood pressure (SBP), heart rate (HR), respiratory rate (RR), and Glasgow Coma Scale (GCS)), emergency medical services (EMS)/ED intubation, initial 24-hour blood product and crystalloid resuscitation, tube feeding status, injury pattern and severity (including severe single vs multi-system trauma),, presence of a comorbid condition and foley catheter days. SBP was considered both as a continuous variable and a categorical y/n variable (hypovolemic shock, SBP < 110 mmHg). BMI was calculated from the patient's height and weight at admission. Severe injury for a specific anatomic site was defined based on an Abbreviated Injury Scale (AIS) value of 3 or greater; patients were considered to have multisystem trauma if they had at least 2 body regions with an AIS value of 3 or greater. Patients were considered to have a comorbid condition if any one of the following pre-existing conditions were noted: diabetes, heart disease, cardiovascular disease, pulmonary disease, chronic kidney disease, liver disease and coagulopathy. Additionally information on outpatient medication use was also abstracted. Unadjusted comparisons between the two patient groups were performed using the independent Student's t test or Mann-Whitney Wilcoxon test for continuous variables and for categorical variables, the chi-square statistic and Fisher's Exact tests were used. Multivariable analysis was performed using Cox regression to evaluate interaction and to account for potentially confounding variables. Covariates were considered for multivariable adjustment if they were deemed *a priori* to be clinically important and potentially confounding (e.g. ISS, comorbidity, tube-feeding, resuscitation, etc.), or had p-value of 0.2 based on unadjusted comparisons, A p-value of .05 was used to assess all statistical significance. Since the study objective was to determine the relationship between serum albumin *at ED admission* and risk of in-hospital complications, the association was evaluated with and without including patients transferred from other facilities. All analyses were performed using SAS (SAS 9.3, SAS Institute, Cary, NC).

Results

A total of 130 patients met study eligibility. Of these, 85 (65%, 95%CI: 58–74%) had hypo-albuminemia upon ED arrival and were therefore considered to be protein energy malnourished (PEM). Table 1 summarizes patient demographics, injury etiology and initial ED characteristics by PEM status. Unadjusted comparisons showed no significant differences ($p > 0.05$) by PEM status in the distribution of age, BMI, race, mechanism of injury, EMS/ED intubation, initial ED vital signs (GCS, HR and RR) and those transferred from other facilities. Patients in the PEM group however, were significantly ($p <0.05$) more likely to be in shock (SBP <110 mm Hg), more likely to be taken to the OR from the ED, and were predominantly female. There were no significant differences ($p>0.05$) in the amount of initial 24-hour blood product or crystalloid resuscitation with the exception of fresh frozen plasma (FFP) of which larger volumes were administered to patients in the PEM group ($p<0.05$) (Table 2).

Table 3 summarizes patients' clinical characteristics and outcomes by PEM status. Compared to the NO PEM group, patients in the PEM group did not differ in their distribution of overall injury severity scores (ISS), severe head, chest and extremity single system injuries, multisystem injuries, pre-existing conditions, ventilation, ICU, and hospital length of stay days, discharge destination and overall mortality. Patients in the PEM group however, were significantly ($p < 0.05$) more likely to have severe abdominal injuries, disproportionately used more outpatient antihypertensive and diabetes medication, to have a foley catheter and were more likely to be tube-fed although only marginally significant ($p=0.078$). Although the proportion of patients with a foley catheter was higher in the PEM group, the median foley catheter days did not differ between the two groups.

In terms of morbidity, patients in the PEM group had a significantly higher incidence of overall in-hospital complications in particular, a higher incidence of infectious complications. Pneumonia and UTI were the most common infectious complications while ARDS and thromboembolism were the most common non-infectious complications. Covariates ISS, multisystem injury, tube-feeding, gender, initial ED SBP, EMS/ED intubation, ED disposition to OR, severe torso injury, foley catheter, blood product and crystalloid resuscitation were all considered in the initial multivariable model. Packed red blood cell (pRBC) utilization was highly correlated with FFP utilization, so only pBRC was considered for multivariable adjustment. Variables were only retained if they met statistical significance or deemed clinically important. After adjusting for tube feeding ,initial 24-hour packed red blood cell (pRBC) utilization and ISS, PEM at admission was associated with a two-fold increase in the risk of 30-day overall hospital complications (HR=2.1, 95%CI: 1.1–3.8) and an even higher risk of infectious complications (HR=2.2, 95% CI: 1.2–4.3). There was no association between pre-albumin at admission and in-hospital complications after adjusting for ISS, tube feeding and pRBC utilization. Serum albumin levels at admission were poorly correlated with pre-albumin levels ($r=0.52$).Ninety-one percent of patients who used outpatient diabetes medication also used outpatient blood pressure medication, so only blood pressure medication use was considered for analysis. No significant statistical interactions between PEM status and discharge to OR from ED, medication use, and presence of severe torso injuries were observed. Medication use was not significantly associated with incidence of complications in the NO PEM group and was therefore not treated as a confounder but a predictor of PEM.

Discussion

Our results suggest that low ED serum albumin level (hypoalbuminemia) at admission is a significant predictor of in-hospital complications especially, of infectious complications in geriatric patients sustaining severe injuries. ED pre-albumin levels were not associated with inhospital complications in our study population. These findings suggest ED serum albumin levels, rather than pre-albumin levels, have a prognostic value in geriatric patients sustaining severe injuries. While hypoalbuminemia typically characterizes protein energy malnutrition (PEM), its use as a nutritional index has long been criticized due to its lack of specificity and a long half-life (18–20 days).[15, 16] Levels of this visceral protein can be altered in various disease states even in the absence of PEM related to inadequate dietary intake.[15] Low albumin levels occur in nephrotic syndrome, protein losing enteropathies, hepatic insufficiency or failure, and may also occur in the setting of acute injury and illness as the liver reprioritizes protein synthesis from visceral proteins to acute phase reactant proteins.[1] Systemic inflammation reduces albumin synthesis and increases its degradation. Despite these numerous factors that can alter the levels of serum albumin, several studies have found this protein to be a significant and independent predictor of adverse outcomes. [4, 5, 8–11]

While our results are similar to a number of studies which have noted a similar association, there is a paucity of information regarding this association in geriatric trauma patients sustaining single or multisystem injuries. A number of studies, particularly in medical and surgical patients have documented a significant independent association between hypoalbuminemia and an increased risk of adverse outcomes, in particular postoperative complications and mortality. Results from the National VA Surgical Risk Study using a prospective database to study 54,215 noncardiac elective surgery patients concluded that preoperative albumin levels were the best predictor of postoperative morbidity and mortality.[4] Kudsk et al. conducted a retrospective cohort study of 526 patients undergoing elective esophageal, gastric and pancreaticoduodenal or colon surgery and concluded that preoperative albumin levels correlated inversely with complications, length of stay, postoperative stay, ICU stay, mortality and resumption of oral intake and that, this inverse relationship varied by operative site. [5]

Most of the studies evaluating the association between albumin and adverse outcomes in trauma patients have primarily focused on patients who sustained neurological injuries. A study by Bernard et al. using the Glasgow Outcome Scale (GOS) to define favorable (GOS grades 4 and 5) and unfavorable outcomes (GOS grades 1, 2, and 3) at 6 months post traumatic brain injury, identified low albumin levels at admission and persistent hypoalbuminemia during hospital stay in addition to age, initial GCS, ISS as independent predictors of unfavorable outcomes.[8] These results are similar to a study by Jin et al. which concluded that severity of a cervical spinal cord injury, neurologic levels and persistent hypoalbuminemia were independent predictors of mechanical ventilation and/or death after cervical injury.[10] Chen et al compared the predictive value of albumin and prealbumin in predicting poor outcomes (defined based on the GOS) following traumatic brain injury and concluded that both albumin and prealbumin could detect poor outcome of TBI, but that the former was much better based on AUC analysis. We were able to identify only one study which evaluated admission serum albumin as a predictor of adverse outcomes in critically ill adult trauma patients without restriction to the type of injury sustained. In this study, Sung et al. reported an inverse relationship between ICU days, hospital length of stay, ventilator days and mortality and that, a combination of increased age and low albumin level was most predictive of infection and mortality. It should be noted however that, this study was not focused primarily on geriatric trauma patients and that the average age of the study cohort was 43 (±21) years. In this study, a cutoff value of less than 2.6g/dL was used to define low serum albumin levels. [11] The rationale for using this cutoff value to define hypoalbuminemia was that, it had been used in a prior study evaluating mortality after coronary artery bypass graft. Our study is the first to specifically focus on predictive value of ED serum albumin levels at admission in geriatric trauma patients suffering both non-extremity and extremity injuries using an objectively determined cutoff value to define hypoalbuminemia in this population. Our study results suggest that the detrimental effect of lower albumin levels may begin at much higher levels in geriatric trauma patients, a population already at a higher risk of PEM; based on AUC analysis, a cutoff value of less than 3.6 maximized sensitivity and specificity in predicting in-hospital complications in this population.

A few studies have concluded prealbumin to be a significant predictor of infectious postoperative complications in patients undergoing elective surgery and hence, a better nutritional index than albumin.[6, 7] The external generalizability of these studies however, may be limited because they were conducted in patients undergoing one specific type of elective surgery[17] or excluded patients undergoing cardiac, orthopedic or neurosurgery.[7] The long half-life of albumin while long-viewed as a limitation, offers a unique opportunity in using this biomarker as a surrogate marker of PEM, particularly in patients with traumatic injuries as done in this study. Traumatic injury and subsequent surgical management of the injury induces a hypermetabolic and catabolic state which can lead to the onset of protein calorie malnutrition within a few days.[11, 18] Thus, the lag time between the injury and injury/surgery-induced PEM allows one to use albumin levels at admission as a surrogate marker of pre-existing PEM. Prealbumin is the first visceral protein to show altered levels under acute PEM alterations and returns to normal as soon as nutritional reposition occurs. [15, 16] The higher sensitivity of prealbumin to acute protein alterations makes it the better biomarker for nutritional monitoring but this sensitivity limits its use in the initial screening of patients for pre-existing PEM particularly in trauma patients as, both patients with and without pre-existing PEM will likely have indistinguishable ED prealbumin values at admission as a result of the catabolic stress induced by the injury. In our study,ED prealbumin levels were not predictive of in-hospital complications and were poorly correlated with albumin levels at admission(r=0.52). As such, low serum albumin levels at admission observed in our study are unlikely explained by hemodilution resulting from resuscitative efforts prior to ED arrival at the Level I trauma center. If this was the case, both albumin and pre-albumin would be similarly affected by hemodilution and would be highly correlated. While patients in the PEM group received more blood products and crystalloid in general, adjusting for these variables did not alter the statistical significance and magnitude of the association between PEM and in-hospital overall and infectious complications. As such, blood product utilization is an unlikely explanation of increased infectious complications in our study. Furthermore, excluding patients transferred from other facilities as well as adjusting for the presence of hypovolemic shock did not alter the magnitude of association nor the statistical significance.

As indicated earlier, various approaches are used to measure the concept of PEM. The approaches include, in addition to biochemical indices, dietary assessment methods such as the Subjective Global Assessment (SGA), anthropometric methods, and functional methods. As previously stated, it is easiest to diagnose PEM when fat stores are depleted, but it can occur without apparent fat loss in, previously obese patients, in chronic protein deficiency without energy deficiency, and in highly protein catabolic states.[1] An inadequate, but logical way to classify PEM and its severity is simply by degree of weight loss; there is consensus that a 10% loss in weight over 6 months is a useful predictor of adverse outcomes, however this approach is limited in the elderly, especially because of the difficulty these patients have in remembering their habitual weights.[12, 19] In our study the only anthropometric measure obtained at admission was BMI calculated from the patient’s height and weight. The average

BMI for our study cohort was 28.4 (±7.1) kg/m^2, and did not significantly vary between the two PEM groups. Elderly patients with a BMI less than 21 are considered to be malnourished.[20, 21] Using this definition, only 5% of our study cohort would be considered malnourished. Given an overweight cohort in general, BMI would not be a valid approach to assess PEM; our results suggest albumin may be the most important marker, albeit a surrogate one, for pre-existing PEM and an important prognostic tool in geriatric patients sustaining severe injuries. Whether the predictive value of serum albumin is directly related to nutrition or a reflection of overall underlying chronic disease may not be entirely clear. In our study female gender and outpatient blood pressure medication (antihypertensives) use were associated with PEM status. The greater proportion of PEM patients taking antihypertensives may explain the significant lower average ED SBP observed in this group. Habitual use of medication has been identified as a risk factor for PEM and female gender may be a marker of psychosocial risk factors of PEM rather than being a biological risk factor.[7] Regardless of its etiology, hypoalbuminemia is an important finding in nutritional assessment as hypoalbuminemic patients are usually both catabolic or have inadequate dietary protein intake.[1, 2] The diagnosis of PEM is frequently missed by clinicians and when this happens the opportunity is lost to discover whether treating it with nutritional support will improve the patient's clinical outcome.[1, 22] Early detection of risk factors can limit the negative impact of PEM. Early nutritional supplementation at least places the hospitalized patient at a better starting point for the additional nutritional assault resulting from the metabolic stress that accompanies traumatic injury and any subsequent major surgical operation. Nutritional supplementation has been shown to reduce hip fracture-related complications in the elderly[23] as well as improve anthropometric, biochemical and functional parameters.[24, 25]

This study has a few limitations that warrant discussion. Only BMI at admission was available, as such we could not assess the impact of significant weight loss during hospitalization as an independent risk factor for in-hospital complications. Additionally, we did not obtain information on the site and frequency of major surgical operations for patients in our study. Major surgical operations as well as the site of operation may have an independent effect on the risk of in-hospital complications or possibly modify the effect of admission hypoalbunemia on the risk of complications. To mitigate the impact of the lack of information on major surgical operations and site, we considered the incidence of severe injuries (AIS >=3) and multisystem injuries, as well as overall injury severity score in our risk adjustment, however, this may have been inadequate. Despite these limitations, the observation that low ED serum albumin levels at admission rather than prealbumin levels have a predictive and prognostic value is an important finding that enables clinicians to identify early, geriatric trauma patients who may benefit from early nutritional supplementation.

Conclusions

ED Serum albumin level is a significant predictor of in-hospital complications especially, of infectious complications in geriatric patients sustaining severe injuries. ED prealbumin levels have no predictive or prognostic value in geriatric trauma patients sustaining severe injuries. Given serum albumin is a relatively low-cost, easily obtainable test, clinicians should use this test more often as a prognostic tool to detect malnutrition and to predict risk of in-hospital complications, particularly in the geriatric patient population in whom comorbid conditions are relatively frequent. Early identification and nutritional intervention will mitigate the increased risk of complications associated with protein energy malnutrition.

Acknowledgments

The authors would like to thank University of Oklahoma Vice President for Research Seed Grant Program for providing financial support for this study. Partial funding provided by National Institutes of Health, National Institute of General Medical Sciences (Grant 1 U54GM104938), an IDeA-CTR to the University of Oklahoma Health Sciences Center.

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Table 1

Patient Demographics, Mechanism of Injury, and ED Characteristics by ED Admission Hypoalbuminemia (PEM)

	PEM n=85	No PEM n=45	p-value
Variable			
Mean Age (±SD)	67 (11)	67 (10)	0.8376
Age >=65, n (%)	52 (61)	25 (56)	0.5350
Mean BMI (±SD)	28 (7)	27 (6)	0.6053
Female, n (%)	28 (33)	7 (16)	†**0.0335**
Race, n (%)			
White	71 (84)	38 (84)	
Black	6 (7)	2 (4)	
AI/AN	3 (4)	1 (2)	
Pac Islander	0 (0)	0 (0)	
Asian	0 (0)	1 (2)	
Blunt Injury, n (%)	82 (97)	45 (100)	0.5510
MOI, n (%)			0.2418
Traffic	52 (61)	28 (62)	
Falls	18 (21)	14 (31)	
GSW/Stab	3 (4)	0 (0)	
Other	12 (14)	3 (7)	
EMS Transported, n (%)	77 (91)	41 (91)	0.9219
Transferred, n (%)	38 (45)	16 (36)	0.3138
Initial ED Mean (±SD)			
GSC	12 (5)	12 (5)	0.9358
HR	98 (21)	96(22)	0.5713
RR	16 (10)	18 (9)	0.1456
SBP (mmHg)	129 (28)	150 (29)	†**<0.0001**
TBI (GCS <9), n (%)	19 (22)	11(24)	0.7877
Shock (SBP <110 mmHg)	20 (24)	4 (9)	†**0.0407**
EMS/ED Intubation, n (%)	18 (21)	5 (11)	0.1525
ED Disposition, n (%)			†**0.0128**
OR	18 (21)	2 (4)	
ICU	65 (77)	39 (87)	
Floor	2 (2)	4 (9)	

† $p<0.05$; % refer to column proportions

Table 2

Patients' Initial 24-hour Blood Product and Crystalloid Resuscitation by ED Admission Hypoalbuminemia (PEM)

	PEM n=85	No PEM n=45	p-value
Variable			
Received at least 1 unit, n (%)			
pRBC	30 (35)	9 (21)	0.0894
Platelets	17 (20)	6 (14)	0.3860
Fresh Frozen Plasma	33 (39)	6 (14)	**0.0036**
Crystalloid	85 (100)	45 (100)	-
***Mean Fluid (cc), (±SD)**			
pRBC	1135 (537)	742 (537)	0.0790
Fresh Frozen Plasma	730 (606)	458 (102)	0.0220
Platelets	406 (191)	346 (127)	0.4892
Crystalloid	2411 (1452)	2124 (1222)	0.2643

*Conditional on receiving at least 1 unit

Table 3

Patients' Clinical Characteristics and Outcomes by ED Admission Hypoalbuminemia (PEM)

	PEM n=85	**No PEM n=45**	**p-value**
Variable			
Tube Fed, n (%)	42 (49)	15 (33)	0.0788
Mean ISS (±SD)	24 (11)	21(11)	0.1534
ISS Group			
1–8	1 (1)	5 (9)	†**0.0477**
9–15	18 (25)	7 (12)	
16–24	28 (33)	18 (40)	
>=25	37 (44)	15 (33)	
Severe Injury, n (%)			
Head	36 (42)	22 (49)	0.4757
Chest	56 (66)	25 (56)	0.2477
Abdomen	22 (26)	2 (4)	†***0.0027**
Extremity	18 (21)	10 (22)	0.8903
Multisystem trauma, n (%)	44 (52)	18 (40)	0.2014
Comorbidity, n (%)	44 (52)	22 (49)	0.7550
Outpatient Medication Use, n (%)			
Antihypertensive	44 (52)	13 (29)	†**0.0124**
Diabetes	20 (24)	3 (7)	†***0.0165**
At least 1 Day, n (%)			
Ventilator	50 (59)	21 (47)	0.1853
Foley Catheter	40 (47)	11 (25)	**0.0175**
ICU	85 (100)	45 (100)	-
Median Days (IQR)			
ICU	12(11)	10 (11)	‡0.1315
Vent	13 (14)	10 (9.5)	‡0.3514
Foley Catheter	7 (10.5)	6 (4)	‡0.3478
Hospital Length of Stay	14 (9)	12 (8)	‡0.0784
Overall Complications, n (%)	56 (66)	16 (36)	†**0.0009**
Infectious	49 (58)	12 (27)	†**0.0008**
Non-Infectious	29 (34)	10 (22)	0.1591
Pneumonia	33 (39)	11 (24)	0.0993
UTI	19 (22)	5 (11)	0.1160
ARDS	14 (17)	4 (9)	0.2338
DVT/PE	15 (18)	8 (18)	0.9852
Discharge Destination, n (%)			0.3518

	PEM n=85	No PEM n=45	p-value
Variable			
Home	17 (20)	15 (33)	
SNF	18 (21)	4 (9)	
ICF	11 (13)	6 (13)	
Rehab	24 (29)	15 (33)	
Mortality, n (%)	12 (14)	5 (11)	0.6286

† p<0.05;

* Fisher's Exact test; % refer to column proportions;

‡ Mann-Whitney-Wilcoxon