Hyperglycemia in nondiabetic adult trauma patients is associated with worse outcomes than diabetic patients: An analysis of 95,764 patients

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BACKGROUND: The adverse impact of acute hyperglycemia is well documented but its specific effects on nondiabetic trauma patients are unclear. The purpose of this study was to analyze the differential impact of hyperglycemia on outcomes between diabetic and nondiabetic trauma inpatients.

METHODS: Adults admitted 2018 to 2019 to 46 Level I/II trauma centers with two or more blood glucose tests were analyzed. Diabetes status was determined from International Classification of Diseases—10th Rev.—Clinical Modification, trauma registry, and/or hemoglobin A1c greater than 6.5. Patients with and without one or more hyperglycemic result >180 mg/dL were compared. Logistic regression examined the effects of hyperglycemia and diabetes on outcomes, adjusting for age, sex, Injury Severity Score, and body mass index.

RESULTS: There were 95,764 patients: 54% male; mean age, 61 years; mean Injury Severity Score, 10; diabetic, 21%. Patients with hyperglycemia had higher mortality and worse outcomes compared with those without hyperglycemia. Nondiabetic hyperglycemic patients had the highest odds of mortality (diabetic: adjusted odds ratio, 3.11; 95% confidence interval, 2.8–3.5; nondiabetics: adjusted odds ratio, 7.5; 95% confidence interval, 6.8–8.4). Hyperglycemic nondiabetics experienced worse outcomes on every measure when compared with nonhyperglycemic nondiabetics, with higher rates of sepsis (1.1 vs. 0.1%, $p < 0.001$), more SSIs (1.0 vs. 0.1%, $p < 0.001$), longer mean hospital length of stay (11.4 vs. 5.0, $p < 0.001$), longer mean intensive care unit length of stay (8.5 vs. 4.0, $p < 0.001$), higher rates of intensive care unit use (68.6% vs. 35.1), and more ventilator use (42.4% vs. 7.3%).

CONCLUSION: Hyperglycemia is associated with increased odds of mortality in both diabetic and nondiabetic patients. Hyperglycemia during hospitalization in nondiabetics was associated with the worst outcomes and represents a potential opportunity for intervention in this high-risk group. (*J Trauma Acute Care Surg.* 2022;93: 316–322. Copyright © 2022 American Association for the Surgery of Trauma.)

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

KEY WORDS: Hyperglycemia; wounds and injuries; outcomes; mortality; diabetes mellitus.

Hyperglycemia in response to rising levels of stress, or "stress induced hyperglycemia" (SIH), is a natural physiologic defense response that enables the body to deliver increased energy to vital organs and body systems in times of crisis.[1] While transient hyperglycemia is a protective response, persistent hyperglycemia is not, and can lead to multiple untoward effects on the vascular and immune systems, precipitating a damaging cascade of counterregulatory hormonal responses, resulting in insulin resistance, increased gluconeogenesis, reduction in glucose utilization, and insulin deficiency, which contribute to increased rates of morbidity and mortality.

In contrast, patients with diabetes mellitus experience diabetic hyperglycemia (DH) as a chronic condition of endocrine dysfunction, with diabetic patients spending months or even years in fluctuating states of chronic hyperglycemia that gives rise to its own specific set of morbidities.[2] While the detrimental effect of diabetes in general on outcomes is well documented, the specific role of DH alone during acute illness has not been clearly delineated, nor has the interplay of DH with SIH in diabetic patients been well investigated. It is possible that diabetic patients' longstanding hyperglycemia may be protective in the event of sudden SIH from injury or illness, or conversely, DH may instead predispose them to even poorer outcomes in the event of SIH. There are no definitive studies addressing this question.

Hyperglycemia is common in the inpatient trauma population and is frequently due to SIH that is a manifestation of the physiologic response to injury. Its adverse effect on trauma patient morbidity and mortality is well documented.[1,3–6] Multiple studies have evaluated the impact of admission hyperglycemia on trauma patient outcomes and have consistently reported higher morbidity and mortality, yet few studies specifically evaluated the effect of SIH as compared with DH, or included the impact in trauma patients of hyperglycemia detected during hospitalization.

The clinical implication of SIH versus DH in trauma patients has not been well investigated. The literature has yet to determine whether DH and SIH are similar phenomena with comparable sequela or if hyperglycemia in diabetic patients represents a unique clinical entity, distinct from SIH in nondiabetic patients, resulting in a unique clinical response with different outcomes. The aim of this study was, therefore, to analyze the differential impact of hyperglycemia on outcomes between diabetic and nondiabetic trauma inpatients.

PATIENTS AND METHODS

Patients from the trauma registries of 46 United States Level I and II trauma centers in a large hospital network were included if they were 18 years or older, had an inpatient stay with an admission date between January 1, 2018, and December 31, 2019, and had at least two glucose measurements recorded during their stay. Patients were excluded if they were admitted as hospice. Trauma registry data were retrospectively reviewed to collect patient demographics, injury details, complications, and patient outcomes. Glucose results were retrieved from the electronic medical records (EMRs) and included both point of care (POC) and laboratory tests with information on testing dates, times, and reported results.

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TABLE 1. Patient Demographics and Injury Characteristics by Diabetic and Hyperglycemic Status

	HNDs	HDs	NHDs	NHNDs
	n = 9,380 (9.8%)	n = 14,722 (15.4%)	n = 5,760 (6.0%)	n = 65,902 (68.8%)
Male, % (n)	60.9 (5,708)*	50.9 (7,492)*	46.7 (2,689) *	54.7 (36,030)
Race, % (n)				
White	75.5 (7,083)*	77.3 (11,373)*	79.5 (4,582) *	78.2 (51,564)
Black	10.2 (955)*	7.8 (1,151)*	9.1 (524)	9.3 (6,153)
Asian	1.9 (179)*	2.8 (406)*	2.0 (114) *	1.5 (986)
Other	10.6 (991)*	11.0 (1,622)*	8.5 (490) *	9.5 (6,269)
BMI, mean (SD)	27.4 (7.4)*	29.8 (8.2)*	28.7 (7.7)	26.7 (7.1)
Age, mean (SD)	58.2 (22.6)	70.5 (14.1)*	71.2 (15.6)*	58.5 (23.0)
ISS, mean (SD)	16.2 (12.0)*	9.7 (7.0)*	8.6 (5.7)*	9.3 (6.6)
Injury type, % (n)				
Blunt	86.8 (8,141)*	96.6 (14,217)*	96.0 (5,531)*	91.3 (60,150)
Penetrating	10.7 (1,007)*	2.1 (302)*	2.4 (136)*	6.4 (4,233)
GCS score, mean (SD)	12.2 (4.6)*	14.4 (2.2)	14.6 (1.5)*	14.4 (2.1)
SBP on arrival, mean (SD)	136.3 (35.7)*	150.7 (31.3)*	148.3 (28.8)*	143.3 (27.3)
Pulse, mean (SD)	93.9 (25.9)*	85.1 (18.1)	81.8 (16.7)*	85.4 (18.1)
Shock Index, mean (SD)	0.75 (0.55)*	0.59 (0.26)*	0.58 (0.78)*	0.62 (0.28)

*Group differs significantly from NHD/NHND group ($p < 0.05$).

Patients were defined as "diabetic" if they met any one of the following criteria: (1) a diagnosis of "Diabetes" in the trauma registry "preexisting conditions" section per the National Trauma Data Standard (NTDS) definition, (2) an International Classification of Diseases—10th Rev.—Clinical Modification diagnosis of diabetes (E08–E13) on admission listed in the EMR, or (3) a hemoglobin A1c measure of 6.5% (48 mmol/mol) or greater at any time during the current admission. Patients not meeting any of these criteria were labeled "nondiabetic." Patients were defined as being "hyperglycemic" if they had one or more glucose readings above 180 mg/dL at any time during their hospitalization and "not hyperglycemic" if all glucose measures were less than 180 mg/dL. Four groups were then available for analysis: (1) hyperglycemic nondiabetics (HNDs), (2) hyperglycemic diabetics (HDs), (3) not hyperglycemic diabetics (NHDs), and (4) not hyperglycemic nondiabetics (NHNDs).

Medication administration information about pharmaceuticals received was obtained from the electronic medication administration record section of the EMR. A patient was defined as having received insulin if there was insulin of any type administered during their hospitalization either intravenously or subcutaneously. Steroid use was defined as the patient having received any one or combination of oral (PO or NG tube), intramuscular, or intravenous steroids at any time during their stay.

The primary outcome for this study was hospital mortality, which was defined per the NTDS definition as a discharge disposition of "deceased/expired." Secondary outcomes were also defined using individual NTDS definitions with the exception of 'Surgical site infection' (SSI), which used a composite of the three TQIP indicators for infection of the operative location. SSI was defined as positive if any of the following were present: "Deep Surgical Site Infection," "Organ/Space Surgical Site Infection," or "Superficial Incisional Surgical Site Infection."

Data were summarized and analyzed using the univariate summary statistics Pearson χ^2 test of independence and Wilcoxon rank-sum. Using the four groups based on hyperglycemia and diabetic status, the associations between hyperglycemic/diabetic status and outcomes were estimated using multivariable logistic regression adjusting for potential confounders including age, sex, body mass index (BMI), and Injury Severity Score (ISS). Age, BMI, and ISS were included in the model using restricted cubic splines with three knots. Variables controlled for in the logistic regression modeling were chosen based on a review of the available research on hyperglycemia in hospitalized surgical patients, as well as our own published work on metabolic syndrome in trauma patients.[7] The association of hyperglycemia and diabetes status on outcomes was summarized using an odds ratio (OR) and 95% confidence interval (CI) and tested for statistical

TABLE 2. In-Hospital Insulin, Steroids, and Glucose Testing by Diabetic and Hyperglycemic Status

	HND	HD	NHD	NHND
	n = 9,380 (9.79%)	n = 14,722 (15.37%)	n = 5,760 (6.01%)	n = 65,902 (68.82%)
Insulin, % (n)	38.6% (3,617)*	89.3% (13,150)*	40.1% (2,307)*	7.4% (4,894)
Steroid, % (n)	17.3% (1,623)*	8.8% (1,295)*	3.9% (222)	4.4% (2,899)
Glucose tests: mean (SD), d	5.4 (6.8)*	9.4 (4.6)*	5.1 (3.9)*	2.4 (5.4)

*Group differs significantly from NHND group ($p < 0.05$).

TABLE 3. Outcomes by Hyperglycemic and Diabetic Status

	HND	HD	NHD	NHND
	n = 9,380 (9.8%)	n = 14,722 (15.4%)	n = 5,760 (6.0%)	n = 65,902 (68.8%)
Mortality, % (n)	14.6 (1,373)*	3.9 (573)*	1.6 (91)*	1.1 (706)
Sepsis, % (n)	1.1 (104)*	0.5 (69)*	0.1% (3)	0.1 (55)
SSI, % (n)	1.0 (92)*	0.2 (29)*	0.0% (0)*	0.1 (76)
Hospital LOS, mean (SD), d	11.4 (16.5)*	6.9 (8.2)*	4.4 (4.4)*	5.0 (6.5)
ICU LOS, mean (SD), d	8.5 (10.1)*	5.8 (6.7)*	3.4 (3.0)*	4.0 (4.2)
Any ICU, % (n)	68.6 (6,439)*	40.2 (5,925)*	35.1 (2,019)	35.1 (23,160)
Ventilation, % (n)	42.4 (3,981)*	10.6 (1,567)*	3.5% (203)*	7.3 (4,805)

*Group differs significantly from NHD/NHND group ($p < 0.05$).

significance using the associated Wald test. For all adjusted models, p values less than .05 were considered statistically significant. R software version 3.6.2 (R Core Team 2017) was used for all statistical analyses.[8] This research was formally determined to be exempt or excluded from the need for Institutional Review Board (IRB) oversight in accordance with current Federal regulations and institutional policy. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines were utilized in the reporting of this research and a complete checklist has been uploaded as Supplemental Digital Content (SCD Table 1, http://links.lww.com/TA/C376).

RESULTS

There were 95,764 adult inpatients who met the inclusion criteria and were included in the final dataset. The overall group was 54.2% male, with a mean age of 61.1 years, and mean ISS of 10. There were 24,102 (25.2%) hyperglycemic patients (one or more blood glucose >180 mg/dL), of whom 9,380 (38.9%) had no preexisting known diabetes status. There were 71,662 patients who did not experience hyperglycemia, of which 65,902 (68.8%) were nondiabetic. Of the 24,102 who had hyperglycemia at any time, 11,530 (48%) had their first hyperglycemic value (>180) on admission while 12,572 (52%) had a hyperglycemic value (>180) at a later time during their hospitalization.

When examining individual groups, the HNDs had a higher proportion of males (60.9% vs. 54.7%, $p < 0.001$) a lower proportion of white patients (75.5% vs. 78.2%, $p < 0.001$) and a higher BMI (27.4 vs. 26.7, $p < 0.001$) compared with the referent group of NHND, but was not statistically different in age (mean age, 58.2 vs. 58.5 years; $p = 0.069$). In the HND, injury severity was significantly higher (mean ISS 16.2 vs. 9.32, $p < 0.001$) and Glasgow Coma Scale (GCS) was lower (mean score 12.2 vs. 14.4, $p < 0.001$) than the NHND group (Table 1).

While the majority of HDs received insulin during their stay (89.3%), only 38.6% of HNDs received insulin ($p < 0.001$). The HD patients were, however, less likely to receive steroids during their stay compared with NHND (4.4% vs. 17.3%, $p < 0.001$). There were also differences in how often these groups were tested for glucose values, with the HND group receiving on average 5.4 tests per day compared with 2.4 in the NHND group ($p < 0.001$) (Table 2).

Overall hospital mortality among HND patients (14.6%) was significantly ($p < 0.001$) higher than every other group including HD (3.9%), NHD (1.6%), and NHND (1.1%). In addition, when comparing the HND to the NHND group, the HND group experienced worse outcomes on every measure, with higher rates of sepsis (1.1 vs. 0.1%, $p < 0.001$), more surgical site infections (1.0 vs. 0.1%, $p < 0.001$), a longer mean hospital length of stay (LOS) (11.4 vs. 5.0, $p < 0.001$), a longer mean intensive care unit (ICU) LOS (8.5 vs. 4.0, $p < 0.001$), higher rates

TABLE 4. Mortality Rates for Subgroups by ISS, TBI Severity, Critical Care Use, and Transfusion

	HNDs	HDs	NHDs	NHNDs
	n = 9,380 (9.8%)	n = 14,722 (15.4%)	n = 5,760 (6.0%)	n = 65,902 (68.8%)
By injury severity				
ISS > =9	17.4%* 1,280 of 7,373	5.5%* 497 of 9,047	2.4%* 76 of 3,186	1.6% 617 of 38,315
ISS > =15	27.5%* 1,081 of 3,933	15.1%* 353 of 2,335	5.3% 37 of 704	4.4% 424 of 9,651
By TBI severity				
Head AIS ≥ 2	32.2%* 907 of 2,816	11.3%* 317 of 2,798	3.8% 44 of 1,157	3.8% 422 of 11,021
Head AIS ≥ 3	40.5%* 751 of 1,854	17.9%* 253 of 1,416	6.8% 34 of 503	7.5% 348 of 4,671
By critical care				
Any ICU	20.3%* 1,309 of 6,439	9.0%* 533 of 5,925	3.3% 66 of 2,019	2.6% 599 of 23,160
Any ventilation	31.5%* 1,254 of 3,981	29.5%* 463 of 1,567	22.2%* 45 of 203	9.6% 460 of 4,805
≥ 10 units pRBC	35.9%* 147 of 410	28.7%* 25 of 87	20.0% 1 of 5	13.7% 10 of 73

*Group differs significantly from NHD/NHND group ($p < 0.05$).
TBI, traumatic brain injury; pRBC, packed red blood cells.

TABLE 5. aOR* of Mortality for Each Group Compared With the Referent Group

Glycemic-Diabetic Status	aOR (95% CI)
HND	7.54 (6.79–8.37)
HD	3.11 (2.76–3.51)
NHD	1.46 (1.17–1.83)
NHND	Referent group

* Logistic regression adjusting for potential confounders including age, sex, BMI, and ISS.

of ICU use (68.6% vs. 35.1), and more ventilator use (42.4% vs. 7.3%). Highest rates of sepsis were in nondiabetics who were not hyperglycemic on admission, but developed hyperglycemia during their hospitalization, compared to those who were hyperglycemic on admission (1.4% vs. 0.7%, $p = 0.002$) (Table 3).

The higher hospital mortality rate among HND patients compared with NHND patients persisted on sub-group analysis. The HND patients had significantly higher mortality in subgroup analysis of ISS ≥ 9 (17.4% vs. 1.6%, $p < 0.001$), ISS ≥ 15 (27.5% vs. 4.4%, $p < 0.001$), head abbreviated Injury Scale (AIS) ≥ 2 (32.2% vs. 3.8%, $p < 0.001$), head AIS ≥ 3 (40.5% vs. 7.5%, $p < 0.001$), any ICU use (20.3% vs. 2.6%, $p < 0.001$), any ventilator use (31.5% vs. 9.6%, $p < 0.001$), and transfusion administration of >10 units of pRBCs (35.9% vs. 13.7%, $p < 0.001$). The HND group also had significantly higher hospital mortality than both the HD group and NHD group on every subgroup measure of mortality ($p < 0.001$ all comparisons) (Table 4).

Even when adjusting for age, sex, BMI, and ISS, HNDs still had a more than a seven-fold increased odds of hospital mortality compared to Not Hyperglycemic Not Diabetic patients (adjusted OR [aOR], 7.54; 95% CI, 6.79–8.37). This was more than double the increase seen in hyperglycemic diabetics (aOR, 3.11; 95% CI, 2.76–3.51) and five times the increase in NHDs (aOR, 1.46; 95% CI, 1.17–1.83) when these groups were compared with not hyperglycemic not diabetic patients (Table 5).

Several sensitivity analyses were performed to further refine the results. To better evaluate the impact potential errors in the results obtained from glucometer use in our study, a sensitivity analysis was performed to examine whether removing POC glucose results would affect the results. Of the 24,103 patients who had 1 or more values of blood glucose greater than 180 mg/dL, 80% would continue to be classified as high if POC results are excluded. There were 5,397 (3,618 D/1,779 ND) patients that had high values present on POC results, but not on laboratory results. Altering the groupings to include these 5,397 as not hyperglycemic does not alter the results of the study. The odds of death are approximately the same and highest in the HND group compared with the NHND group (7.92).

Given the potential that a number of factors beyond inflammation or infection could result in a single elevated blood glucose value, a sensitivity analysis was performed to examine whether limiting the sample to those with two or more values over 180 would affect the results. Of the 24,102 patients who had one or more value of blood glucose greater than 180 mg/dL, 96% (23,104) had 2+ values. Altering the groupings to count patients as hyperglycemic only if they had two or more values does not change the results of this research. The odds of death are approximately the same and highest in the HND group compared with the NHND group (7.41).

To address the potential impact of shock present on admission, a sensitivity analysis was performed to examine whether adding systolic blood pressure (SBP) and Pulse rate upon admission to the model would affect the results. The odds of death are approximately the same and highest in the HND group compared with the NHND group (7.19).

Younger, more severely injured patients likely sustained higher rates of bleeding as evidenced by their higher transfusion volumes (Table 4). To determine the extent to which shock at admission affected hospital mortality, we performed a sensitivity analysis to examine whether adding SBP and pulse rate to the adjustment models would affect the results. The odds of death are approximately the same and highest in the HND group compared with the NHND group (6.67).

DISCUSSION

In this large study of 95,764 adult inpatients from 46 Level I and Level II trauma centers, hyperglycemia at any time during hospitalization was associated with significantly higher hospital mortality in both diabetics and nondiabetics. Hyperglycemic nondiabetic patients had significantly higher odds of hospital mortality than HDs and were also more likely to have longer hospital LOS, higher ISS, and lower GCS score, higher rates of sepsis, higher rates of ventilator use and greater likelihood of transfusion. Approximately half the hyperglycemic patients in this series were documented to be hyperglycemic on admission and the other half at some later point in their hospitalization, and both groups had inferior outcomes compared with nonhyperglycemic patients. The highest rates of sepsis were detected in HND patients who were not hyperglycemic on admission but became so later in their hospital stay.

Many previous studies of hyperglycemia in trauma patients specifically excluded known and occult diabetic patients. A 2020 study by Tsai et al[9] evaluated hyperglycemia in patients with traumatic brain injury and found higher odds of mortality in nondiabetic trauma patients with hyperglycemia compared with nondiabetic normoglycemic trauma patients. Richards et al.[10] evaluated nondiabetic orthopedic trauma patients admitted to an intensive care unit and noted hyperglycemia to be an independent risk factor for surgical site infections.

Previous studies identified the association of hyperglycemia at the time of admission with worse outcomes in trauma patients,[1,5,11–13] but did not include patients who were not hyperglycemic on admission and developed hyperglycemia later during the hospitalization. Yendamuri et al.[11] reported on 738 adult trauma patients from their Level I trauma center and found that both mild hyperglycemia (>135 mg/dL) and moderate hyperglycemia (>180 mg/dL) detected at admission were associated with increased mortality, LOS, and infectious complications. They did not separate diabetics from nondiabetics in their analysis. Sung et al.[12] reported similar findings in 1,003 trauma patients admitted to their intensive care unit over a 2-year period. A hospital admission glucose level greater than 200 mg/dL was associated with a 2.2 times greater mortality rate and higher rates of infection and longer hospital stays. These findings were duplicated in a report by Laird et al.[13] in patients admitted to their intensive care unit. At their Level I trauma center, Kerby et al.[5] studied 5,117 patients over a 2-year period and found that 9.9% presented with hyperglycemia (>200 mg/dL), and approximately half were diabetic by history or based on an elevated admission hemoglobin A1c. The nondiabetic patients with hyperglycemia on admission had an over twofold increase in mortality compared with nonhyperglycemic patients (risk ratio, 2.41; 95% CI, 1.81–3.23). Kerby et al.[5] specifically examined trauma patients with admission SIH compared with those with DH and found admission SIH to be associated with increased mortality in trauma patients, while DH was not; however, the sample was relatively small, did not include patients with hyperglycemia detected during hospitalization, and represented the work of a single institution.

The results of the present study are consistent with previously reported research in trauma patients on the association of hyperglycemia on admission with worse outcomes. In addition, this analysis provides data on the differential impact of a diagnosis of diabetes and that of hyperglycemia detected after admission in patients who were not hyperglycemic on admission. Hyperglycemia at any time during hospitalization was associated with significantly increased odds of mortality in both diabetics and nondiabetics. Although diabetic patients were more likely to be hyperglycemic than those without a history of diabetes, hyperglycemia in nondiabetics was associated with significantly worse outcomes: HND patients were found to be over 3 ½ times as likely to die as HD patients. Hyperglycemic diabetic patients were tested for hyperglycemia more than twice as often as the NHND group and were more likely to receive insulin during their stay than HNDs (89.3% vs. 38.6%, $p < 0.001$). Hyperglycemic trauma patients represent a high-risk population that may benefit from tighter glucose control and this may be especially true of the NHND patients given the lower frequency of testing and insulin administration. Persistent hyperglycemia in critically ill trauma patients has been shown to be associated with deleterious effects on outcomes.[14–16]

Hyperglycemic nondiabetic patients had the highest rates of sepsis, ventilator use, and likelihood of transfusion. This may be related in part to their underlying patient characteristics (younger, more male, higher ISS and lower GCS) but after adjusting for age, sex, BMI and ISS, their odds of hospital mortality remained substantially higher than the other groups. The likely mechanism of hyperglycemia in these patients is that of stress hyperglycemia and reflects progressive physiologic derangement such as that that occurs with impending sepsis. The highest rates of sepsis were detected in HND patients who were not hyperglycemic on admission but became so later in their hospital stay suggesting that the development of hyperglycemia in a nondiabetic trauma patient may be an indication for a "sepsis work-up."

There are several limitations to this study. The large number of patients in this analysis notwithstanding, the usual cautions regarding retrospective analysis of large administrative datasets are warranted.[17,18] The analysis may not have captured all of the undiagnosed (occult) diabetics since not every patient had a HgA1c level measured. Because of its retrospective nature, this study cannot determine the impact of varying treatment decisions on the outcomes of the different study groups analyzed and determine whether they affected the results. A significant number of patients, especially nondiabetic patients, received steroids for various indications and this may have contributed to the development of hyperglycemia in those patients but this study design did not allow an assessment of the indications for the steroid use or its relation to hyperglycemia.

In conclusion, this large study from 46 Level I and Level II trauma centers demonstrated that hyperglycemia both at admission and at any time during hospitalization is associated with increased odds of hospital mortality in both diabetic and nondiabetic trauma patients. Hyperglycemia at any time during hospitalization in nondiabetics was associated with the worst outcomes including increased odds of sepsis and represents a potential opportunity for intervention in this high-risk group. The appearance of hyperglycemia in a nondiabetic trauma patient should alert the clinician to the possibility of complications, such as sepsis, and may warrant the initiation of diagnostic and therapeutic measures.

AUTHORSHIP

All authors certified they made contributions in design, data acquisition, data analysis/interpretation and drafting/revising the article. The authors have given approval of the version to be published.

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DISCLOSURE

The authors declare no conflicts of interest.

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