Evaluating The Role Of Nystatin And Chlorhexidine In Mediating Pneumonia Infections In Inhalation Injuries

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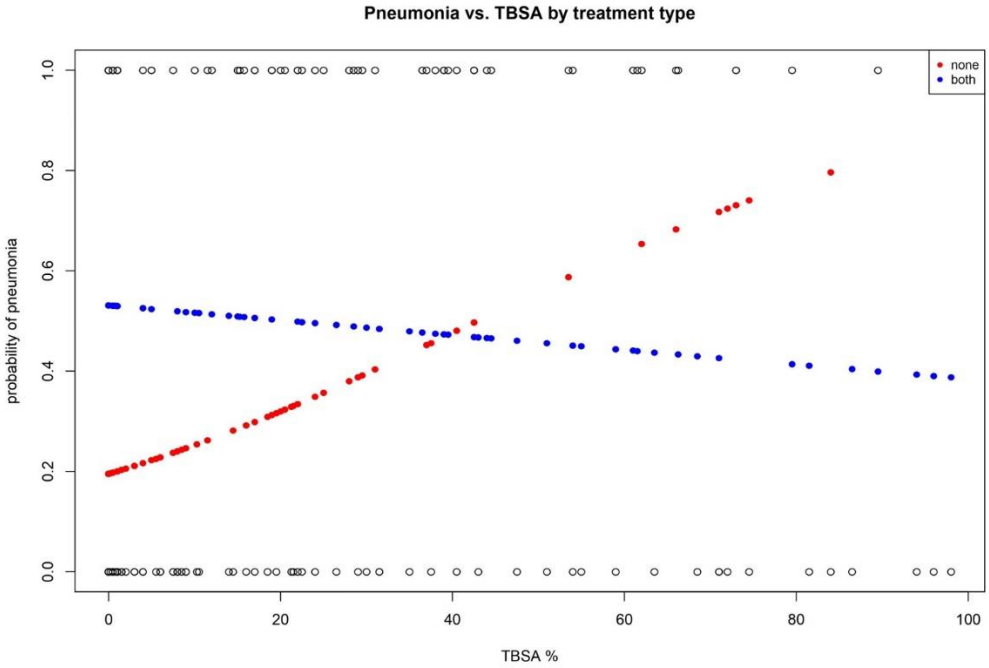
Introduction/Background
Inhalation injuries are a severe clinical entity that has increased morbidity and the probability of death in the burn population. There is currently no standardized procedure for mitigating adverse outcomes associated with these patients. A prevention "package" was implemented for burn patients with inhalation injury; this was done to prevent pneumonia. This prevention package revolved around a topical decontamination of the upper respiratory tract using Nystatin and Chlorhexidine.

Methods:
Using the electronic health record, we obtained the records of 184 patients admitted with an inhalation injury (with an inhalation grade from 1 to 4), who were 18 or older, and who were admitted within the last 6 years.

Results:
Logistic regression was fitted to retrospective data on 179 patients to model the incidence of pneumonia with a pool of predictors consisting of treatment type (none or both nystatin and chlorhexidine) and percent of body surface area burned (TBSA). We found that the treatment type and TBSA are highly predictive of pneumonia occurrence ($p<0.004$).

Conclusion
The results reveal that, for the treated group, the probability of pneumonia is approximately 50% across all levels of TBSA, with a gradual decline as TBSA increases. For patients receiving no treatment, the outcome is dramatically different, with the probability of pneumonia increasing steadily from 20% at the lowest values of TBSA to 80% at the largest values. We believe this study shows the potential benefits that this topical treatment could have for inhalation injury patients with large TBSA burns and necessitates further research.


Pneumonia vs. TBSA by treatment type
probability of pneumonia
TBSA %
none
both
0.0
0.2
0.4
0.6
0.8
1.0
0
20
40
60
80
100

Etomidate versus Ketamine for Urgent Intubation in Severe Burn Patients

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Introduction/Background
Urgent intubation is often utilized to establish airway control and ventilation in the severely burned. Both etomidate and ketamine are commonly used for induction for preservation of hemodynamic stability. The purpose of this study is to investigate if either agent is preferred in severe burn patients with regards to mortality, anesthetic complications, and various burn-related complications.

Methods:
We queried TriNetX, a national research database that provides real-time access to de-identified medical records, for severely burned patients (ICD-10-CM T31.2-.9), defined as those whose burn comprises 20 percent or more of total body surface area (TBSA), who underwent urgent intubation (CPT 31500) on the same day. These patients were stratified into two groups based on whether ketamine or etomidate was used as the induction agent. The groups were propensity score matched for age, sex, race, ethnicity, and TBSA burned and subsequently compared for the following outcomes within 1 month after burn: mortality, fever, cardiac arrest, hypotension (< 90/60), hyponatremia (< 135 mEq/L), and anemia. Risk ratios and risk differences for each outcome were generated using the TriNetX analytics tool.

Results:
We identified a total of 1,526 patients across 39 health care organizations in the United States who had severe burns and underwent urgent intubation on the same day. 178 of these patients were given ketamine for induction, while 410 were given etomidate. Propensity score matching resulted in 164 patients from each cohort. Those receiving ketamine were at higher risk of developing fever (risk ratio [RR], 2.118, p = 0.004), cardiac arrest ([RR], 2.100, p = 0.038) hypotension ([RR], 1.594, p = 0.016), hyponatremia ([RR], 1.244, p = 0.035), and anemia ([RR], 1.425, p = 0.040) within one month after burn than those receiving etomidate. However, the patient group receiving etomidate for induction was at greater risk of mortality ([RR], 1.499, P = 0.049).

Conclusion
Severe burn patients undergoing urgent intubation who receive anesthetic ketamine have an increased risk of developing fever, cardiac arrest, hypotension, hyponatremia, and anemia compared to those who receive etomidate in the month after burn injury. Despite these many complications, they have a relatively lower mortality rate during this same period.

Abstract| Trauma/Burn/Critical Care

Resolution of Subdural Hematomas treated with middle meningeal artery embolization with or without decompressive surgery at early and late clinical follow-up: a single-center experience

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Introduction/Background
Subdural hematoma (SDH) is a common neurological disease affecting the elderly, primarily presenting as trauma patients in emergency departments. Surgical evacuation of the SDH is the current mainstay therapy. However, on antithrombotic therapy, SDH recurrence, especially in the elderly population, is a persistent challenge for neurosurgeons. Prior work identified that embolization of the middle meningeal artery (MMAe) is a safe and effective strategy to prevent SDH recurrence. Here, we estimated the duration of the resorption of SDH and analyzed the recurrence in patients undergoing MMAe with or without decompressive surgery at our center.

Methods:
We conducted a retrospective analysis of patients with SDH undergoing MMAe alone or in tandem with decompressive surgery between January 2021 and February 2022 at our center. We divided patients into the MMAe-only group (n=19) and the combined therapy (MMAe+surgery) group (n=19). We performed a volumetric analysis of hematoma volume and midline shift at multiple intervals to observe the trends in recurrence in each group.

Results:
We analyzed a total of 38 patients. Both groups had similar demographics, relevant comorbidities, and antithrombotic therapy usage. The most common presentation was following ground-level falls. Patients had a clinical presentation with headache, focal weakness, aphasia, and altered mental status. A total of five patients had small acute SDH in the MMAe-only group. Patients who underwent combined therapy had larger hematomas (mean 33.5 vs. 12.7 mL) and midline shifts (mean 6.4 vs. 3.5 mm) than their MMAe-only counterparts. All patients underwent MMAe using polyvinyl alcohol particles. We combined particle embolization with coil embolization in 61.5% (24/36) patients. There was a significant reduction of initial SDH volume (33.5 vs. 5.7 mL; p=0.0001) for the combined therapy group at 1-month follow-up. In contrast, we observed a significant reduction in hematoma volume at the 2-month follow-up in the MMAe-only group (12.7 vs. 3.5 mL; p=0.01). Both groups had significant reductions in midline shift at 1-month follow-up (6.4 vs. 1.7 mm; p=0.0005 for combined therapy; 3.5 vs. 0.7 mm; p=0.002 for MMAe-only). In subsequent clinical follow-ups, we did not observe a significant difference in the reduction of SDH volume or midline shift between the two groups. At 6-month follow-up, three patients had SDH recurrence (1 in the combined therapy group and 2 in the MMAe-only group). All patients with radiographic SDH recurrence had bilateral SDH on presentation, and the recurrence was not associated with clinical worsening.

Conclusion
In a cohort of SDH patients, combined therapy was significantly associated with a quicker reduction in hematoma volume, as predicted. Surprisingly, midline shift reductions were comparable in both cohorts at 1-month follow-up, though the embolization group had more minor midline shifts at the onset. Both groups had comparable numerical recurrence SDH rates.

Racial and Ethnic Disparities in Prehospital Pain Management for Trauma Patients

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Introduction/Background

Although evidence suggests that racial and ethnic minority (REM) patients receive inadequate pain management in the acute care setting, it remains unclear if these disparities also occur during the prehospital period. The aim of this study is to assess the impact of race and ethnicity on prehospital analgesic utilization by emergency medical services (EMS) in trauma patients.

Methods:

Retrospective chart review of adult trauma patients aged 18-89 years old transported by EMS to our ACS verified Level 1 trauma center from 2014-2020. Patients who identified as Black, Asian, Native American, or Other for race and/or Hispanic or Latino or Unknown for ethnicity were considered REM. Patients who identified as white, non-Hispanic were considered white. Groups were compared in univariate and multivariate analysis. The primary outcome was prehospital analgesic administration.

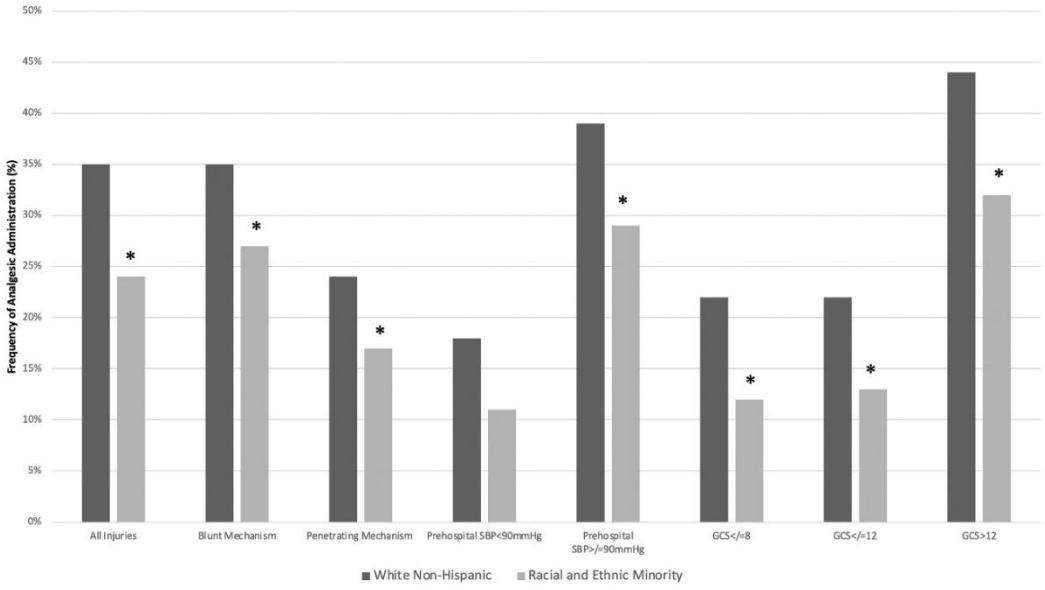
Results:

2,476 patients were transported by EMS (47% white and 53% REM). White patients were older (46 vs. 38, $p<0.001$) and had higher rates of blunt trauma (76% vs. 60%, $p<0.001$). There were no differences in injury severity score (ISS) (21 vs. 20, $p=0.22$). Although REM patients reported higher subjective pain rating (7.2 vs. 6.6, $p=0.002$), they were less likely to get prehospital pain medication (24% vs. 35%, $p<0.001$)(Figure 1) and that difference remained significant after controlling for baseline characteristics, transport method, pain rating, prehospital hypotension, and payor status (Adjusted OR [95% CI] 0.67 [0.47 – 0.96], $p=0.03$).

Conclusion

Patients from racial and ethnic minority groups were less likely to receive prehospital pain medication after traumatic injury than white patients. Forms of conscious and unconscious bias contributing to this inequity need to be identified and addressed.

Figure 1: Frequency of Any Analgesic Administration; *p<0.05



SBP = Systolic Blood Pressure, **GCS** = Glasgow Coma Scale

Primary Repair versus Resection for AAST Grade I and II Colon Injuries: Does the Type of Repair Matter?

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Introduction/Background
The management of traumatic colon injuries has evolved over the past two decades. Recent data suggests primary repair or resection over colostomy may decrease morbidity and mortality. Data comparing patients undergoing primary repair versus resection is lacking. We sought to compare the outcomes of patients undergoing primary repair versus resection for low-grade colon injuries. We hypothesized that patients undergoing primary repair would have less post-operative complications than those patients undergoing resection with anastomosis.

Methods:
A retrospective review of all patients who presented with AAST grade I and II traumatic colon injury to our Level I trauma center between 2011 and 2021 was performed. Patients were further dichotomized based on whether they underwent primary repair or resection with anastomosis. Outcome measures included length of stay data, infectious complications, and mortality.

Results:
A total of 120 patients met inclusion criteria. The majority of patients (76.7%) were male, and the average age was 32 [25-44.25] years. Most patients also underwent primary repair (81.1%). There were no statistically significant differences between the groups in arrival physiology. The injury severity score was similar between groups while the abdominal abbreviated injury scale was higher in the group that underwent resection with anastomosis (2.7 [2-3] vs. 3.2 [3-4], p=0.003). Length of stay data including hospital length of stay, intensive care unit length of stay, and ventilator days was similar between groups. Post-operative complications including pneumonia, surgical site infections, fascial dehiscence, the development of enterocutaneous fistulas, and unplanned returns to the operating room were also all found to be similar between groups. The group who underwent resection with anastomosis did demonstrate a higher rate of intra-abdominal abscesses (3.1% vs. 26.1%, p<0001). Mortality between both groups was not found to be statistically significant (7.2% vs. 4.3%, p=0.4)

Conclusion
For low grade (AAST I and II) traumatic colon injuries, primary repair demonstrated a decreased rate of intraabdominal abscesses and was associated with lower morbidity than resection with anastomosis.

	Primary (n=97)	Resection (n=23)	p-value
Hospital LOS	13.2 ± 11.1	14.0 ± 10.7	0.7
ICU LOS	4.1 ± 6.4	5.4 ± 8.1	0.4
SSI	8 (8.2%)	3 (13%)	0.5
Intra-Abdominal Abscess	3 (3.1%)	6 (26.1%)	<0.001
Mortality	7 (7.2%)	1 (4.3%)	0.4

Abstract| Trauma/Burn/Critical Care

WHOLE BLOOD VERSUS COMPONENT THERAPY COST ANALYSIS IN PEDIATRIC TRAUMA PATIENTS

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Introduction/Background

Low titer O+ whole blood (LTOWB) has recently gained momentum in the resuscitation of traumatically injured patients. Both adult and pediatric trauma patients have benefited from whole blood (WB) resuscitation in both the pre-hospital (PH) and hospital settings. Although the physiologic benefits of WB resuscitation have been demonstrated in certain populations, little has been studied regarding the cost impact. The WB program at our institution began in January 2018 and included males >10 years of age. Starting in July 2021, WB has been transfused to male and female children age 2 and older. The objective of this study was to determine the impact on total cost of care of WB vs component therapy (CT) resuscitation in pediatric trauma patients.

Methods:

This is a retrospective review of a prospectively collected database of pediatric trauma patients (ages 0-17) who received either LTOWB and/or CT from time of injury to within 6 hours of arrival during the time period of 2016-2022. Annual mean cost per unit of blood product was obtained from the regional blood bank. Costs reflect charges for the blood products, but do not include processing or hospital charges. Pediatric patients were analyzed and compared on a cost per unit and per milliliter (mL) basis for the PH setting, the emergency center (EC), the initial 24 hours of hospital stay, and for overall costs. Comparisons were made using Mann-Whitney U tests with a P value of

Results:

Of the 316 pediatric patients identified in the database, 202 received CT alone (mean ratio achieved = 3.7:2.2:0.4), 17 received WB alone (mean 2.8 units/patient) and 39 received a combination of both WB and CT during the first 24 hrs of admission. The mean injury severity score (ISS) was 23.6. In pediatrics, WB was associated with a significantly lower cost per patient and per mL compared to CT in the EC ($p<0.001$), at 24 hours ($p<0.001$), and overall ($p<0.001$). Overall, WB was associated with a 3.4-5.8 times reduction in costs when compared to CT, including a nearly sixfold reduction in the EC setting.

Conclusion

With the increased use of LTOWB in pediatric trauma resuscitation, the potential cost savings compared with traditional CT are notable. This study demonstrates how LTOWB is associated with a reduced overall cost of transfusion therapy. However, these cost savings do not take into account the workflow

optimization by nursing staff in units of blood products transfused. Additionally, there is a benefit of reduced overall donor exposure with transfusion of WB vs CT when transfusing in a 1:1:1 fashion; a factor especially important to the pediatric population. Resource utilization and health care costs are important factors for ongoing analysis as WB resuscitation gains popularity in the care of injured patients.

Table 1	Component		LTO+WB		*Difference	CT/WB	
	Mean	SD	Mean	SD			p-value
PH Cost	$ 132.41	$ 346.17	$ 39.34	$ 157.03	$ 93.07	3.4	<0.001
EC Cost	$ 760.98	$ 2,384.09	$ 175.68	$ 403.59	$ 585.30	4.3	<0.001
24hr Cost	$ 1,899.67	$ 3,254.80	$ 498.08	$ 920.34	$ 1,401.59	3.8	<0.001
Overall Cost	$ 2,032.08	$ 3,293.90	$ 537.42	$ 995.57	$ 1,494.66	3.8	<0.001
PH Cost/mL	$ 0.37	$ 0.96	$ 0.08	$ 0.35	$ 0.28	4.4	<0.001
EC Cost/mL	$ 2.20	$ 7.09	$ 0.38	$ 0.86	$ 1.82	5.8	<0.001
24hr Cost/mL	$ 5.98	$ 10.16	$ 1.20	$ 2.26	$ 4.77	5.0	<0.001
Overall Cost/mL	$ 6.34	$ 10.24	$ 1.29	$ 2.43	$ 5.06	4.9	<0.001
*A positive difference reflects lower cost of whole blood within each category							

Early Administration of High-Dose Enoxaparin in Low-Risk Traumatic Brain Injury Patients is Not Associated with Progression on Imaging

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Introduction/Background
The safety of early enoxaparin (LMWH) 30 mg BID administration at 24 hours post-injury has been demonstrated in patients with traumatic brain injury (TBI). Prior studies demonstrate this dose yields subtherapeutic levels in up to 50% of trauma patients, suggesting larger doses may be required for adequate prophylaxis. The safety of LMWH 40 mg BID (high-dose LMWH, or "HDL") in trauma patients has been shown – however, these studies have largely excluded TBI patients. We sought to demonstrate the safety of early HDL in a low-risk group of TBI patients.

Methods:
We performed a retrospective review of TBI patients at a Level 1 trauma center considered low-risk using the modified Berne-Norwood criteria. Patients with stable computed tomography (CT) of the head at 6 to 24 hours post-injury who received HDL were identified, and TBI progression reviewed based on serial CT imaging. To evaluate the safety of this dosing regimen, we compared outcomes with patients with low and high risk TBI profiles (low vs high risk) who had received 5,000 units of subcutaneous heparin (SQH).

Results:
Of the 203 TBI patients from April – December 2017, 22 patients received HDL; 10/22 were low-risk. 5/10 patients presented with sub-arachnoid hemorrhage (SAH), 1 patient with subdural hematoma (SDH) and 1 with an epidural hematoma (EDH). There were 5 low-risk patients in the SQH group (n=22). 3/5 patients had a SDH, 1/5 with a contusion. Low risk TBI patients in both LMWH and SQH groups, demonstrated no radiographic progression of intracranial hemorrhage on serial CTs.

Conclusion
In this small, retrospective pilot study of low-risk TBI patients, 40mg BID of LMWH dosing did not lead to CT progression of intracranial hemorrhage. Given this dose is superior to 30 mg BID for VTE prophylaxis, our data supports further research for higher dose prophylaxis in patients with low risk TBI.

TABLE 1. Descriptive Statistics

	Enoxaparin (LMWH)		Subcutaneous Heparin	
n	22		22	
	Low risk	**High risk**	**Low risk**	**High risk**
n	10	12	5	17
Age, y	36.6 ± 15.2	40.5 ± 12.7	55.4 ± 15.8	43.7 ± 16.6
Male/female, %	80/20	83/17	40/60	76/24
Blunt/penetrating mechanism, %	90/10	100/0	100/0	100/0
ISS	19.2 ± 9.1	26.1 ± 13.9	18.8 ± 6.4	17.7 ± 6.3
ED GCS	11.1 ± 4.6	11.6 ± 4.2	12.4 ± 5.3	11.3 ± 4.1
Single isolated lesion, %	70	0	80	6
No visible lesions, %	30	0	20	0
Includes SAH, %	50	92	0	76
Includes SDH, %	10	50	60	53
Includes EDH, %	10	42	0	29
Includes IVH, %	0	17	0	12
Includes contusion, %	0	83	20	82
Mixed injury patterns, %	0	100	0	94
1st CT scan since TA, m	27.8 ± 15.5	34.9 ± 12.5	56.2 ± 52.4	33.9 ± 55.6
Total CT count	2.1 ± 0.3	3.6 ± 2.1	2.0 ± 0.0	4.6 ± 3.7
Time of PTP initiation since TA, h	28.4 ± 15.4	40.1 ± 21.7	38.4 ± 26.4	86.0 ± 45.0
Total PTP duration, d	8.3 ± 13.0	15.5 ± 23.8	2.7 ± 2.5	8.7 ± 12.3
ICU LOS, d	4.4 ± 5.7	6.7 ± 6.1	3.0 ± 2.2	7.1 ± 6.1
Hospital LOS, d	10.7 ± 12.8	27.2 ± 31.2	6.4 ± 4.2	14.9 ± 14.4
Mortality, %	0	0	20	0
Radiographic progression, %	0	75	0	69

ISS, injury severity score; ED, emergency department; GCS, Glasgow Coma Scale; SAH, subarachnoid hemorrhage; SDH, subdural hemorrhage; EDH, epidural hemorrhage; IVH, intraventricular hemorrhage; CT, computed tomography; TA, trauma activation; PTP, pharmacological thromboprophylaxis; ICU, intensive care unit; LOS, length of stay.