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Correlation of Sedation Depth During Critical Care Transport and Hospitalization

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Abstract

Purpose: We aim to assess the impact of the exposure to deep versus light sedation by a critical care transport agency during prehospital and interhospital transport on hospital sedation levels, medication exposure, and outcomes of mechanically ventilated patients. **Materials and Methods:** Retrospective cohort review of mechanically ventilated adult critical care transport patients from January 1, 2019, to March 11, 2020, who arrived at an academic medical center. The primary outcome was the correlation of deep sedation during transport with deep sedation within the first 48 h of hospitalization (defined as Richmond Agitation Sedation Scale [RASS] −3 to −5). The secondary outcomes were duration of mechanical ventilation, hospital length of stay, intensive care unit (ICU) length of stay, inpatient mortality, delirium within 48 h, and coma within 48 h. **Results:** One hundred and ninety-eight patients were included, of whom 183 (92.4%) were deeply sedated during transport which persisted through the first 48 h of hospital care. Deep sedation during transport was not correlated with deep sedation in the hospital within the first 48 h (OR 2.41; 95% CI, 0.48-12.02). There was no correlation with hospital length of stay, ICU length of stay, duration of mechanical ventilation, or hospital mortality. Deep sedation during transport was not correlated with delirium or coma within the first 48 h of hospitalization. There was a negligible correlation between final transport RASS and initial hospital RASS which did not differ based on the lapsed time from handoff (<1 h corr. coeff. 0.23; ≥1 h corr. coeff. 0.25). **Conclusions:** Deep sedation was observed during critical care transport in this cohort and was not correlated with deep sedation during the first 48 h of hospitalization. The transition of care between the transport team and the hospital team may be an opportunity to disrupt therapeutic momentum and re-evaluate sedation decisions.

Keywords

deep sedation, coma, mechanical ventilation, prehospital, sedation

Introduction

The management of analgesia and sedation in mechanically ventilated patients is a cornerstone of critical care. Adequate sedation is integral to maintain ventilator synchrony, patient comfort during mechanical ventilation, and life-supporting therapies. In recent decades, the sedation paradigm shifted from the practice of deep sedation to targeted light analgosedation. This shift was in response to evidence that deeper levels of sedation were associated with increased mortality and delirium.[1–3] However, despite the known risks and a concerted effort to target light sedation, deep sedation remains prominent in intensive care units (ICUs). For instance, a multicenter prospective cohort study found that 98% of patients are deeply sedated at some point during their ICU stay.[4]

Understanding the prevalence and causes of deep sedation is imperative because of the association with increases in ICU length of stay, duration of mechanical ventilation, and mortality.[1,4–6] Control of agitation and achieving ventilator synchrony are likely driving factors. Historically, patients were deeply sedated to match ventilator mechanics, however, current practice is evolving to allow lighter levels of sedation with similar clinical outcomes.[7,8] The use of sedative agents such as propofol and dexmedetomidine, which can facilitate lighter levels of sedation, have been found to have superior outcomes when compared to benzodiazepines.[9,10] In addition to these factors, it is also important to consider the role of therapeutic momentum.

For a proportion of critically ill patients, the continuum of critical care begins in the emergency department (ED), operating room, referral units, delivered by a critical care transport, or emergency medical service agencies. Transitions of care from these locations are often underrecognized and may influence

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initial ICU care. For example, the initiation of deep sedation in the emergency department has been shown to have downstream effects resulting in deeper sedation in the ICU, increased mortality, and ICU length of stay, highlighting the impact of therapeutic momentum.[11] Recently, literature from the critical care transport environment mirrored these findings with similarly high levels of deeply sedated patients and negative impacts on long-term outcomes.[12,13] Considering the effect of therapeutic momentum it is important to understand the impact of receiving deeply sedated patients on ICU practice and outcomes. The objective of this study was to assess the impact of the exposure to deep versus light sedation by a critical care transport agency during pre-hospital and inter-hospital transport on ICU sedation levels, medication exposure, and outcomes.

Materials and Methods

Study Design

This was a retrospective cohort of mechanically ventilated patients ≥18 years of age from January 1, 2019, to March 11, 2020, who received invasive positive pressure ventilation through an endotracheal tube or supraglottic airway. Patients were transported by a hospital-based critical care transport team via ground ambulance or rotor wing aircraft during pre-hospital and inter-hospital transport to a single academic medical center. Patients were excluded if they died within the first 48 h of admission or had a duration of mechanical ventilation less than 48 h. The transport team consisted of a nurse and paramedic crew. The academic medical center was a rural 396 bed tertiary referral center with 60 adult ICU beds. This study was approved by the organization's Institutional Review Board. The primary outcome was the correlation of deep sedation during transport with deep sedation within the first 48 h of hospitalization (Richmond Agitation Sedation Scale [RASS] −3 to −5). The secondary outcomes were duration of mechanical ventilation, hospital length of stay, ICU length of stay, inpatient mortality, delirium within 48 h (one Confusion Assessment Method for the ICU [CAM-ICU] positive score), and coma (RASS −4 or −5) within 48 h.

Data Collected

Data abstraction was performed by chart review of scanned critical care team transport forms, inpatient medication administration records, and flowsheets that detailed RASS and CAM-ICU scoring. Deep sedation was defined as a RASS of −3 to −5 and light sedation was defined as a RASS of 1 to −2. Indications for mechanical ventilation were classified based on the transport team documentation into the categories of trauma, cardiac arrest, chronic obstructive pulmonary disease (COPD), asthma, pulmonary edema/congestive heart failure (CHF), neurological, sepsis, and other. Traumatic brain injury was classified as a traumatic injury rather than a neurological indication for mechanical ventilation. Prehospital medications were recorded if they were administered by the transport crew. Medications administered prior to transport crew arrival were not captured. Total administration quantities of continuous infusion medications were extrapolated based on the final infusion rate and total transport time. Extrapolated values were used to represent the total infusion quantity over transport because of the logistical complexity of the environment and inability to chart medication titrations in real-time. Transport time was defined as the time between the crew's arrival at the patient's bedside from the referring agency/hospital to handoff at the receiving hospital. Referring hospitals were classified into critical access (≤25 beds), small (26-100 beds), medium (100-400 beds), or academic medical center. Study data was collected and managed using REDCap (Research Electronic Data Capture).

Statistical Analysis

Statistical analysis was performed using STATA IC/16 (StataCorp, College Station, TX). The groups were compared using summary statistics. Continuous variables were presented as median values with interquartile ranges. Categorical variables were presented as counts with percentages. Analysis was conducted using Wilcoxon rank sum test for continuous variables, and Fisher exact test for categorical variables. A P-value of <.05 was considered statistically significant.

Results

A total of 198 patients were included in the analysis (Figure 1). One hundred and forty-seven (74.2%) were transported by rotor wing. One hundred and eighty-five (93.4%) were interfacility transports, with 99 (50%) originating from a critical access hospital. The median transport time was 75 min (IQR 60-105). One hundred and forty-six (73.7%) were admitted directly to the ICU. See Table 1 for a description of intubation indications, patient descriptions, facility type, and unit destination. The final median transport RASS was −5 (IQR −5 to −4). One hundred and eighty-three patients (92.4%) were deeply sedated at the end of transport.

Deep sedation during transport was not correlated with deep sedation in the hospital within the first 48 h (OR 2.41; 95% CI, 0.48-12.02). Deep sedation during transport was not correlated with hospital length of stay (coefficient −0.0002; 95% CI, −0.001-0.001), ICU length of stay (coefficient −0.002; 95% CI, −0.005-0.005), duration of mechanical ventilation (coefficient −0.0005; 95% CI, −0.003-0.002), or inpatient mortality (OR 1.59; 95% CI, 0.49-5.19) as seen in Table 2. Deep sedation during transport was also not correlated with delirium (OR 1.06; 95% CI, 0.36-3.12) or coma (OR 2.2; 95% CI, 0.65-7.42) within the first 48 h of hospitalization.

During transport, patients received similar quantities of sedating medications despite deep or light levels of sedation (Table 3). The total exposure to fentanyl was the only statistically different medication, with the lightly sedated patients receiving a greater quantity (250 vs 200 mcg; $P = .04$). Sixty-two patients (31.3%) were exposed to benzodiazepines during transport, with midazolam being the most frequently

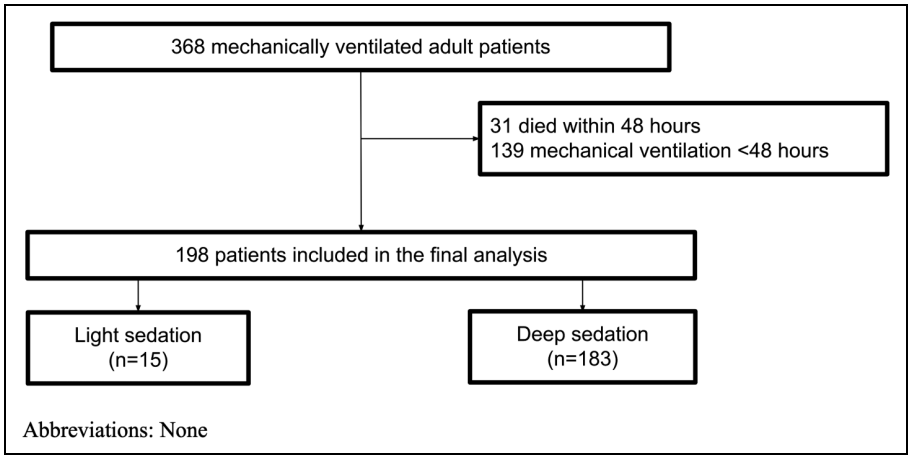

Figure 1. Study participants.

Table 1. Baseline Characteristics.

Characteristic	All patients (n = 198)	Deep sedation (n = 183)	Light sedation (n = 15)	*P*-value
Age (years)—median [IQR]	57 [41 to 70]	56 [41 to 69]	63 [35 to 79]	.36
Male—no. [%]	122 [61.6]	113 [61.8]	9 [60]	1
Admission height (inches)—median [IQR]	66.9 [63.4 to 70]	67 [63.8 to 70]	66 [60 to 72]	.55
Admission weight (kg)—median [IQR]	84 [68.1 to 103.6]	84.1 [68.8 to 103.9]	68.1 [55 to 86]	.05
Transport mode				
Ground—no. [%]	51 [25.8]	47 [25.7]	4 [26.7]	1
Rotor wing—no. [%]	147 [74.2]	136 [74.3]	11 [73.3]	
Referral agency type				
Scene—no. [%]	13 [6.6]	12 [6.6]	1 [6.7]	.65
Critical access hospital—no. [%]	99 [50]	89 [48.6]	10 [66.7]	
Small hospital—no. [%]	27 [13.6]	26 [14.2]	1 [6.7]	
Medium hospital—no. [%]	58 [29.3]	55 [30.1]	3 [20]	
Academic medical center—no. [%]	1 [0.5]	1 [0.6]	–	
Receiving unit				
ED—no. [%]	48 [24.2]	41 [22.4]	7 [46.7]	.02
Cardiac catheterization laboratory—no. [%]	4 [2]	3 [1.6]	1 [6.7]	
ICU—no. [%]	146 [73.7]	139 [76]	7 [46.7]	
Transport time (minutes)—median [IQR]	75 [60 to 105]	77 [60 to 105]	71 [52 to 85]	.33
Reason for intubation				
Sepsis—no. [%]	29 [14.7]	29 [15.9]	–	.16
Neurological—no. [%]	44 [22.2]	40 [21.9]	4 [26.7]	
Pulmonary edema/CHF—no. [%]	12 [6.1]	11 [6]	1 [6.7]	
Asthma—no. [%]	1 [0.5]	1 [0.6]	–	
COPD—no. [%]	18 [9.1]	14 [7.7]	4 [26.7]	
Trauma—no. [%]	37 [18.7]	33 [18]	4 [26.7]	
Cardiac arrest—no. [%]	33 [16.7]	32 [17.5]	1 [6.7]	
Other—no. [%]	24 [12.1]	23 [12.6]	1 [6.7]	
Final transport tidal volume (mL)—median [IQR]	450 [400 to 500]	460 [410 to 500]	450 [350 to 500]	.12
Final transport PEEP (cmH_2O)—median [IQR]	5 [5 to 8]	5 [5 to 9]	5 [5 to 5]	.1
Final transport systolic BP (mmHg)—median [IQR]	116 [102 to 131]	116 [102 to 132]	111 [97 to 121]	.26
Final transport diastolic BP (mmHg)—median [IQR]	70 [61 to 78]	70 [62 to 79]	69 [61 to 76]	.29
Final transport GCS—median [IQR]	3 [3 to 4]	3 [3 to 3]	5 [3 to 7]	.003
Final transport RASS—median [IQR]	−5 [−5 to −4]	−5 [−5 to −4]	0 [−2 to −1]	<.001
First admission serum creatinine (mg/dL)—median [IQR]	1 [0.8 to 1.5]	1.1 [0.8 to 1.5]	0.9 [0.7 to 2.4]	.49
First admission serum lactate (mmol/L)—median [IQR]	1.2 [0.9 to 1.7]	1.2 [0.9 to 1.7]	1 [0.8 to 1.9]	.6

Abbreviations: ED, emergency department; ICU, intensive care unit; CHF, congestive heart failure; COPD, chronic obstructive pulmonary disease; PEEP, positive end-expiratory pressure; BP, blood pressure; GCS, Glasgow Coma Score; RASS, Richmond Agitation-Sedation Scale.

Table 2. Patient Outcomes.

Outcome	All patients (n = 198)	Deep sedation (n = 183)	Light sedation (n = 15)	*P* value
Duration of mechanical ventilation—median [IQR]	4 [2-8]	4 [2-8]	4 [2-8]	.92
Hospital length of stay—median [IQR]	12 [7-24]	12 [6-24]	10 [7-45]	.85
ICU length of stay—median [IQR]	8 [4-15]	8 [4-15]	8 [4-27]	.65
Inpatient mortality—no. [%]	71 [35.9]	67 [36.6]	4 [26.7]	.58
Delirium within 48 h—no. [%]	82 [41.4]	76 [41.5]	6 [40]	1
Coma within 48 h—no. [%]	169 [85.4]	158 [86.3]	11 [73.3]	.24

Abbreviation: ICU, intensive care unit.

Table 3. Transport Medication Exposure.

Medication information	All patients (n = 198)	Deep sedation (n = 183)	Light sedation (n = 15)	*P* value
Fentanyl				
Total—no. [%]	169 [85.4]	155 [84.7]	14 [93.3]	.7
Total exposure (mcg)—median [IQR]	200 [100-250]	200 [100-250]	250 [200-350]	.04
Infusion—no. [%]	1 [0.51]	1 [6.7]	–	–
Final infusion rate (mcg/h)—median [IQR]	300	300	–	–
Midazolam				
Total—no. [%]	61 [30.8]	54 [29.5]	7 [46.7]	.24
Total exposure (mg)—median [IQR]	4 [2-5.5]	4 [2-5]	5 [4-8]	.13
Infusion—no. [%]	2 [1]	2 [1.1]	–	–
Final infusion rate (mg/h)—median [IQR]	5 [2-8]	5 [2-8]	–	–
Lorazepam				
Total—no. [%]	2 [1]	2 [1.1]	–	–
Total exposure (mg)—median [IQR]	3 [2-4]	3 [2-4]	–	–
Propofol				
Total—no. [%]	124 [62.6]	114 [62.3]	10 [66.7]	1
Total exposure (mg)—median [IQR]	242.2 [111.1-456]	245 [111.6-457]	177.7 [83.9-326.1]	.4
Infusion—no. [%]	124 [62.6]	114 [62.3]	10 [66.7]	1
Final infusion rate (mcg/kg/min)—median [IQR]	35 [20-50]	32.5 [20-50]	37.5 [25-50]	.89
Ketamine				
Total—no. [%]	10 [5]	9 [4.9]	1 [6.7]	.55
Total exposure (mg)—median [IQR]	199.7 [120-240]	200 [175-240]	65.5	.12
Infusion—no. [%]	4 [2]	3 [1.6]	1 [6.7]	.27
Final infusion rate (mg/kg/h)—median [IQR]	1.1 [0.7-1.2]	0.9 [0.5-1.2]	1.2	.35

Medication total reflects the number of patients who received bolus and/or infusion dosing.

administered. Frequency and quantities of benzodiazepines were not statistically different between the deep and light sedation groups. Benzodiazepine exposure during transport was not associated with deep sedation within the first 24 h of hospital care (OR 3; 95% CI, 0.85-10.59). Similarly, benzodiazepine exposure during transport was not associated with ICU length of stay (coefficient 0.001; 95% CI, −0.004-0.006), hospital length of stay (coefficient 0.002; 95% CI, 0.001-0.004), ventilator days (coefficient −0.001; 95% CI, −0.006-0.003), inpatient mortality (OR 0.71; 95% CI, 0.38-1.36), or delirium at 24 (OR 1.06, 95% CI 0.54-2.05) and 48 h (OR 1.17; 95% CI, 0.64-2.15).

As seen in Figure 2, patients who were deeply sedated during transport continued to experience deep sedation during the first 24 h of hospital care. The patients who were lightly sedated during transport also trended toward deeper sedation (RASS < -2) during this period. Light sedation during transport was not correlated with the maintenance of light sedation at 24 (OR 2.26; 95% CI, 0.74-6.86) or 48 h (OR 1.3; 95% CI, 0.43-3.95). Similarly, sedation assessment scores by the transport and hospital team were not correlated at patient handoff. There was a negligible correlation between final transport RASS and initial hospital RASS (Figure 3). This correlation did not differ based on the lapsed time from handoff (<1 h corr. coeff. 0.23; ≥1 h corr. coeff. 0.25) or by admitting unit (ED coeff. 0.28, ICU coeff. 0.25). The median time difference between final transport RASS scoring and initial hospital RASS scoring was 57.5 min (IQR 13-229).

Benzodiazepine exposure during transport was not associated with benzodiazepine exposure during the first 48 h of hospitalization (OR 1.57; 95% CI, 0.84-2.93). The propofol infusion rate at transport handoff was moderately correlated with the initial hospital propofol infusion rate (correlation coefficient 0.63) seen in Figure 4. Paralysis exposure during

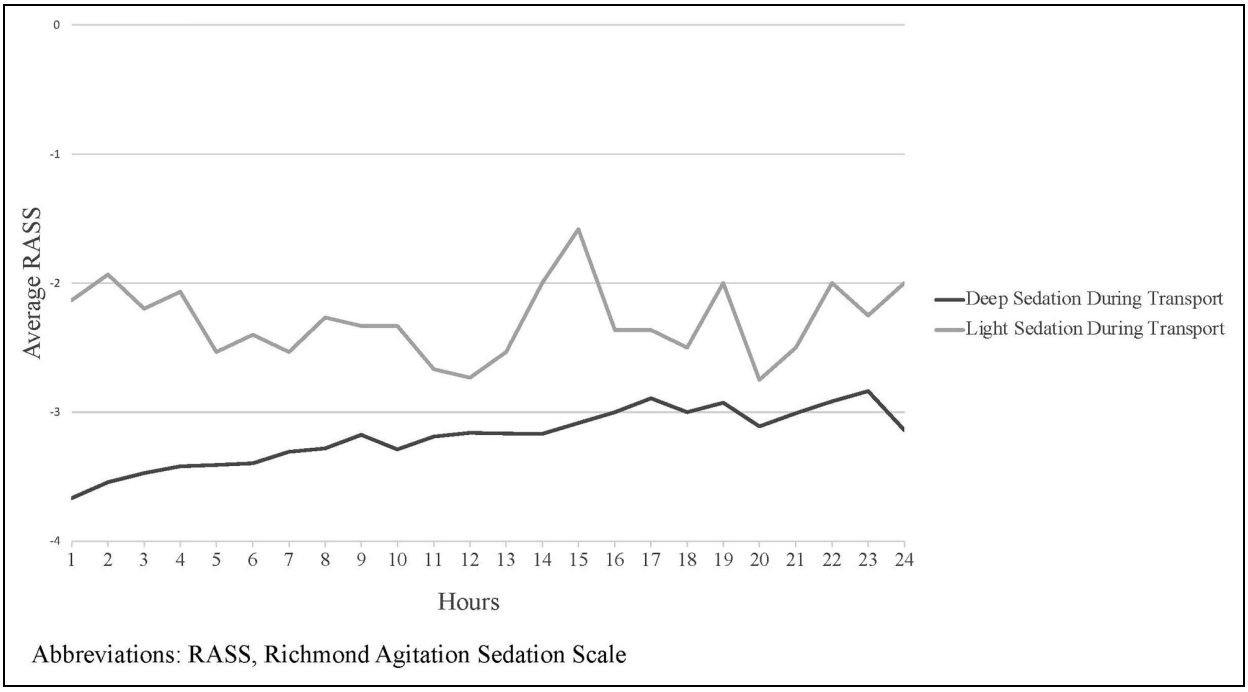

Figure 2. Hourly differences in hospital RASS.

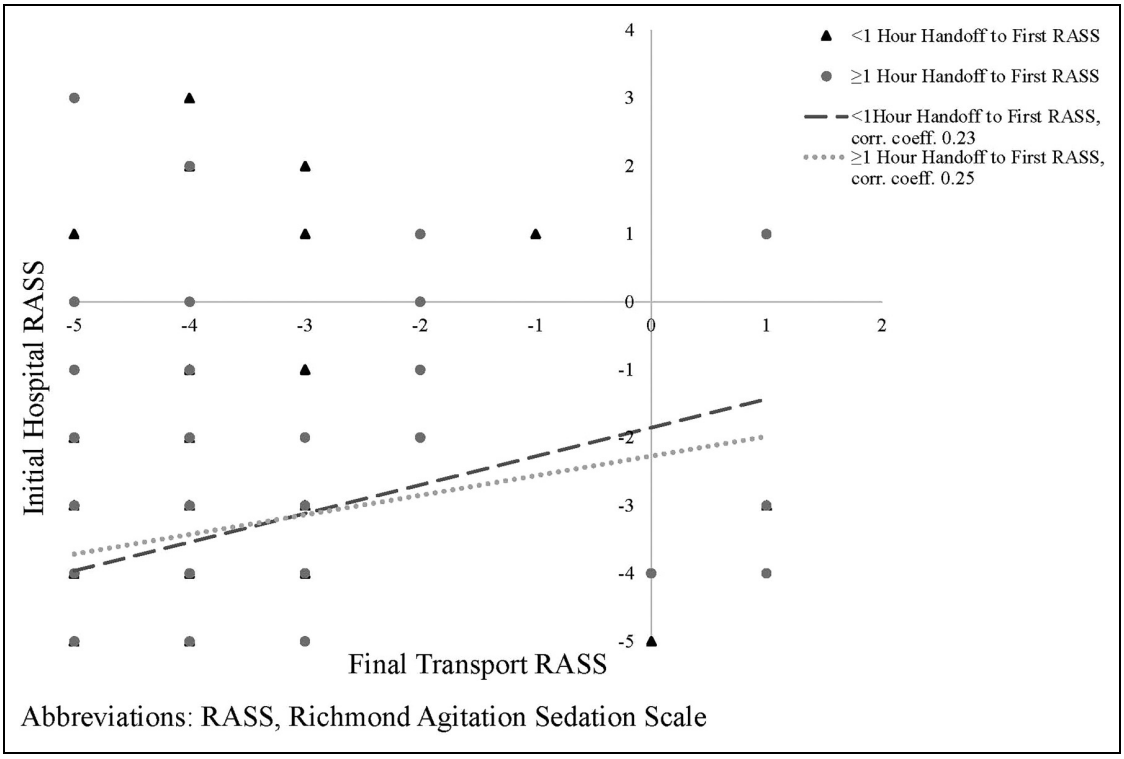

Figure 3. Relationship of final transport RASS and initial hospital RASS.

transport (not administered during intubation) was associated with paralysis exposure during the first 48 h of hospitalization (n = 52, OR 3.34; 95% CI, 1.38-8.08). However, deep sedation during transport was not associated with paralysis during the first 48 h of hospitalization (OR 0.78; 95% CI, 0.21-2.95).

As seen in Table 4, patients in both the deep and light sedation during transport groups received similar quantities of

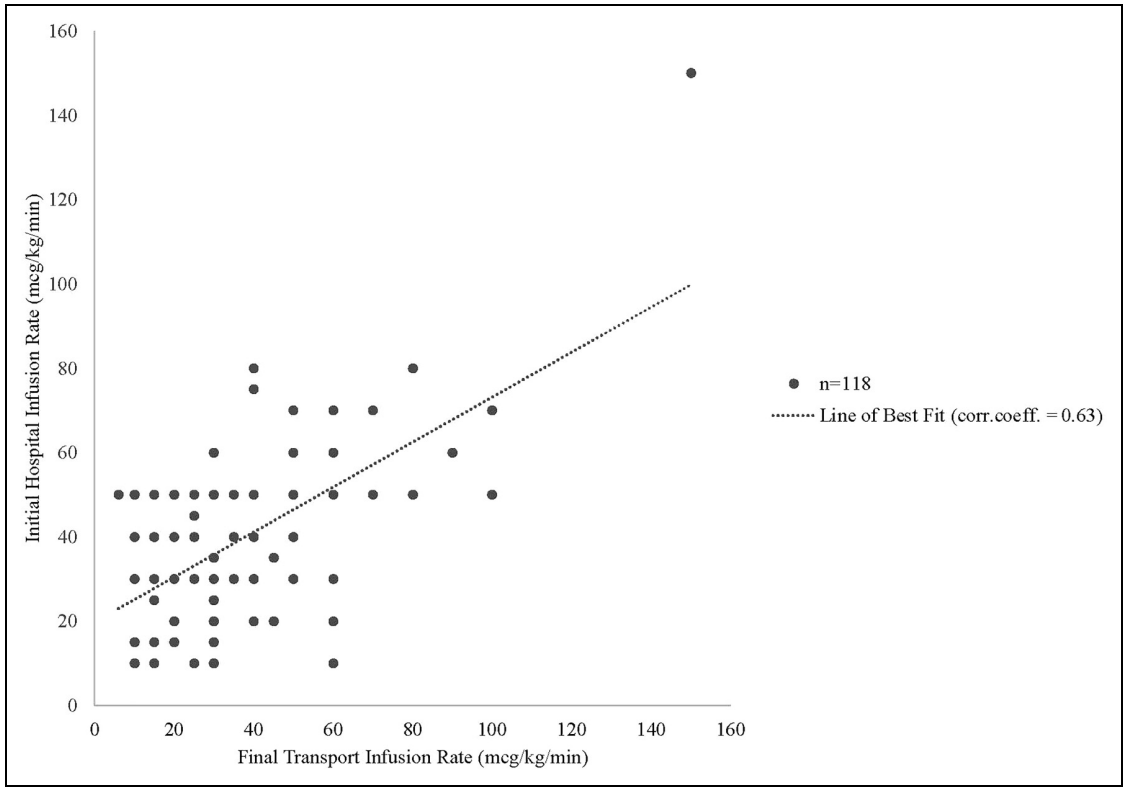

Figure 4. Relationship of final transport propofol infusion rate and initial hospital propofol infusion rate.

sedatives and paralytics during the first 48 h of hospitalization. Benzodiazepines remained prevalent in the inpatient setting (midazolam 24.7% and lorazepam 9.1%). Patients in the light sedation group received higher rates of dexmedetomidine during this period with median 48-h exposure quantities being 448 mcg as compared to 2137 mcg ($P = .05$). Patients who were deeply sedated during transport received higher total quantities and higher rates of vasopressors during the first 48 h of hospitalization. No patients in the light sedation group received vasopressin as compared to 48 (26.2%) in the deep sedation group. Additionally, the median hourly rate of norepinephrine was greater in the deeper sedation group as compared to the light sedation group, 0.06 mcg/kg/min (IQR 0.02-0.14) versus 0.02 mcg/kg/min (IQR 0.01-0.02) respectively ($P = .01$).

A subgroup analysis was conducted for patients who had a transport diagnosis of cardiac arrest. Likewise, patients with cardiac arrest received similar medications and total exposure quantities of medications during the first 48 h of their hospital course (Table 5). Midazolam was frequently administered in both groups, with exposure rates being 30.3% in the cardiac arrest population and 30.9% in all other populations.

Discussion

Deep sedation was prevalent during critical care transport and persisted throughout the first 48 h of hospital care. Despite the small proportion of lightly sedated patients in either environment, medication exposure during transport and during hospitalization did not differ significantly. Increases in vasopressor requirements were seen in the deeply sedated cohort which may be attributed to confounders beyond medication exposure. Notably, there were also high rates of delirium and coma seen across both sedation cohorts. Despite this high prevalence, 27 (13.6%) of patients who were eligible for CAM-ICU scoring during hospitalization did not receive scoring during the evaluation time frame. Benzodiazepine exposure may be a contributing factor as ~30% of patients received benzodiazepines either in transport or during the first 48 h of hospitalization. Due to the high prevalence of deep sedation in our cohort compared to prior studies, we hypothesize that this influenced the inability to display outcome differences related to delirium, coma, mortality, duration of mechanical ventilation, and length of stay.[11,13]

Limited evidence exists evaluating the correlation from critical care transport or the ED to ICU care regarding sedation scoring and medication infusion rates. Our review displayed a lack of correlation in RASS assessments irrespective of the time elapsed between handoffs. One hour was selected for the handoff sedation assessment time as this was likely the highest acuity period when patient re-evaluation would be ongoing. It was our hypothesis that the longer the time lapse from handoff, the less correlation would be evidenced, however, this was not the case. Prior literature has demonstrated

Table 4. Inpatient Medication Exposure During the First 48 Hours of Care.

Medication information	All patients (n = 198)	Deep sedation (n = 183)	Light sedation (n = 15)	*P* value
Fentanyl				
Total—no. [%]	158 [80]	145 [79.2]	13 [86.7]	.74
Total exposure (mcg)—median [IQR]	2524.4 [1170.4-6130]	2523.8 [1130-6250.8]	2526 [1633-2942]	.7
Starting infusion rate (mcg/h)—median [IQR]	50 [50-75]	50 [50-67.5]	50 [50-100]	.42
Hydromorphone				
Total—no. [%]	19 [9.6]	17 [9.3]	2 [13.3]	.64
Total exposure (mg)—median [IQR]	4.3 [0.4-50]	2.6 [0.4-46.6]	321.7 [4.3-639]	.22
Starting infusion rate (mg/h)—median [IQR]	1 [0.5-1.5]	0.8 [0.5-2]	1 [1-1]	.72
Morphine				
Total—no. [%]	4 [2]	4 [2.2]	–	–
Total exposure (mg)—median [IQR]	7.5 [3-50.5]	7.5 [3-50.5]	–	–
Starting infusion rate (mg/h)—median [IQR]	1	1	–	–
Propofol				
Total—no. [%]	173 [87.4]	159 [86.9]	14 [93.3]	.7
Total exposure (mg)—median [IQR]	6092 [2618-10,300]	6507 [2618-10,500]	5352 [2205-7512]	.35
Starting infusion rate (mcg/kg/min)—median [IQR]	35 [20-50]	35 [20-50]	40 [30-50]	.62
Midazolam				
Total—no. [%]	49 [24.7]	43 [23.5]	6 [40]	.21
Total exposure (mg)—median [IQR]	10 [2-80.5]	10 [2-83.5]	28.1 [2-78.4]	.86
Starting infusion rate (mg/h)—median [IQR]	1 [1-4]	2 [1-4]	1 [1-2.5]	.43
Dexmedetomidine				
Total—no. [%]	60 [30.3]	53 [29]	7 [46.7]	.16
Total exposure (mg)—median [IQR]	728.1 [187.8-1649.7]	448.4 [176.3-1376.9]	2137.7 [788-2281.3]	.05
Starting infusion rate (mcg/kg/h)—median [IQR]	0.4 [0.4-0.4]	0.4 [0.4-0.4]	0.4 [0.4-1.7]	.1
Lorazepam				
Total—no. [%]	18 [9.1]	16 [8.7]	2 [13.3]	.63
Total exposure (mg)—median [IQR]	4 [2-6]	4 [2-6]	5 [2-8]	.77
Ketamine				
Total—no. [%]	9 [4.5]	6 [3.3]	2 [13.3]	.12
Total exposure (mg)—median [IQR]	697.1 [442.9-3320]	1318.3 [494.8-4550.5]	619.1 [391-847.2]	.51
Phenobarbital				
Total—no. [%]	6 [3.1]	5 [2.7]	1 [6.7]	.38
Total exposure (mg)—median [IQR]	447.8 [385.5-1230]	508.2 [385.5-1230]	387.4	.77
Norepinephrine				
Total—no. [%]	118 [59.6]	107 [58.5]	11 [73.3]	.29
Total exposure (mcg)—median [IQR]	14,457.5 [4034-32,829]	16,217 [4887-36,556]	4304 [1190-7309]	.004
Average hourly rate (mcg/kg/min)—median [IQR]	0.05 [0.02-0.13]	0.06 [0.02-0.14]	0.02 [0.01-0.02]	.01
Vasopressin				
Total—no. [%]	48 [24.2]	48 [26.2]	–	–
Total exposure (units)—median [IQR]	53.3 [23.7-99.9]	53.3 [23.7-99.9]	–	–
Average hourly rate (units/h)—median [IQR]	0.02 [0.01-0.03]	0.02 [0.01-0.03]	–	–
Epinephrine				
Total—no. [%]	18 [9.1]	17 [9.3]	1 [6.7]	1
Total exposure (mcg)—median [IQR]	2735 [1000-5427]	2729 [1000-4829]	1000	.21
Average hourly rate (mcg/kg/min)—median [IQR]	0.01 [0.004-0.032]	0.01 [0.004-0.027]	0.04	.21
Phenylephrine				
Total—no. [%]	35 [17.7]	32 [17.5]	3 [20]	.73
Total exposure (mcg)—median [IQR]	18,000 [7230-44,960]	16,585 [6467.5-45,032.5]	26,325 [18,000-35,400]	.56
Average hourly rate (mcg/kg/min)—median [IQR]	0.08 [0.03-0.2]	0.07 [0.03-0.22]	0.09 [0.07-0.11]	.77
Paralytic administration—no. [%]	33 [16.7]	30 [16.4]	3 [20]	.72
Paralytic infusion—no. [%]	26 [13.1]	23 [12.6]	3 [20]	.42
Rocuronium—no. [%]	3 [1.5]	2 [1.1]	1 [6.7]	.21
Cisatracurium—no. [%]	25 [12.6]	23 [12.6]	2 [13.3]	1
Vecuronium—no. [%]	9 [4.6]	8 [4.4]	1 [6.7]	.52

Medication total reflects the number of patients who received bolus and/or infusion dosing.

high inter-rater reliability with RASS scoring among various members of the ICU team.[14] However, no data exists evaluating inter-rater reliability across transitions of critical care. The lack of sedation assessment correlation highlights the need for further education and re-evaluation of sedation assessments across transitions of critical care. Depth of sedation evaluation

Table 5. Medications in Cardiac Arrest.

	Cardiac arrest (n = 33)	All others (n = 165)	*P* value
Fentanyl			
Transport total—no. [%]	26 [78.8]	145 [87.9]	.17
Transport total exposure (mcg)—median [IQR]	225 [100-250]	200 [100-250]	.82
Inpatient total—no. [%]	25 [75.8]	133 [80.6]	.49
Inpatient total exposure (mcg)—median [IQR]	2094 [1411-3595]	2650 [1170.4-6295]	.22
Hydromorphone			
Inpatient total—no. [%]	1 [3]	18 [10.9]	.21
Inpatient total exposure (mg)—median [IQR]	27.8	3.5 [0.4-50]	.58
Morphine			
Inpatient total—no. [%]	–	4 [2.4]	–
Inpatient total exposure (mg)—median [IQR]	–	7.5 [3-50.5]	–
Midazolam			
Transport total—no. [%]	10 [30.3]	51 [30.9]	1
Transport total exposure (mg)—median [IQR]	4 [1.5-6]	4 [2-5.5]	.76
Inpatient total—no. [%]	6 [18.2]	43 [26.1]	.39
Inpatient total exposure (mg)—median [IQR]	15.5 [2-47.6]	10 [2-83.6]	.43
Lorazepam			
Transport total—no. [%]	–	2 [1.2]	–
Transport total exposure (mg)—median [IQR]	–	3 [2-4]	–
Inpatient total—no. [%]	2 [6.1]	16 [9.7]	.74
Inpatient total exposure (mg)—median [IQR]	2 [2-2]	4.3 [2-6]	.19
Propofol			
Transport total—no. [%]	15 [45.4]	109 [66.1]	.03
Transport total exposure (mg)—median [IQR]	4.4 [2.2-7.7]	4 [1.8-7.6]	.8
Inpatient total—no. [%]	28 [84.9]	145 [87.9]	.58
Inpatient total exposure (mg)—median [IQR]	8067 [3320-1100]	5838 [2433-9989]	.36
Ketamine			
Transport total—no. [%]	–	10 [6.1]	–
Transport total exposure (mg)—median [IQR]	–	200 [120-240]	–
Inpatient total—no. [%]	1 [3]	7 [4.2]	1
Inpatient total exposure (mg)—median [IQR]	298.4	847.2 [494.8-4550.5]	.13
Phenobarbital			
Inpatient total—no. [%]	–	6 [3.6]	–
Inpatient total exposure (mg)—median [IQR]	–	447.8 (385.5-1230)	–
Dexmedetomidine			
Inpatient total—no. [%]	5 [15.1]	55 [33.3]	.04
Inpatient total exposure (mcg)—median [IQR]	367.5 [297-748.3]	763.6 [187.7-1683.1]	.34

Medication total reflects the number of patients who received bolus and/or infusion dosing.

should be conducted prior to continuation or re-evaluation of a sedation strategy. Lack of agreement with RASS scoring likely contributed to the continuation of a deep sedation strategy. In our cohort propofol infusions were the only example of a continuous infusion medication that spanned both transport and inpatient care environments. In this retrospective review, it is unclear what contributed to the selection of propofol infusion rates, but we hypothesize that infusion rates were continued from transport or inpatient teams started a frequently prescribed infusion rate without a sedation assessment.

Prior literature demonstrates that critical care transport patients are frequently deeply sedated.[12,13] Handoff from the transport team represents an opportunity to reassess and reset sedation regimens and infusion quantities. While there is no literature about the transport to inpatient transition, we believe it is a time to disrupt therapeutic momentum. Admission to a critical care service in the hospital is often a time of information gathering and defining the pathological processes with many unknowns. However, this transition may offer an opportunity to also perform a spontaneous awakening trial in appropriate patient populations. Literature surrounding implementation of a daily spontaneous awakening trial has demonstrated benefits in morbidity and mortality outcomes.[15] Adoption of this approach requires a multidisciplinary team at handoff to assure appropriate patients are being selected with patient and staff safety taken into consideration. Identification of patients who are at risk to have potentially harmful complications from ongoing deep sedation or benzodiazepine exposure (eg, post-cardiac arrest or neurologically injured) is important during this reassessment as well.[16–18] In contrast, deep sedation remains appropriate for patients who recently received paralytics or as part of the evidence-based medicine treatment algorithm (eg, status epilepticus). Although sedation management and recommendations are evolving, further emphasizing the

pause to reassess treatment goals and trajectories may be beneficial to increase the time spent in light sedation during ICU care.

Limitations

Our study is limited by the retrospective assessment of patients from a single hospital-based critical transport service to a single academic medical center. Medications were not captured prior to the transport team's arrival. If paralysis was administered immediately prior to transport this likely influenced medication selection and sedation depth. Extrapolation of continuous infusion rates during transport may not capture the total quantity of medication administered if there were multiple dose changes during transport. Patients arrived at various levels of care and locations including the ED, multiple ICU specialties, or the cardiac catheterization laboratory. Medications were not captured in the cardiac catheterization laboratory space. Furthermore, practice deviations were not specifically investigated for patients in the ED versus the ICU, for example, patients with significant ventilator dyssynchrony. A majority of the patients who were admitted to the ED (33/48, 68.8%) were trauma patients. Immediate operative or interventional procedures for traumatically injured patients were not captured in this review. This may confound the decision for appropriate deep sedation in the early phase of care. ED boarding times were also not evaluated in this review. Additionally, it was not captured if patients went to the operating room during the first 48 h. This would have had an influence on sedation levels and medication exposure during the review time period. Severity of illness scoring was not captured due to lack of availability over the study time period which limits generalizability.

Conclusions

Deep sedation was frequently observed during critical care transport in this cohort and was not correlated with deep sedation during the first 48 h of hospitalization. There were no differences in duration of mechanical ventilation, hospital, and ICU length of stay, inpatient mortality, delirium, and coma within 48 h. We hypothesize this is because of the high prevalence of deep sedation during transport and hospital care. Medication exposure during transport and hospitalization did not differ between sedation cohorts. There was no correlation between final transport RASS and the initial hospital RASS. The transition of patient care between the transport team and the hospital team may be an opportunity to disrupt therapeutic momentum and re-evaluate sedation decisions.

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