



Original Contribution

Acute respiratory distress syndrome and outcomes after near hanging[☆]

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ABSTRACT

Purpose: The purpose of this study is to assess the case rate of acute respiratory distress syndrome (ARDS) after near hanging and the secondary outcomes of traumatic and/or anoxic brain injury and death. Risk factors for the outcomes were assessed.

Method: The method is a single-center, statewide retrospective cohort study of consecutive patients admitted between August 2002 and September 2011, with a primary diagnosis of nonjudicial “hanging injury.”

Results: Of 56 patients, 73% were male. The median age was 31 (Interquartile range (IQR), 16–56). Upon arrival, 9% (5/56) did not have a pulse, and 23% (13/56) patients were intubated. The median Glasgow Coma Scale (GCS) was 13 (IQR, 3–15); 14% (8/56) had a GCS = 3. Acute respiratory distress syndrome developed in 9% (5/56) of patients. Traumatic anoxic brain injury resulted in 9% (5/56) of patients. The in-hospital case fatality was 5% (3/56). Lower median GCS (3 [IQR, 3–7] vs 14 [IQR, 3–15]; $P = .0003$) and intubation in field or in trauma resuscitation unit (100% [5/5] vs 16% [8/51]; $P = .0003$) were associated with ARDS development. Risk factors of death were GCS = 3 (100% [3/3] vs 9% [5/53]; $P = .002$), pulselessness upon arrival of emergency medical services (100% [3/3] vs 4% [2/53]; $P < .001$), and abnormal neurologic imaging (50% [1/2] vs zero; $P = .04$).

Conclusions: The ARDS case rate after near hanging is similar to the general trauma population. Low GCS and intubation are associated with increased risk of ARDS development. The rate of traumatic and/or anoxic brain injury in this population is low.

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1. Introduction

Between 2000 and 2010, suicide rates in the United States increased by 16%, and suicide by hanging or suffocation accounted for 52% of the increase [1]. Hanging or suffocation suicide case fatality rates ranged from 69% to 84% [1]. Injuries occurring after near hanging include cervical spine and laryngotracheal fractures, anoxic brain injury, and retinal bleeding [2–4]. Previously, pulmonary complications such as aspiration pneumonia [3] and pulmonary edema [5–8] have been observed. However, the acute respiratory distress syndrome (ARDS), as defined by modern consensus definition, has not been evaluated as an outcome after near hanging.

We hypothesized that patients with injury by near hanging are at risk for ARDS development. In a cohort of consecutive near-hanging patients presenting to a statewide trauma center, the association of near hanging with ARDS was evaluated. Risk factors for death and traumatic and/or anoxic brain injury were also assessed.

2. Methods

We conducted a single-center, statewide retrospective cohort study of consecutive patients admitted with a primary diagnosis of nonjudicial “hanging injury” between August 2002 and September 2011, to the R Adams Cowley Shock Trauma Center (STC) at the University of Maryland Medical Center. The STC is an independent, trauma center that is the main referral center for critically injured adults in the State of Maryland, from urban, suburban, and rural communities of more than 6 million people for greater than 30 years [9].

For the assessment of ARDS development, the Berlin definition [10] was incorporated into a validated screening algorithm [11–13]. This algorithm was combined with administrative data for ventilator

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charges, to identify all mechanically ventilated patients at risk for ARDS. All patients presenting to STC are routinely assessed for Glasgow Coma Score (GCS) upon arrival. Low GCS was defined as 3 and low injury severity score (ISS) as less than 16. Neurologic outcome was assessed by computed tomography (CT) head/CT angiography (CTA) neck and/or clinical assessment by the neurology service. Patients' characteristics were presented as medians with SDs and compared using Student *t* test for independent samples with continuous variables and comparison of proportions for categorical variables using Fishers test. We used the traditional threshold of $P \leq .05$ to determine statistical significance.

3. Results

Between August 2002 and September 2011, 56 patients were admitted with primary diagnosis of hanging injury (Table 1). Of these, 73% (41/56) were male. The median age was 31 (IQR, 16–56). The median GCS was 13 (IQR, 3–15); 14% (8/56) had a GCS equal to 3 (unresponsive). Upon arrival, 9% (5/56) were pulseless. Low ISS (ISS, <16) was noted in 98% (55/56), blood alcohol content (BAC) was positive in 20% (11/56), and urine toxicology screen was positive in 48% (27/56) and composed of the following: benzodiazepine (16/56), barbiturates (9/56), opiates (6/56), marijuana (6/56), *phencyclidine* (PCP) (1/56), amphetamines (1/56), and tricyclics (1/56).

Among the cohort, 23% (13/56) patients were intubated, either in the field or in the trauma resuscitation unit. Acute respiratory distress syndrome developed in 9% (5/56) of patients (Table 2). Low GCS and younger age were associated with ARDS development. An association with high ISS was also found, but this did not meet our definition of significance ($P = .09$). After near hanging, 3% (2/56) of patients were transferred to acute care rehabilitation facilities, 57% (32/56) transferred to inpatient psychiatric facilities, 30% (17/56) were discharged to home, and 3% (2/56) transferred to prison. Traumatic anoxic brain injury occurred in 9% (5/56) of patients. Of the patients receiving mechanical ventilation, 38% (5/13) patients developed ARDS. Those with ARDS and receiving mechanical ventilation had lower median 28-day ventilator-free days than patients receiving mechanical ventilation without ARDS (Table 3). Lower median GCS (3 [IQR, 3–7] vs 14 [IQR, 3–15]; $P = .0003$) and mechanical ventilation (100% [5/5] vs 16% [8/51]; $P = .0003$) were associated with the ARDS development (Table 3).

The in-hospital case fatality rate was 5% (3/56) (Table 4). Risk factors for death were GCS equal to 3 (100% [3/3] vs 9% [5/53]; $P = .002$), pulselessness upon arrival of emergency medical services (100% [3/3] vs 4% [2/53]; $P < .001$), and abnormal neurologic imaging (50% [1/2] vs 0/50; $P = .04$).

Table 1
Patient characteristics

Total patients (n)	56
Sex	
Male (%)	73% (41/56)
Female (%)	27% (15/56)
Age (y) ± SD, median (IQR)	32 ± 10, 31 (16–56)
ISS ^a < 16 (%)	98% (55/56)
GCS ^b	
Average (± SD), median (IQR)	11 ± 4, 13 (3–15)
GCS ^b = 3 (%)	14% (8/56)
Fatalities among patients with GCS ^b = 3 (%)	37% (3/8)
Pulselessness upon EMS ^c arrival (%)	9% (5/56)
Positive blood alcohol level (%)	20% (11/56)
Positive urine toxicology screen (%)	48% (27/56)

^a Injury severity score.

^b Glasgow Coma Score.

^c Emergency medical services.

Table 2
Patient outcomes

Total patients (n)	56
In-hospital death (%)	5% (3/56)
ARDS ^a (%)	9% (5/56)
Mechanical ventilation (%)	23% (13/56)
Abnormal CT ^b head (%)	2% (1/52)
Abnormal CT ^b neck/CTA ^c neck (%)	2% (1/53)
TBI ^d and/or anoxic brain injury (%)	9% (5/56)
Disposition	
Home (including original place of residence) (%)	30% (17/56)
Inpatient psychiatric unit (%)	57% (32/56)
Acute care rehabilitation facility (%)	3% (2/56)
Expired (%)	5% (3/56)
Prison (%)	3% (2/56)

^a Acute respiratory distress syndrome.

^b Computed tomography.

^c Computed tomography angiography.

^d Traumatic brain injury.

4. Discussion

Acute respiratory distress syndrome is an important outcome after near hanging. Low GCS and mechanical ventilation were associated with ARDS development. Higher case fatality rates were observed in patients with low GCS, pulselessness upon arrival of emergency medical services, and abnormal neurologic imaging. Interestingly, despite the mechanism of injury, anoxic brain injury was relatively uncommon.

Acute respiratory distress syndrome development after suicidal hanging has previously been reported in literature [14,15]. Disruption of alveolar-capillary membrane results in exudation of fluid and pulmonary congestion leading to decreased lung compliance [16,17].

Table 3
Patient characteristics and outcomes by ARDS^a status

	ARDS ^a (5)	No ARDS ^a (51)	<i>P</i>
Total patients (%)	9% (5/56)	91% (51/56)	.60 ^b
Male (%)	60% (3/5)	75% (38/51)	
Female (%)	40% (2/5)	25% (13/51)	
Age (y) ± SD, Median (range)	26 ± 2, 27 (23–29)	31 ± 10, 31 (19–56)	.004 ^c
In-hospital death (%)	20% (1/5)	4% (2/51)	.25 ^a
ISS ^d < 16 (%)	80% (4/5)	100% (51/51)	.09 ^b
ISS ^d > 16 (%)	20% (1/5)	0	
GCS ^e			
Average (± SD), median (IQR)	4 ± 2, 3 (3–7)	11.5 ± 4, 14 (3–15)	.0003 ^c
Total no. of patients with GCS ^e equal to 3 (%)	60% (3/5)	10% (5/51)	.02 ^b
Absence of pulse upon arrival of EMS ^f (%)	20% (1/5)	8% (4/51)	.39 ^b
Positive BAC (%)	40% (2/5)	18% (9/51)	.25 ^b
Urine toxicology screen positive (%)	40% (2/5)	49% (25/51)	1 ^b
Mechanical ventilation (%)	100% (5/5)	16% (8/51)	.0003 ^b
Ventilator-free days median (IQR)	19 (0–27)	27 (21–26)	
Abnormal CT ^g head (%)	20% (1/5)	0 (0/47)	.10 ^b
Abnormal CT ^g neck/CTA ^h neck (%)	0 (0/5)	2% (1/49)	1 ^b
Disposition			.14 ^b
Home (including original place of residence) (%)	20% (1/5)	31% (16/51)	
Inpatient psychiatric unit (%)	40% (2/5)	59% (30/51)	
Acute care rehabilitation facility (%)	20% (1/5)	2% (1/51)	
Expired (%)	20% (1/5)	4% (2/51)	
Prison (%)	0 (0/5)	4% (2/51)	

Data presented as medians with interquartile range or as proportions.

^a Acute respiratory distress syndrome.

^b Fisher exact test.

^c Student *t* test.

^d Injury severity score.

^e Glasgow Coma Score.

^f Emergency medical services.

^g Computed tomography.

^h Computed tomography angiography.

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