Research

Outcome of Patients with Attempted Suicidal Hanging with Pre-Hospital Cardiac Arrest: A Pilot Observational Study

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ABSTRACT

Background: The outcomes of hanging-induced cardiac arrest are not well understood. Hanging with pre-hospital cardiac arrest may be associated with increased hospital mortality and significant long-term neurological morbidity.

Purpose: To explore clinical outcomes of hanging patients with pre-hospital cardiac arrest.

Setting: Single-centre study at a tertiary care ICU.

Methods: We conducted a retrospective exploratory cohort study. All patients with suicidal hanging admitted to the study ICU from 1 January 2014 to 31 December 2019 were included in the study. Patient data obtained from the ICU database and electronic health records were analyzed for predictors of ICU outcomes.

Results/Findings: Seventy-six patients with suicidal hanging presented to the Emergency Department (ED) over 6 years; of these, 47 (33 males, 14 females) were admitted to ICU. The mean age of the patient cohort was 39.0 years (+13.6) and the median APACHE-III score was 69.0. Twenty-seven patients (57.4%) were admitted following pre-hospital cardiac arrest due to a non-shockable rhythm (16 with pulseless electrical activity, 11 asystole) as the first documented rhythm. Most (74.0%) of these patients had a Glasgow Coma Score of 3 at the scene, which remained unchanged on arrival in the ED. This notwithstanding, 33.3% of patients had a good neurological outcome. Among hanging patients without pre-hospital arrest, 95% had a good neurological outcome. This difference in outcome was significant. While several factors were associated with patient outcomes on univariate analysis, only a high APACHE-III score demonstrated a significant inverse relationship with good outcome in regression analysis.

Conclusions: The outcome of hanging patients with pre-hospital cardiac arrest admitted to the ICU was poor despite successful initial resuscitation as per international guidelines. A high APACHE-III score was associated with poor outcome.

Keywords: Hanging, out-of-hospital cardiac arrest, predictive factors, outcome, hospital survival, prognosis.

INTRODUCTION

Suicidal hanging is the commonest cause of asphyxial cardiac arrest among young adults worldwide (Wilkinson et al., 2000; McHugh, 1983). The incidence of suicidal hanging in Australia has increased significantly over the last 30 years (Harrison & Henley, 2014) and presentations to the Emergency Department (ED) following a cardiac arrest at scene or during transport to hospital are not uncommon. Prognosis among those admitted to hospital

following cardiac arrest has been shown to be worse in comparison to patients without cardiac arrest (Deasy et al., 2013; Shin et al., 2014). The crude mortality rate is estimated to be >80% (Elnouro et al., 2002).

A few studies (Shin et al., 2014; Penney et al., 2002; William et al., 2018) have described the unique characteristics and outcome of hanging-induced cardiac arrest in contrast to the arrest of cardiac origin. Generally, patients with hanging-induced cardiac arrest are relatively young and require a shorter resuscitation time. They have a higher survival compared to those with arrest due to a cardiac cause, although most patients with asphyxial cardiac arrest have a non-shockable rhythm at the scene. A number of survivors emerge with a poor neurologic outcome (Baldursdottir et al., 2010; Wee et al., 2012); these neurological sequelae vary from mild neurological insult to permanent disability (Salim et ao, 2006).

The decision to offer cardio-pulmonary resuscitation (CPR) to patients who have suffered a cardiac arrest (CA) following suicidal hanging either at the scene or *enroute* to the hospital is guided by the recommendations of the Australian Resuscitation Council (2016). Ambulance officers are not obliged to commence resuscitation when injuries are inconsistent with life. However, there are no specific recommendations for patients who suffer a hanging-related cardiac arrest. The prognosis of this group of patients is uncertain. Considering this, we hypothesised that hanging patients with pre-hospital cardiac arrest have a high chance of poor neurological recovery. Although several studies have investigated the outcome of hanging patients, most research has included the entire cohort and not analysed patients with CA separately (Penney et al., 2002). Second, studies so far have reported high mortality among patients with CA to preclude any meaningful analysis. A small, single intensive care unit (ICU) study from UK (William et al., 2018) reported a survival rate of 16% among patients with CA due to hanging. A larger case series from 12 academic centres in South Korea (Kim et al., 2016) included 121 patients with CA following suicidal hanging and found a good outcome in only 4.1% of their patients. One of the largest studies published so far (Shin et al, 2014) reported a low survival rate (3.3%) as well. Third, risk factors predictive of poor outcome identified in these studies have been variable.

Considering this, we planned to conduct an observational study to analyse outcome of hanging patients with pre-hospital cardiac arrest. With reports of improved neurological outcome among patients with out-of-hospital cardiac arrest (Bernard et al., 2002), and improvements noted since application of targeted temperature management in ICU (Nielsen et al., 2013) we felt it was opportune to re-examine the question in hanging victims. We planned this single centre study to inform our planning for a larger state-wide study.

METHODS

Study Design

This was a single-centre, retrospective exploratory study of patients admitted to a major tertiary Hospital ICU from 1-Jan-2014 to 31-Dec-2019.

Setting

The study hospital is a 700-bed, tertiary care teaching hospital situated in the metropolitan region of Sydney. The Level III ICU is a 24-bed mixed medical-surgical ICU which manages critically ill medical, surgical, trauma, and neuro-surgery patients. This ICU admits approximately 1300 patients per annum and has a 90-95% bed occupancy rate.

Patients are admitted to the ICU electively or following an emergency surgery from the Operating Room (OR). Alternatively, acutely unwell patients are admitted from the Emergency Department (ED), Hospital wards, or High Dependency Units (HDU). All patients have their severity of illness data recorded routinely following admission to ICU (APACHE [Acute Physiology and Chronic Health Evaluation] -III during the first 24 hours of ICU stay), and their SOFA (sequential organ failure assessment) score recorded by medical staff daily.

Inclusion and Exclusion Criteria

All patients (≥18 years of age) with a history of attempted suicidal hanging who were admitted to ICU over 6 years from 1-Jan-2014 to 31-Dec-2019 were included. Patients with features of brain death at time of ICU admission or imminent demise were excluded.

Data Collection

The study ICU maintains a searchable database containing records of all patients admitted to the ICU. All data regarding patient characteristics (age, sex, co-morbidities, APACHE-II and III score, Day 1 SOFA, circumstances of the incident – location, time of the incident, associated injuries [if any], pre-hospital CA, bystander CPR, first documented rhythm, intubation at the scene, duration of CPR, GCS at scene) were extracted from the database or the digital patient medical record. Assessment and interventions in ED - GCS on ED arrival, vitals at ED arrival, initial CT scan result were also obtained. Details of ICU management (mechanical ventilation, inotropes, Rapid Response Team [RRT] activation, adverse events) and outcome (ICU length of stay, hospital length of stay, ICU and hospital mortality, and destination at discharge) were extracted from the ICU database. They were supplemented, as needed, by information obtained from the digital or paper medical record.

Data Privacy

Personal identifiers were removed soon after data collection and before data collation for analysis. Raw data was maintained in a spreadsheet (MS Excel, 2016) without identifiers in a password-protected file on a secure network drive in the ICU research office. Data copy was utilised for analysis.

Terms & Definitions

A pre-hospital cardiac arrest was defined as cessation of cardiac mechanical activity without any signs of circulation in a setting outside of a hospital and included CA suffered *enroute* to the hospital.

The neurological status of all patients was assessed using the GCS obtained at the scene and at the time of hospital admission (to the ED). The patient's discharge destination was used as a surrogate outcome measure of neurological status.

Missing and Incomplete Data

Data of patients with incomplete or missing records were not included in the analysis.

Statistical Analysis

Data was presented as mean and standard deviation (SD) for normally distributed variables, median and interquartile range (IQR) for non-normally distributed variables, and frequency and percentage for categorical variables. Where data were found to be normally distributed, the Students t-test was applied. To assess the significance of the association of nominal data, the Chi-square or Fisher's exact test was applied to the data. All tests were two-sided and α=0.05 was accepted as the level of significance.

Binary logistic regression analysis was used to assess the strength of association between predictive factors and outcome and the adjusted risk estimates were presented as odds ratios (OR) with 95% confidence intervals (CI). All analyses were carried out using Statistical Package for Social Services (SPSS) ® Version 21.0 (Armonk, NY: IBM Corp).

Ethical considerations

The study proposal was reviewed and approved by the Scientific Advisory Committee and the Human Research Ethics Committee (HREC 2020/ 6356) at Westmead Hospital as a low and negligible-risk project. Consent from participants was not required.

RESULTS

Study Population

Over a period of 6 years (Jan 2014 to Dec 2019), a total of 76 patients presented to the ED with suicidal hanging. Of these, 47 patients (62%) required an ICU admission and were therefore included in our study cohort. Among these patients, 27 patients (57.4%) had out-of-hospital CA. Most of the hanging episodes occurred at home (80.9%) and involved young adults (33 Males, 14 Females) with a mean age of 39.0 years. Most of the patients had no major medical illness; however, 64% had a history of pre-existing neuro-psychiatric comorbidities (Table 1 and Table 2) including previous suicide attempts.

Table 1.

Demographics of Study Population

Characteristics	Number (percent)
Total No of Patients	47 (100%)
Caucasian	43 (91.5%)
Indigenous	3 (6.4%)
Other	1 (2.1%)
Age in years, mean ± (SD)	39.0 (13.6)
Gender	
Male (%)	33 (70.2%)
Female (%)	14 (29.8%)
APACHE II, Median (IQR)	19 (13-25)
APACHE III, Median (IQR)	69 (42-94)
Day 1 SOFA, Median (IQR)	5 (4–7.5)

Circumstances of cardiac arrest

The first documented rhythm among 27 hanging patients with pre-hospital CA were PEA (n=16) and asystole (n=11) and were therefore non-shockable rhythms. All patients received bystander CPR; however, it was not clear if CA or hanging was witnessed, even though the vast majority of incidents (85.2%) occurred at home. Bystanders also initiated CPR in 2 patients in whom sinus rhythm was the first documented rhythm. Pre-hospital placement of a definite airway or a supra-glottic airway device was required in 77.8% of patients with CA. This contrasted with the requirement for intubation in 80% of patients in ED among the subgroup without CA. Nearly 90% of patients with CA at the scene had GCS <7; most had GCS of 3 (Table 2). Brain and cervical spine CT were performed in all patients. Other than hyoid bone fracture in 2 patients, no abnormalities were seen in the bony or vascular structures in the neck (Table 3).

ICU outcome

Thirty patients out of 47 patients survived with a survival rate of 64%. Among the dead, all had a CA at the scene. Among survivors, 28 patients (59.6%) had good neurological recovery at the time of hospital discharge. Only 2 (4%) patients suffered from severe neurological impairment requiring discharge to a nursing home (Table 4).

Table 2

Baseline Parameters Among Hanging Victims Presenting With or Without Cardiac Arrest

Parameters	No Cardiac Arrest (n;%)	Post Cardiac Arrest (n;%)	Total
Total No of Patients; n(%)	20 (100%)	27 (100%)	47
Location of Incident			
Home	15 (75.0%)	23 (85.2%)	38
Outdoor	3 (15.0%)	1 (3.7%)	4
Prison	1 (5.0%)	1 (3.7%)	2
Hospital	1 (5.0%)	2 (7.4%)	3
Time of Incident			
0800 – 1759	9 (45.0%)	13 (48.2%)	22
1800 – 0759	11 (55.0%)	14 (51.8%)	25
Initial Rhythm			
Normal Sinus Rhythm	19 (95.0%)	0 (0.0%)	19
Asystole	0 (0.0%)	11 (40.7%)	11
Pulseless Electrical Activity	0 (0.0%)	16 (59.3%)	16
Other	1 (5.0%)	0 (0.0%)	1
CPR at scene			
Initiated	2 (10.0%)	27 (100.0%)	29
Not Done	18 (90.0%)	0 (0.0%)	18
Endotracheal Intubation			
At the scene (including LMA)	4 (20.0%)	20 (74.1%)	24
In the Ambulance (including LMA)	0 (0.0%)	1 (3.7%)	1
In the Emergency Dept	16 (80.0%)	6 (22.2%)	22
GCS at scene			
GCS 3	4 (20.0%)	21 (77.8%)	25
GCS 4-6	6 (30.0%)	3 (11.1%)	9
GCS 7-10	8 (40.0%)	3 (11.1%)	11
GCS 11-15	2 (10.0%)	0 (0.0%)	2
Pre-existing Medical Illnesses			
Asthma	1 (5.0%)	1 (3.7%)	2
Coronary Artery Disease	0 (0.0%)	1 (3.7%)	1
Quadriplegia	1 (5.0%)	0 (0.0%)	1
Other*	2 (10.0%)	1 (3.7%)	3
Pre-existing Neuro-psychiatric Co-morbidity			
Depression /Bipolar	6 (30.0%)	11 (40.7%)	17
Alcohol/Substance abuse	4 (20.0%)	4 (14.8%)	8
Post-partum psychosis	0 (0.0%)	2 (7.4%)	2
PTSD/Anxiety disorder	1 (5.0%)	1 (3.7%)	2
Developmental disorder	1 (5.0%)	0 (0.0%)	1

*HIV positive, Psoriasis, Haemorrhoids

Table 3

Assessment Findings and Management of Patients Post-Suicide by Hanging

Parameters	No Cardiac Arrest (n;%)	Post Cardiac Arrest (n;%)	Total
Total No (%) of patients	20 (100%)	27 (100%)	47
GCS in ED compared to GCS at scene			
Improved	10 (50.0%)	6 (22.2%)	16
Unchanged	5 (25.0%)	20 (74.1%)	25
Worsened	5 (25.0%)	1 (3.7%)	6
Initial Temperature in ED			
<36.5 C	5 (25.0%)	20 (74.1%)	25
36.5 – 37.5 C	15 (75.0%)	7 (25.9%)	22
>37.5 C	0 (0.00%)	0 (0.00%)	0
Initial Heart Rate in ED			
<60 bpm	0 (0.0%)	1 (3.7%)	1
60 – 100 bpm	13 (65.0%)	7 (25.9%)	20
>100 bpm	7 (26.9%)	19 (73.1%)	26
Systolic Blood Pressure in ED			
>160 mmHg	3 (15.0%)	6 (22.2%)	9
90 – 159 mmHg	15 (75.0%)	18 (66.7%)	33
<89 mmHg	2 (10.0%)	3 (11%)	5
Initial Oxygen Saturation in ED			
>92%	20 (100.0%)	26 (96.3%)	46
<92%	0 (0.00%)	1 (3.7%)	1
Blood Lactate (By VBG or ABG)			
<2.5 mmol/L	6 (30.0%)	3 (11.1%)	9
>2.5 mmol/L	14 (70.0%)	21 (77.8%)	35
Not recorded	0 (0.00%)	3 (11.1%)	3
Myoclonus /Seizure in ED			
Present	1 (5.0%)	10 (37.0%)	11
Absent	19 (95.0%)	17 (63.0%)	36
CT Brain findings			
Normal	18 (90.0%)	16 (59.3%)	34
Diffuse Cerebral Oedema	0 (0.0%)	3 (11.1%)	3
Loss of gray-white differentiation	1 (5.0%)	8 (29.7%)	9
Deep gray matter lesion(s)	1 (5.0%)	0 (0.00%)	1
Associated Injuries			
Hyoid Bone Fracture	2 (10.0%)	0 (0.00%)	2
Parietal Bone Fracture	1 (5.0%)	0 (0.00%)	1
Soft Tissue Injuries	2 (10.0%)	1 (3.7%)	3
Time from ED triage to ICU admission			

< 2 hours	9 (45.0%)	10 (37.0%)	19
2 – 6 hours	11 (55.0%)	15 (55.6%)	26
>6 hours	0 (0.0%)	2 (7.4%)	2
Support provided in ICU			
Mechanical Ventilation	20 (100.0%)	27 (100.0%)	47
Inotropes and Vasopressors	1 (5.0%)	9 (33.3%)	10
Renal Replacement Therapy	0 (0.00%)	0 (0.00%)	0
Hypothermia applied			
Yes	1 (5.0%)	7 (25.9%)	8
No	19 (95.0%)	20 (74.1%)	39
Tracheostomy in ICU			
Yes	0 (0.00%)	3 (11.1%)	3
No	20 (100.0%)	24 (88.9%)	44

Table 4

Outcomes of Patients with Attempted Suicide by Hanging by Pre-Hospital Cardiac Arrest Status

Outcomes	No Cardiac Arrest (n;%)	Post Cardiac Arrest (n;%)	Total
Total No of patients	20 (100%)	27 (100%)	47
Mortality			
ICU mortality, n (%)	0 (0.0%)	15 (56.0 %)	15
Hospital mortality, n (%)	0 (0.0%)	17 (63.0%)	17
Mode of Death			
On active therapy, n (%)	0 (0.0%)	2 (7.4%)	2
Limitation of Support, n (%)	0 (0.0%)	15 (55.6%)	15
Length of stay – patients alive, in days			
ICU, median (IQR)	1.8 (1.5-3.5)	4.4 (8.0-17.3)	-
Hospital, median (IQR)	4.9 (2.6-14.7)	11.2 (16.0-35.3)	-
Discharge destination – patients alive			
Home, n (%) *	17 (85.0%)	7 (25.9%)	24
Mental Health facility, n (%)	2 (10.0%)	2 (7.4%)	4
Nursing Home, n (%)	1 (5.0%)	1 (3.7%)	2
Outcome (Composite)			
Good Outcome, n (%)	19 (95.0%)	9 (33.3%)	28
Poor Outcome, n (%) **	1 (5 %)	18 (66.7%)	19

* Including discharge to the correctional facility or group home.

** Mortality or Discharge to Nursing Home at the end of rehabilitation

Table 5.

Univariate Analysis of Variables associated with a Good Outcome

Variables	Good Outcome	Poor Outcome	Total	P value
No of patients	28	19	47	
Age in years, mean ± SD	37.8 ± 13.7	40.7 ± 13.7		0.48
Gender				
Males	22	11	33	0.13
Females	6	8	14	
APACHE II score, Median (IQR)	13.0 (10-18)	26.0 (22-28)		<0.001*
APACHE III score, Median (IQR)	44.0 (31-65)	93.0 (84-112)		<0.001*
Day 1 SOFA score, Median (IQR)	4.0 (3 – 6)	8.0 (5 – 9)		<0.001*
Timing of incident				
0800 – 1759 h	13	9	22	0.95
1800 – 0759 h	15	10	25	
Cardiac Arrest at scene				
No	19	1	20	<0.001*
Yes	9	18	27	
GCS (ED) compared with GCS (scene)				
Improved	16	0	16	<0.001*
Unchanged or Worse	12	19	31	
Blood Lactate level in ED				
<2.5 mmol/L	9	0	9	<0.001*
≥2.5 mmol/L	18	17	35	
Not recorded	1	2	3	
Myoclonus				
No	27	9	36	<0.001*
Yes	1	10	11	
Initial CT Brain				
Normal	25	9	34	<0.01*
Abnormal	3	10	13	
ED triage to ICU admission time				
<2 hours	7	12	19	<0.01*
≥ 2 hours	21	7	28	
Hypothermia applied				
Yes	1	7	8	<0.01*
No	27	12	39	
Length of stay among survivors				
ICU stay, Median (IQR)	14.5 (11.3-7.8)	7 (4-11)		<0.01*
Hospital stay, Median (IQR)	31 (24-61)	18 (11.5-32)		<0.01*

- Statistically significant

Variables associated with a clinical good outcome

On univariate analysis, hanging patients with pre-hospital CA had a worse neurological outcome than those without pre-hospital CA (P<0.001). In addition, higher severity of illness scores (APACHE-II, APACHE-III or Day 1 SOFA) were all associated with poor outcome. Patients whose GCS remained low or did not improve following initial resuscitation showed poor functional outcome (P<0.001) as well. The presence of myoclonus at admission, CT Brain abnormalities and high blood lactate level (>2.5) were also statistically significant on univariate analysis (Table 5). Two management-related variables were also found to be significant - early admission to ICU (<2 hrs) and application of hypothermia in ICU showed an association with patient outcome.

Regression analysis

Regression analysis was performed using good outcome as the dependent variable. Initial model development used CA and severity of illness scores (APACHE II, APACHE III, Day 1 SOFA) as independent variables. The best predictive model was obtained when APACHE III scores were used in the equation. In the second step, other variables found to be significant in univariate analysis were added sequentially to the model. The best predictive equation was obtained with the addition of CT Brain abnormalities and the presence of myoclonus to the model. If a fifth variable (any) was added, the predictive power of the model did not increase, nor did the statistical significance of variables in the equation change significantly. With a limited number of subjects in the cohort (40-50), the model with four explanatory variables was accepted as the final model. This model accurately classified >90% of the outcomes and was associated with a pseudo-R^2 (Negelkerke) of 86.7%.

Higher APACHE-III score was the only variable inversely associated with a good outcome (adj OR 0.89, 95%CI 080-0.99; p=0.04). After controlling for severity of illness, patients with pre-hospital CA or those with myoclonus at admission also had an inverse association with good outcome, but these were not statistically significant (Table 6).

Table 6.

Regression Analysis of Risk Factors Associated with Good Clinical Outcome

Risk Factor(s)	OR (95% CI)	P Value
APACHE-III score	0.89 (0.80-0.99)	0.04
Cardiac arrest vs. no arrest	0.07 (0.01-1.77)	0.06
GCS in ED improved vs. worse	-	-
Blood Lactate <2.5 vs. ≥ 2.5 mmol	-	-
Myoclonus present vs. absent	0.01 (0.00-1.47)	0.08
CT Brain abnormal vs. normal	0.64 (0.03-15.64)	0.79
ED to ICU <2 h vs. >2 h	-	-
Induced hypothermia applied vs. not applied	-	-

DISCUSSION

The main finding of this study was that all patients with attempted hanging without CA survived, and 95% had a good neurological recovery at hospital discharge. In comparison, those with pre-hospital CA had significantly higher hospital mortality of 62.9% and an overall good neurological outcome in only 33.3% of patients admitted to ICU. Most deaths (88%) occurred in the ICU following limitation of active life-support measures.

A number of variables showed an association with good neurological outcome on univariate analysis. Only three variables, APACHE-III severity of illness score, pre-hospital CA, and presence of myoclonus at ICU admission, showed an inverse association with good neurological outcome. Of these three, only the APACHE-III score was statistically significant in the final predictive model. The number of enrolled patients in this study cohort was small, restricting the number of predictive variables that could be studied in logistic regression analysis. Abnormalities on CT Brain at admission did not show a significant association with outcome.

In our study, we looked at the influence of GCS on outcome as this variable has been found to have a strong association with poor neurological outcome in hanging patients (Boots et al., 2006; Karnath et al., 2005). We looked at GCS in three separate ways, including GCS recorded at the scene, on arrival in ED, but importantly on the difference in GCS between the two recordings. In our study cohort, 96% of patients arrived in ED with GCS <10, and most (72%) had a GCS <7. In two-thirds of patients, GCS remained the same or worsened by the time they arrived in ED, and this variable showed a significant association with poor outcome on univariate analysis, consistent with findings from other studies (Boots et al., 2006; Karnath & Nayoyar, 2005; Kao O&O OHsu 2018). In most instances where this was observed, the GCS on evaluation in ED was 3 or 2T. As a variable, the GCS could not be used in logistic regression analysis.

Notably, greater than 50% of our study subjects had a prior history of suicidal attempts by other means. Nearly two-thirds had a history of a neuropsychiatric disorder. Among these, mortality was high (65%). Although National suicide prevention strategies (Taylor et al., 19997) have markedly reduced the rate of suicides in Australia, unfortunately, the incidence of suicidal hanging has remained high. The proportion of deaths due to suicidal hanging as a percentage of all suicidal deaths in Australia has increased to 54% over three decades ending in 2010-2011 (Harrison & Henley, 2014). Harrison and Henley (2014) reported a steep increase in the incidence of hanging in both males and females since the early 1980s, accounting for 3 in 5 male suicides and 2 in 5 female suicides in 2010-11. Based on the current population of NSW, we estimate the death rate due to suicidal hanging to be approx. 350 – 450 per annum, of which one-third potentially occur in ICU.

Death in suicidal hanging usually occurs as a consequence of cerebral hypoxia or vascular obstruction related to the noose around the neck (Taylor et al., 1997). Most suicidal hanging patients are young with no pre-existing medical conditions. A significant proportion of patients are found dead at the scene by paramedics, and only a few make it to the hospital alive. Among these, patients admitted to the ICU require skillful medical management. Those with pre-hospital CA constitute a subgroup in whom the prognosis is uncertain. Predicting outcomes in patients with hanging who have suffered a CA to decide, if and when to limit therapy in the ICU is notoriously difficult. In 2015, the ERC-ESICM joint statement (2015) suggested that repeated clinical examination over 72 hours forms the basic element of neuro-prognostication among patients with a CA. Additional investigations such as EEG, SSEP, CT Brain, or MRI were recommended as tests that improve the specificity of clinical findings and help clinicians in decision-making regarding the limitation of therapy. Based on findings from our study, we can additionally suggest that a high APACHE-III score at admission to ICU is associated with an increased risk of a poor outcome. Similar to previous studies (Shilpa et al., 2018) our results also show a non-significant association of myoclonus with poor outcome. It is possible to speculate that other factors are also prognostically important, but we could not establish these conclusively in this pilot study. The possibility that these factors influence clinician behavior regarding treatment during resuscitation and the decision to impose limitation of care in ICU and may indirectly influence outcomes was also not studied.

One of the objectives of this pilot study was to obtain patient-specific data from databases to study variables that have a bearing on patient outcome. In particular, we were interested in Utstein style (Jacobs et al., 2004) reporting associated with cardiac arrest related to hanging. Unfortunately, some data points related to the pre-hospital care of patients were unavailable, especially the time lapse between hanging and commencement of CPR, time to transport to a medical

facility, and details related to bystander CPR – all elements that have a bearing on outcome. The ambulance records were available only as a paper record from an earlier period, switching to an electronic format more recently. We plan to do further research on the state-wide pre-hospital electronic database to confirm our findings in a larger cohort of patients.

Another contentious issue that we hope to study further relates to the use of therapeutic hypothermia among patients post-CA following hanging. In our cohort, 17% of patients had hypothermia applied while in ICU. It is uncertain if this influenced the outcome. Targeted temperature management (TTM) in hanging patients has not been studied in detail except in case series (Lee et al., 2012) or case reports (Sadaka et al., 2012). There have been no randomised controlled trials to study the efficacy of TTM in preventing long-term neurological sequelae in hanging patients. This, we believe, should be a topic of further investigation.

The strength of our study was that we studied clinically identifiable predictive factors that were associated with the outcome. However, our study had several limitations. First, we obtained data from our ICU database, which contained prospectively collected but largely unvalidated data. Hence, this study can, at best, be hypothesis-generating. Human error during data collection could impact the findings, and this remains a challenge while utilising patient data from a database. Although prospectively collected by medical staff, lack of standardisation could affect the calculation of APACHE-III score. Second, the study was observational and was conducted at a single centre, so it can only establish association and not causation. Thirdly, the number of patients was low; therefore, results may not be generalizable to ICUs in a different healthcare system or even ICUs with a different case mix within the same healthcare system. We specifically included patients who survived to be admitted to ICU, thereby introducing a survival bias. For patients not requiring ICU admission, results of this study may not be valid. Fourthly, we used discharge destination as a surrogate for neurological outcome at hospital discharge as long-term follow-up was not feasible in this study. Finally, the modelling technique could have used a mixed regression analysis, given that the APACHE-III score is not a numerical scale.

CONCLUSION

Outcomes of hanging patients with pre-hospital CA are poor, even in patients who survive initial resuscitation to be admitted to ICU. A higher APACHE-III score at ICU admission was associated with poor outcome.

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