The abbreviated burn severity index as a predictor of acute respiratory distress syndrome in young individuals with severe flammable starch-based powder burn

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ABSTRACT

Here, we investigated whether the abbreviated burn severity index (ABSI) scoring system predicts acute respiratory distress syndrome (ARDS) in a retrospective analysis of a severe flammable starch-based powder burn population. Demographics, total body surface area (TBSA) burn, the presence of mouth and nose burn, ABSI, inhalation injury, and clinical outcomes for each patient were analysed for association with inpatient ARDS based on the Berlin definition. We treated 53 patients (64% male, 36% female) and observed no fatalities. The median age, TBSA burn, and the ABSI were 22.2 ± 3.6, 42.2 ± 21, and 7.8 ± 2.8, respectively. Inhalation injury was present in 56.6% of the cases, and mouth and nose burn was present in 30.2%. ARDS was prevalent at 30%. The mean abbreviated burn severity index (ABSI) was 10.6 ± 1.5 in the ARDS group and 6.6 ± 2.3 in the non-ARDS ($P < 0.001$) group. The mean TBSA burn percentage for ARDS and the non-ARDS groups were $61.4 \pm 13.9\%$ and $34 \pm 18\%$, respectively ($P < 0.001$). The area under the curve of the receiver operating characteristic curves for an ABSI ≥ 9 was 0.905. Our results show that the ABSI is effective for predicting ARDS in young individuals with severe starch-based powder burn.

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1. Introduction

Severe burn injuries require high-cost medical services for serious health issues associated with morbidity, mortality, and rehabilitation [1]. The severity of a burn is mainly related to its total body surface area (TBSA) and the lesion depth. Severe burn injury is also associated with inhalation injury, which is also a risk factor of mortality [2]. Moreover, acute respiratory distress syndrome (ARDS) in patients with critically ill burns commonly leads to mortality [3]. Pneumonia and inflammation are the major causes of ARDS in patients with burns. ARDS progression depends on the patient age and burn size [4–6]. The correlation between ARDS and inhalation injury varies [4,7,8]. The Berlin criteria for ARDS (Table 1) are a revision of the American-European Consensus Conference (AECC) definition of acute lung injury and ARDS [9]. The Berlin criteria are more accurate for assessing burn severity in patients with ARDS [10,11]. The abbreviated burn severity index (ABSI) (Table 2) was mainly developed for predicting mortality after burn trauma [12]. Burn severity should correlate with ARDS. Precise estimates of the burn population that subsequently develop ARDS would improve the accuracy of clinical decisions, such as interventions designed to improve oxygenation. In patients with severe burns, ARDS is a common complication due to various pulmonary problems such as pneumonia and inhalation injury [13], and extrapulmonary problems such as burns or associated trauma [14]. The development of ARDS in patients with severe burns is associated with a high mortality rate [4,9]. However, currently, there is no assessment for predicting ARDS in patients with burns.

The aim of our study was to determine whether the ABSI could be used to predict ARDS in a severe flammable starch-based powder burn population. We also evaluated the effect of burn-related risk factors such as burn size, the presence of mouth and nose burn, and inhalation injury on the incidence of ARDS.

2. Methods

We retrospectively reviewed our admissions of 53 victims of flammable starch-based powder burn at the Formosa Fun Coast Water Park in June 2015. Demographics, TBSA, burns to the mouth and nose, the ABSI, inhalation injury, and clinical outcomes were analysed for an association with inpatient ARDS based on the Berlin definition. The ABSI is an accurate and valuable assessment that was first proposed in 1982 to predict the outcome of patients with burns and thereby promote or guide treatment policies. The ABSI is still the most commonly used score for the prediction of mortality of patients with burns [12,15]. The ABSI is based on five predictive

Table 2 – The abbreviated burn severity index.

Variable	Patient Characteristic	Score
Sex	Female	1
	Male	0
Age in years	0–20	1
	21–40	2
	41–60	3
	61–80	4
	81–100	5
Inhalation injury		1
Full-thickness burn		1
TBSA burned (%)	1–10	1
	11–20	2
	21–30	3
	31–40	4
	41–50	5
	51–60	6
	61–70	7
	71–80	8
	81–90	9
	91–100	10

Total burn score	Threat to life	Probability of survival
2–3	Very low	>99%
4–5	Moderate	98%
6–7	Moderately severe	80–90%
8–9	Serious	50–70%
10–11	Severe	20–40%
12–13	Maximum	<10%

Table 1 – The Berlin definition of acute respiratory distress syndrome (ARDS).

	Acute respiratory distress syndrome		
Timing	Within 7 days of known clinical insult; new or worsening respiratory symptoms		
Chest imaging[a]	Chest imaging (X-ray or CT scan): bilateral opacities—not fully explained by effusions, lobar/lung collapse, or nodules		
Edema	Respiratory failure not fully explained by cardiac failure or fluid overload; need objective assessment, for example by echocardiography, to exclude hydrostatic edema if no risk factors present		
Oxygenation[b]	Mild ARDS	Moderate ARDS	Severe ARDS
	$200 < PFR \leq 300$	$100 < PFR \leq 200$	$PFR \leq 100$
	PEEP/CPAP $\geq$ 5 cm H_2O[c]	PEEP $\geq$ 5 cm H_2O	PEEP $\geq$ 5 cm H_2O

Abbreviations: CPAP, continuous positive airway pressure; FI_{O_2}, fraction of inspired oxygen; Pa_{O_2}, partial pressure of a arterial oxygen; PEEP, positive end-expiratory pressure; PFR.

[a] Chest radiograph or computed tomography scan.
[b] If altitude is higher than 1000 m, the correction factor should be calculated as $[Pa_{O_2}/FI_{O_2}$ (barometric pressure/760)].
[c] This may be delivered noninvasively in the mild acute respiratory distress syndrome group.