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Initial assessment of mortality rates of burn patients in a tertiary care hospital by total body surface area, depth and facial burns, and its correlation with serial total leucocyte count

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ABSTRACT

Background: The pattern of burns in victims varies with the manner of infliction of burns. Age plays an important role in deciding the mortality and morbidity of burn victims. Other factors that decide the prognosis of burn victims are the total body surface area (TBSA), Depth of burns, and inhalational injury as evidenced by facial burns. Assessment of these epidemiological factors and inhalational injury can be done as a part of the initial evaluation. Such an assessment aid in resuscitation including emergent airway and decision making regarding the need for skin grafts or escharotomy. Serial measurement of total leucocyte count also helps in identifying the onset of infection and progress to septicaemia and increased mortality rates.

Methods: As a part of the initial evaluation, we attempt to study the relation between TBSA, Depth of burns, facial burns, and total WBC count with mortality. A background of septicaemia was also noticed in the majority of patients. **Results:** For analysis, patients were divided into two groups- Survivors and Non-survivors. A fall in total WBC count coincided with the onset of sepsis and mortality. The other three factors also had a direct correlation with mortality rates.

Conclusions: A scoring system constituting all the factors is essential as an initial diagnostic step and it will help in deciding early intubation, escharotomy, and aggressive fluid resuscitation.

Keywords: Burns, Depth of burns, Facial burns, Inhalational injury, Total body surface area

INTRODUCTION

Burns can be suicidal, accidental or homicidal. The pattern of injury varies with each of these. Facial burns are more common in suicidal burns and homicidal burns and rare in accidental burns. The epidemiological pattern of burns includes age, gender, mode of burns, and total body surface area and had been included in many studies.¹

In our clinical experience in a tertiary care hospital, accidental burns are seen in children <2 years., housewives and elderly >65 years. Suicidal burn victims usually have a background psychological illness or a

recent socioeconomic or emotional coefficient. Homicidal burn victims have no age specifications, though the young females form a major number in that group. Socioeconomic status has a profound influence in such a scenario.

The assessment of the severity of burns initially is by the body surface area of involvement, depth of the burns, and inhalational injury. BSA calculation is by Wallace rule of nine or by other methods.

Baux score (sum of age and TBSA) emphasizes the relationship between age and mortality rate. A Baux score of 80 to 90 is associated with a mortality of 12%,

and mortality increases to almost 50% with a Baux score of 100 to $110.^2$

Depth of the burns is calculated as superficial, partialthickness, and full-thickness burns. Another classification is based on the degree of burns.³

Inhalational injury is assessed by the extent of facial burns, singed nasal and facial hair, oropharyngeal ulcerations mucous edema, and spitting out of carbonaceous sputum.^{4,5} The incidence of difficult intubation in victims of facial burn is also more.⁴

For all burn victims admitted to the hospital, a series of blood tests are done. This includes Complete blood count (CBC), LFT, RFT, and blood cultures.¹⁰A serial charting of these parameters is important in providing general care and instituting a treatment regimen.

The Abbreviated Burn Severity Index (ABSI) produced a relatively easy scoring system to identify and triage high-risk patients. This model used age, TBSA, inhalational injury, gender, and the presence of full-thickness burns to generate a score and associated probability of survival⁶.

American Burn Association classified burns by (1) depth of injury, (2) extent of injury, and (3) severity.²

In this study, we had incorporated the above parameters in the rapid assessment of the prognosis of burn victims in a tertiary care hospital with access to a full-fledged burn unit.

METHODS

This is a prospective observational study conducted during the period from January 2007 to December 2007 in the General surgical wards of Medical College Hospital, Thiruvananthapuram. The total number of participants in this study is 50.

This sample size was calculated with the followingconfidence level of 95%, the population of burn patients matching the inclusion and exclusion criteria of 61, and a margin of error of 6%. Institutional research committee clearance and Hospital ethical committee clearance was obtained before initiation of the study.

All burn victims admitted irrespective of the nature of burn injury were included after obtaining consent. Exclusion and Inclusion criteria were charted out as follows. This included victims between 20 % burns and 70 % burns only. A cut-off value of >20 % burns or any percentage with facial burns was set up for deciding admission. Those who suffered >70 % succumbed to death before the minimum required days necessary for the study.

A quick assessment on admission day by a senior faculty and a resident and filling of proforma with sending of lab investigations was sufficient. Data abstraction tool was used. Serial monitoring of the patient for complications and prognosis and charting of lab values was also done on Days 1,3,7,14,21 and 29. They were followed up for tracing total Leucocyte count till discharge or till death.

Participants were broadly divided into two groups for analysis-Survivors and Non-Survivors. The statistical test used for analysis was the 'Independent samples t-test'. Since some of the patients were discharged before the 14th-day observations, the values taken on the 1st, 3rd, and 7th days only were included for analysis for the sake of statistical congruity Each parameter was assessed, and mortality rates calculated. Total BSA involvement, facial involvement, and burn depth severity correspond proportionately to the mortality rates as evidenced by the charts.

RESULTS

Manner of burns

Accidental and Suicidal Burns constituted the majority, forming 48% each. Homicidal burns formed the rest, which is 4%.

Extent of burns

The majority of the patients i.e. 70% had burns involving more than 50% body surface area. Only 30% had burns less than 50% surface area. (Figure 1) Of the 35 patients with >50% surface area involvement, 15 expired, indicating a 43% mortality rate. (Figure 2)



Figure 1: Extent of burns.



Figure 2: Mortality rate and TBSA.

Facial involvement

The majority of the patients: 29 out of 50: had burns involving the face (Figure 3).

Out of those with facial involvement, 16 expired, indicating a 55% mortality whereas it was only 10% in the other group (Figure 4).



Figure 3: Facial involvement.



Figure 4: Mortality and facial involvement.

Depth of burns

31 out of the 50 patients had deep burns while 19 had superficial burns. The deep burns were further divided into partial or full-thickness burns. (Figure 5)

16 of the 31 patients with deep burns expired, indicating a 52% mortality. However, of the19 patients with superficial burns, only 2 expired. This amounted to a mortality of only 11%, indicating that the depth of burns has a direct correlation with mortality (Figure 6).

Total leucocyte count

The mean value of total leucocyte count in the group of surviving patients was 8310 whereas it was 8030 in the group of patients who expired (Figure 7).

The following chart shows a comparison between the two groups about total leucocyte values. It was found that there was no significant difference between the two groups (Figure 8).



Figure 5: Depth of burns.



Figure 6: Mortality rates and depth of burns.







Figure 8: Mortality rate and total leucocyte count.

Days		Levene's test for equality of variances		t-test for equality of means						
		F	Sig.	t	df	Sig. (2- tailed)	Mean Std. diff diff	95% confidence interval of the difference		
								um	Lower	Upper
D1L	Equal variances assumed	0.859	0.359	-0.954	48	0.345	-0.282	0.296	-0.877	0.312
	Equal variances not assumed			-1.05	45.3	0.299	-0.282	0.269	-0.824	0.259
D3L	Equal variances assumed	1.23	0.273	-0.05	48	0.96	-3.19E- 02	0.635	-1.31	1.246
	Equal variances not assumed			-0.046	27.1	0.964	-3.19E- 02	0.696	-1.459	1.395
D7L	Equal variances assumed	9.725	0.003	-0.495	48	0.623	-0.352	0.71	-1.78	1.076
	Equal variances not assumed			-0.418	22.1	0.68	-0.352	0.842	-2.098	1.395

Table 1: Total leucocyte count statistical analysis.

Table 2: Total leucocyte count statistical analysis.

Days	E/S	N	Mean	Std. deviation	Std. error mean
D1 I	0	18	7.233	0.783	0.185
DI_L	1	32	7.516	1.107	0.196
D2 I	0	18	8.706	2.596	0.612
D3_L	1	32	8.737	1.873	0.331
D7 I	0	18	8.489	3.339	0.787
D/_L	1	32	8.841	1.699	0.3

DISCUSSION

Lund-Browder chart is readily available for a quick assessment of TBSA of burn patients.^{7,8}"Wallace rule of nines", which is fairly accurate in adult patients was used in this study. The patient's palm is approximately 1% TBSA and is used for estimating patchy areas. Fluid resuscitation calculation is also dependent on TBSA.

Foncerrada et al suggests that there are three types of inhalational injury in burn victims based on the pathophysiology. Supraglottic is due to thermal injury sustained resulting in oedema within a few hours of the insult. Subglottic is mainly due to an increase in bronchial blood flow, hyperaemia, mucosal oedema, increased mucous secretion, and decreased mucociliary activity. It can be improved by bronchoscopy and suctioning to remove secretions, nebulization with nacetyl cysteine for mucus casts and heparin for fibrin casts along with bronchodilators. The systemic type of inhalational injury has got two arms. Direct- metabolic poisons such as carbon monoxide and cyanide.

Indirect-hypoxia or hypercapnia due to loss of pulmonary function and systemic effects of pro-inflammatory cytokines.

The standard diagnostic method to detect inhalational injury is bronchoscopy of the upper airway of the burn victim. The treatment of inhalation injury should start immediately with the administration of 100% oxygen by face mask or nasal cannula. Maintenance of the airway is critical. If early evidence of upper airway oedema is present, early intubation is required because the upper airway oedema normally increases during 9 to 12 hours. There seems to be no role for prophylactic intubation without good indication².

The need for Skin grafts and escharotomy depends on the assessment of depth of burns. Wasiak and Cleland, 2015 suggested an accurate assessment of burn wound depth by laser doppler imaging by measuring blood flow or its disruption, though clinical assessment by experts is considered sufficient. Several modifiable and non-modifiable factors affect the ability of a burn wound to heal. Of these, the most important is the health status and age of the burn victim-with elderly and debilitated individuals and victims with comorbidities contributing to a delay in wound healing and early-onset sepsis and mortality.¹¹

After burns, there is a systemic activation of leucocytes and their number increases followed by a rapid fall to low normal or subnormal levels possibly due to increased extravasation and was published by a prospective singlecenter study by Johannsen et al. The adherence of WBCs to the endothelium of the lungs resulted in an increased vascular permeability and a decreased PaO2: FiO2 ratio, also contributing to pulmonary failure.

CONCLUSION

TBSA plays an important role in determining the management criteria of burns. Overestimation of burn size may result in unnecessary referral, hospitalization, and misuse of resources. This often happens in patients with burn area <20 % as opposed to larger burn areas as evidenced by the study by Pham et al.¹² Computer-based burn analysis can be useful in the assessment of TBSA rather than estimation by using palm, hand, or Rule of 9s, as these tools do not take into consideration the patient body mass index, race, age, and sex.¹²

Along with the presence of facial burns, stridor, difficulty in breathing, singed nasal hairs, cough, soot in the oral cavity, and fire in an enclosed space should be considered as strong indicators for early intubation.¹³ As such, no consensus/ scoring system exists for intubation in inhalational injury. PaO_2/FiO_2 ratio has been vouched as a more reliable indicator of inhalation injury severity in some studies. The Abbreviated Injury Score also may be useful to assess impaired gas exchange and mortality. Further studies are needed to address this grave risk in burn victims.

The initial rise in WBC count is an acute stress response. This is followed by a fall in the total leucocyte count which may correspond to the onset of septicaemia. Hence a serial plotting of leucocyte count may correlate with the mortality rates, which needs to be assessed by further studies. Neutrophil function, IG (immature granulocyte) count, and plasma cfDNA (cell free DNA) levels as biomarkers for the prediction/early diagnosis of sepsis in burn injury and neutrophil dysfunction as an indicator of early sepsis needs to be evaluated as suggested by Peter Hampson et al.

Limitations for the study were the study has to be conducted in bigger samples for better analysis and a long-term follow-up of survivors beyond the hospitalization days too would have been useful.

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