

Burn Septicaemia in Kuwait: Associated Demographic and Clinical Factors

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Key Words

Burns · Septicaemia · Microbes · Methicillin-resistant
Staphylococcus aureus · Mortality

Abstract

Objective: To study the demographic and clinical factors associated with burn septicaemia patients in Kuwait. **Materials and Methods:** All burn in-patients, who developed septicaemia at the Burns Unit, Al-Babtain Centre for Burns and Plastic Surgery, Kuwait, during a 9-year period (June 1992 to May 2001) were included in the study. The data were recorded for age, sex, nationality, cause and percentage of burns, inhalation injury, resuscitation, number of episodes, septicaemia on post-burn day, the microorganisms responsible in each episode, treatment and outcome for statistical analysis. Using SPSS (PC version 11.0) software, a probability level of $p < 0.05$ was considered significant. **Results:** Of the 2,082 patients treated in the Burns Unit, 166 [8%; 99 (60%) males and 67 (40%) females] with a mean age of 26 years (range 1–70) had septicaemia. Significantly higher ($p < 0.001$) cases were recorded among Kuwaiti children (≤ 14 years) and non-Kuwaitis (25–59 years) than other corresponding age groups. The total body surface area burned ranged from 2 to 95% (mean 42%) and the main cause of burn was flame (77.1%). Inhalation injury was

diagnosed in 39 (23.5%) patients. A total of 253 septicaemic episodes occurred in all patients. The majority, 123 (74.1%), had a single episode and the remaining 43 (25.6%) had multiple (2–10) episodes. One hundred and fifty-five (61.3%) episodes were due to gram-positive organisms, mainly methicillin-resistant *Staphylococcus aureus*, and 32 (12.7%) were polymicrobial. One hundred and twenty-four (74.7%) patients had wound excision and skin grafting procedures and their survival was significantly higher (OR = 4.3; 95% CI: 1.98–9.31) than non-surgically treated patients. Thirty-nine (23.5%) patients died mainly due to multi-organ failure. **Conclusion:** The findings indicate that the patients with extensive flame burns were prone to developing septicaemia due mainly to gram-positive bacteria. The surgical excision of eschar and wound covering improved the outcome of the patients while prophylactic antibiotic treatment had no role in the incidence and outcome of the burn patients.

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Introduction

The burn is a devastating injury, jeopardizing the victim's life mainly at two junctures, firstly the hypovolaemia in acute stage, and secondly burn wound complications. Presently the hypovolaemia-related complications

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are effectively dealt with due to better understanding of burn pathophysiology, and therefore the outcome during the acute phase has improved. The burn wound and its sequelae still remain a challenge for the treating burn team. Extensive tissue devitalization due to burn injury and the moist environment due to outflow of serous exudate favour colonization and proliferation of varieties of organisms [1]. The dysfunction of the immune system due to burn [2–4], a large cutaneous bacterial load, the possibility of gastrointestinal bacterial translocation [5, 6], prolonged hospitalization and invasive diagnostic and therapeutic procedures, all contribute to wound sepsis and septicemia. A burn patient is prone to have septicemia as compared to other forms of trauma, because of the above-mentioned factors [6–13]. The management of burn septicemia remains a challenging task once it occurs, in spite of various infection control measures, advanced techniques for early detection of microorganisms, and the availability of various broad-spectrum antibiotics [8–13]. The outcome of a burn patient depends on the severity of the wound, resuscitation measures, wound coverage, wound sepsis and finally the management of septicemia when it occurs [1, 7, 9, 10].

This study was undertaken to analyse the demographic and clinical factors associated with burn septicemia patients in Kuwait.

Subjects and Methods

Two thousand and eighty-two cases were treated as in-patients at the Burns Unit, Al-Babtain Centre for Burns and Plastic Surgery, Kuwait, during the 9-year period from June 1992 to May 2001. The Centre is the only health facility that caters to burns in Kuwait and comprises 44 beds including 8 beds in the Intensive Care Burn Unit. Kuwaitis constitute about 38% of the total population, which was about 2.2 million in the year 2001. A total of 166 patients, who had septicemia either on single or multiple occasions during their stay in the hospital, were studied.

Total body surface area (TBSA) burn percentage was estimated according to the Lund-Browder chart, and the fluid resuscitation was carried out according to the Parkland formula. The clinical diagnosis of the inhalation injury was confirmed by bronchoscopy and the patients were intubated and ventilated till recovery or otherwise. The nutritional requirement in burn catabolic state was calculated as 2–3 g of protein and 50–60 kcal for each percentage of burn surface from 48 h onward post burn. A mixture containing 1 kcal/ml was given orally to all patients from the 3rd post-burn day and 77 (46%) of the patients were supplemented with parenteral nutrition.

Penicillin was used as prophylaxis in burn patients requiring resuscitation till December 1992. From January 1993 to December 1996 amikacin and piperacillin were used as prophylaxis in $\geq 40\%$ burns in adults and $\geq 25\%$ in children. From January 1997 onward no antibiotic prophylaxis was administered to the patients. The use

Table 1. Demographic characteristics of septicemic patients

Demographic characteristics	Number	Age, years	p value
All patients	166	26.5 ± 1.43 (45 days–70 years)	–
Sex			
Male	99	25.6 ± 1.84	NS
Female	67	27.8 ± 2.28	
Nationality			
Kuwaiti	54	20.9 ± 3.05	0.001
Non-Kuwaiti	112	29.2 ± 1.48	

of antibiotics in burn wound sepsis and septicemia was strictly governed by antibiotic policy which was started in 1992 and revised every 6 months. The microbiological surveillance protocol applicable to all burn patients included swabs from wound(s), nose, throat, and perineum on admission and subsequent wound swabs from burn wound twice a week.

The burn wounds were dressed with Sofratulle in superficial burns and Flamazine (1% silver sulphadiazine) in deep burns. Early excision of 15–20% burn area in one operation and skin grafting with either autografts or auto- and homografts were carried out for third-degree burns and the deep dermal burns of functional areas.

The diagnosis of septicemia was based on the signs of disorientation, hyperpyrexia or hypothermia, circulatory embarrassment, petechial haemorrhages, unhealthy burn wound, early eschar separation, increasing oedema in unburned area, thrombocytopenia and leucocytosis. In clinically diagnosed patients two sets of blood samples at an interval of 1 h were taken from different sites for culture. The patients were treated with empirical antibiotic therapy till the blood culture report was available and the antibiotics were changed if needed.

The data were recorded for age, sex, nationality, cause and percentage of burn, response to resuscitation, inhalation injury, intubation, septicemia on post-burn day, number of septicemic episodes, the organisms responsible in each episode, therapy, and finally the patient's outcome for analysis.

SPSS (PC version 11.0) software was used for the data management and statistical analysis. The mean values were compared using t test and ANOVA with post hoc Bonferroni test for multiple comparisons. Chi square was applied for any association and trend. A probability level of $p < 0.05$ was considered significant.

Results

One hundred and sixty-six (8%) burn patients, who had septicemia amongst 2,082 cases treated, comprised 99 (59.6%) males and 67 (40.4%) females (M:F ratio 3:2) with a mean age of 26 ± 1.43 years (table 1). Kuwaitis and non-Kuwaitis were 54 and 112, respectively. The mean age of Kuwaitis was significantly lower than of non-Kuwaitis ($p < 0.001$). The age and sex distribution showed

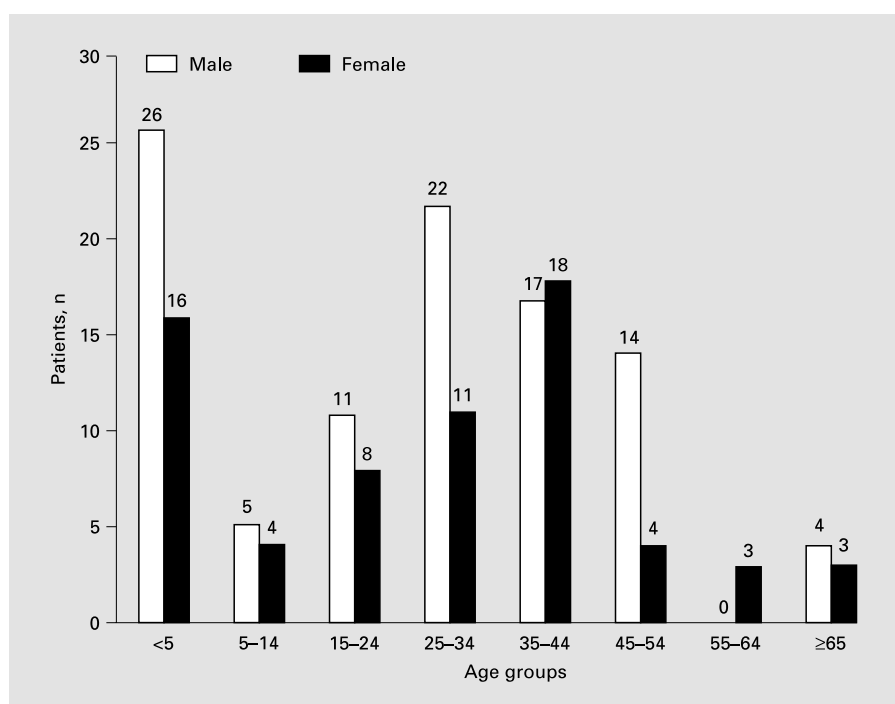


Fig. 1. Septicaemic patients according to age group and gender.

Table 2. Septicaemic patients according to TBSA burn percentage and cause of burn

TBSA percentage of burn	Cause of burn				Total (n = 166)
	scald (n = 32)	flame (n = 128)	electric (n = 3)	others (n = 3)	
≤10	7	5	2	1	15
11-20	13	13	-	1	27
21-30	8	21	-	-	29
31-50	3	32	1	1	37
51-70	1	31	-	-	32
71-90	-	24	-	-	24
>90	-	2	-	-	2
Mean (% burn)	20.2	48.7	14.7	17.3	42.0
Range	3-60	6-95	2-40	2-38	2-95

Flame vs. scald ($p < 0.001$), flame: < 20 vs. > 20 ($p < 0.001$).

male predominance almost in all the age groups (fig. 1). The children up to 5 years of age comprised 25.3% and the age group 25-44 years were 41% of all the cases, significantly higher ($p < 0.001$) cases were recorded among Kuwaiti children (<14 years) and non-Kuwaitis (25-44 years). The mean TBSA burn was 42% ranging from 2 to 95% (table 2). The flame was the predominant cause of burn (77.1%). The percentage of burn was significantly higher in flame than scald burn ($p < 0.001$). However, the

mean age among scald cases was 6.2 years, which was significantly lower ($p < 0.0001$) than other causes.

The Parkland formula was used to satisfactorily resuscitate 142 (85.5%) of the patients, while the remaining 24 (14.5%) had difficult resuscitation either due to the severity of the burn, inhalation injury or both. Thirty-nine (23.5%) patients had inhalation injury along with cutaneous burns, therefore, they were intubated on admission.

Table 3. Post-burn day (PBD) according to the number of septicaemic episodes

PBD	Episodes				Total
	one	two ¹	three ¹	≥ four ¹	
0–3	14	1	–	1	16
4–5	15	1	–	1	17
6–10	39	5	1	4	49
11–15	28	6	2	–	36
16–20	10	2	2	3	17
21–25	5	–	2	1	8
26–30	–	3	1	–	4
31–35	2	2	–	–	4
>35	10	4	–	1	15
Total (%)	123 (74.1)	24 (14.5)	8 (4.8)	11 (6.6)	166
Mean PBD	12.8	17.9	9.0	5.6	13.5
Range	1–105	1–65	5–30	3–19	1–105

PBD (≤20 and >20) vs. number of episodes (≥1): $p < 0.011$.

¹ PBD of first episode only in these patients.

Table 4. Causative microorganisms for the septicaemia

Organisms isolated	Episodes (n = 253)	
	n	%
MRSA	108	42.7
<i>Acinetobacter</i>	33	13.0
MRSE	25	9.9
<i>Pseudomonas</i>	22	8.7
<i>Staphylococcus aureus</i>	11	4.3
Enterococci	11	4.3
<i>Escherichia coli</i>	3	1.2
<i>Klebsiella</i>	4	1.6
<i>Serratia</i>	1	0.4
<i>Proteus</i>	1	0.4
<i>Candida</i>	2	0.8
Mixed	32	12.7

The 166 patients had either single or multiple (2–10) episodes of septicaemia amounting to a total of 253, in 16 patients the first episode occurred as early as 72 h post burn but the maximum number of episodes occurred between 6 and 15 days post burn. The number of post-burn days was significantly higher ($p < 0.011$) among cases with more than one episode, as compared to those with one episode only (table 3). One hundred and fifty-five (61.3%) episodes were due to gram-positive organ-

Table 5. Septicaemic patients who underwent surgery and their outcome

Skin grafting sessions	Patients	% burn mean (range)	Outcome (% survival)
No surgery	42	47.4 (3–95)	54.8
1 session	43	29.6 (2–93)	76.7
2 sessions	34	34.9 (2–85)	85.3
3 sessions	22	45.2 (2–85)	86.4
4 sessions	4	45.3 (23–60)	100
>5 sessions (5–12)	21	63.8 (35–90)	90.5
Total	166	42.0 (2–95)	76.5

Outcome vs. surgery ($p < 0.003$), OR = 4.3 (95% CI: 1.98–9.31).

isms, mainly methicillin-resistant *Staphylococcus aureus* (MRSA), 2 due to *Candida* and 32 (12.7%) were polymicrobial (table 4). Similar organisms as in the blood were also isolated from the burn wounds in most of the cases.

One hundred and twenty-four patients (74.1%) had 345 sessions of skin grafting operation (range 1–12 sessions) and the survival rate was significantly higher ($p < 0.003$) than in non-surgically treated patients (table 5). Of the 124 surgically treated patients, 113 (91.9%) survived while only 23 (55%) of the 42 non-surgically treated patients survived. Of the 21 patients, who had 5–12 surgeries each (total of 140 sessions), 19 survived.

Thirty-nine (23.5%) patients, 14 males and 25 females with a mean age of 31 years, died following septicaemic episodes. Thirty-eight patients sustained flame burn mainly due to cooking gas accident or clothes on fire, and 1 had chemical (ammonia) burn due to leakage of ammonia in petrochemical industries during repair. Twenty-six (67%) of the 39 patients with inhalation injury died following septicaemic episodes. The mortality in relation to post-burn days varied from 3 to 108 days with a mean of 27 days, and 15 patients (9.1%) died within the first 10 days following burn injury. Multiple organ failure was the main cause of death in 71.8% of the septicaemic patients.

Discussion

The outcome of a burn patient depends on the burn severity, resuscitation measures, wound coverage, wound sepsis and finally the management of septicaemia, when it occurs. The high incidence of septicaemia amongst age

groups up to 5 and 21–50 years showed their vulnerability. The high incidence amongst males and non-Kuwaitis as noted in the study can be explained on the basis of similar patterns of burn injuries. The high incidence of septicaemia among non-Kuwaitis could be due to their exposure and involvement in occupational and domestic activities. Flame burn patients were susceptible to develop septicaemia because of their extensive burn surface, deep wounds, and associated inhalation injury as observed in the study. Though, septicaemia can occur even in smaller percentages of burn, most (75%) of them had more than 20% TBSA burned. The combination of extensive burn and inhalation injury were two important risk factors for the occurrence of septicaemia as observed in the study.

Resuscitation by the Parkland formula [14] was found to be satisfactory in the majority of our patients (85.5%), but the presence of an inhalation injury [15] resulted in difficult resuscitation. The intravascular lines and endotracheal tubes, though known as risk factors, could not be incriminated as the source because the intravascular sites indicated no thrombophlebitis and most of the intravascular cannulae and endotracheal tubes were negative on culture. Silver sulphadiazine (1% Flamazine) as topical agent [16] and institution of early nutrition during hypercatabolic state [17] were found to be satisfactory managements and might have helped the better outcome in these patients.

The penicillin prophylaxis was discontinued because beta-haemolytic *Streptococcus* cellulitis was rare in our patients [18] and, as demonstrated by other studies, it is of no benefit and may even be harmful [19, 20]. Piperacillin and amikacin prophylaxis, used during 1993–1996, was stopped in January 1997 on the grounds that specific antibiotics should be given if sepsis or septicaemia was proved clinically or microbiologically. As there was neither increase in the incidence of septicaemia nor mortality amongst septicaemic patients following stoppage of prophylactic antibiotics, we suggest that the use of prophylactic antibiotics has no role in the incidence and outcome of our burn patients.

It is generally considered that occurrence of septicaemia during the 1st week post burn is rare, but a number of our patients had septicaemia during the 1st week (table 3), and this is a significant clinical observation in terms of management of burn patients. However, the majority of septicaemic episodes occurred during the 2nd week post burn, as similarly observed by Wurtz et al. [7]. The continuous clinical observation and timely culture of blood specimens helped in the early detection of septicaemia. Microbiological surveillance was helpful in starting the

empirical antibiotic therapy in clinically diagnosed septicaemia confirming that the wound was the source for the spread of infection to the blood stream, because most of the septicaemic patients' blood isolates were similar to those that colonized/infected the burn wound surface.

The maximum number of septicaemic episodes by MRSA (table 4) might have been due to the fact that burn units are a major source of MRSA, and it has been found that our burn unit also is endemic for this organism [21–23]. The long hospital stay and exposure to numerous antibiotics might have favoured MRSA nosocomial infection in these patients. Numerous methicillin-resistant *Staphylococcus epidermidis* (MRSE) septicaemic episodes suggest that this organism should be considered as a potential pathogen for burn septicaemia, and should not be ignored as a skin contaminant.

Enterococcus has not been reported as a frequent cause of septicaemia in the past but recent studies indicate an increasing incidence of enterococcal bacteraemia in burn patients, and the presence of 4.3% septicaemia due to *Enterococcus* in this study supports the observations made by other investigators [24, 25]. The incidence of gram-negative bacilli, particularly the *Pseudomonas* septicaemic episodes, was much lower than in other studies [13, 26], and the reasons for this decline may be due to the increasing frequency of gram-positive cocci as nosocomial pathogens, and frequent use of antibiotics effective against *Pseudomonas* [27]. *Acinetobacter*, another important gram-negative organism, showed increased septicaemic frequency compared to *Pseudomonas* as a lone pathogen as well as in polymicrobial septicaemia. The various factors, such as burn surface of more than 50% TBSA, prolonged hospital stay (>2 weeks), use of multiple broad-spectrum antibiotics, and delay in wound closure, favour the colonization of burn wounds with the multi-resistant nosocomial pathogens of the unit leading to polymicrobial sepsis. Fungal septicaemia is not uncommon in burn patients [7, 11] and two septicaemic episodes due to this in the study shows its emergence in this unit.

The mortality rate (23.5%) in septicaemic patients was lower than in other studies [11, 28], and this may be attributed to adequate resuscitation, continuous clinical and microbiological surveillance and prompt blood culture, leading to quick detection of aetiology, institution of appropriate antibiotics, care for nutrition, early excision and wound coverage.

Conclusion

The age groups up to 5 and 25–44 years (male non-Kuwaitis) with extensive flame burns were prone to develop septicæmia. The Parkland formula was a satisfactory resuscitation method, but the presence of inhalation injury resulted in difficult resuscitation. Septicæmia occurred within 2 weeks but also as early as 3 days post burn. The burn wound was the likely source of the entry of organ-

isms into the blood stream and gram-positive organisms such as MRSA were the common causative factor. The use of prophylactic antibiotics had no effect on the incidence and mortality in burn septicæmia. The low mortality rate might be attributed to adequate resuscitation, continuous clinical and microbiological surveillance and prompt blood culture leading to quick detection of aetiology, institution of appropriate antibiotics care for nutrition, early excision and wound coverage.

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