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Open versus closed management of burn wounds in a low-income developing country

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ABSTRACT

Over a 38 month period, 264 patients were admitted for management of burns at the Emergency referral hospital in the resource-poor West African country of Sierra Leone. 244 charts and records were available for review, and 196 met the study's inclusion criteria. For the first 27 months, 158 patients were treated with the closed method and for the last 11 months of the study, 86 patients were treated with the open (exposure) method. Overall, the open method had as good or better early outcomes than the closed method, at significantly lower costs, and is the recommended treatment for burns in this particular type of environment.

Burns account for a significant portion of the burden of injuries in developing countries [1]. An important proportion of burn patients are in the pediatric age group. For survivors, lack of or inadequate treatment and rehabilitation can lead to devastating functional sequalae. The scarcity of human and material resources compounds the challenges of burn management, and cost-effectiveness analysis can be a useful tool to inform the resource allocation process [2].

The epidemiology of burns will vary according to geographical, economic and socio-cultural determinants. Poverty, with associated illiteracy and crowded living conditions, is a universal factor [3]. Women were reported at higher risk of severe burns and death in many countries, including India [4], Iran [5], and Iraq [6], whereas in sub-Saharan Africa, the balance might be slightly tilted, if at all, towards the male gender, especially when adjusted for self-inflicted burns [7–13]. The pediatric group usually represents at least 50% of all big series [1,5,9,11,14]. There are also regional variations in the mechanisms of injury: scalding fluids are more common in Africa [7,9,13,15,16], burns by flame are more common in the Indian subcontinent [1,3,4] and the Middle-East [5,14,17]. There is a wide variation in the way data are reported in the literature, particularly in terms of age groups, depth of burn, total body surface area (TBSA) involved, treatment and outcomes, making comparisons between series often difficult. There is however a general consensus that mortality increases with age, TBSA, the interval between injury and treatment, and the presence of inhalation injury [1,18,19].

There are many reported methods of burn wound management. Open (exposure), semi-closed or closed techniques, with or without topical antibiotics, have all been advocated. The open method aims at drying up the burnt area as quickly as possible, leaving tissues to heal under a dry crust. If topical agents are used, it is only on the wet surfaces, without a covering dressing. When large areas are burnt, the patient is encouraged to shower daily, which has a mechanical debridement effect, and promotes mobilization. This method is also well suited for burns of the face or perineum [17,18,20]. The closed method usually entails an initial debridement under anesthesia, application of a topical antibiotic and coverage with some form of sterile dressing. The dressings are changed daily, with or without sedation. Many feel this provides better protection against infection [1,10,14,16]. The semi-open methods combine both other methods to varying degrees, depending on extent, location and severity of burns [12]. Varied topical agents are also widely used, some with

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antibacterial properties such as silvadene, eusol or even phenytoin [19], and some with chemical/mechanical properties such as sugar or papaya [20,21]. In some richer developing countries, such as India, temporary biological coverage can be achieved by skin allograft or even amniotic membrane [22]. Depending on the availability of human and material resources, definitive coverage is left to nature, or can achieved with primary, delayed primary or secondary skin grafting [23].

Sierra Leone is a small West African country of approximately 6 million people, and it is one of the poorest ones, consistently ranking at the lower end of the United Nations' Human Development Index. The share of the total burden of disease due to injuries is increasing every year, mostly because of road traffic injuries, poisonings, burns, and intentional injuries due to violence. Since 2000, the Italian non-governmental organization Emergency has operated a surgical center near the capital, Freetown. Since the national health sector is still struggling to recover from the brutal and devastating civil war that ended in 1999, the Emergency hospital is essentially the only hospital that provides free surgical care in the entire country, and the 100 or so beds are almost always fully occupied. Burns account for less than 5% of admissions but over 10% of bed occupancy-days. Until October 2005, burns were treated with the closed method: almost always an initial debridement of the wound in the operating room (OR) under general anesthesia, generous application of silvadene cream and sterile gauze dressing. Dressings were then changed daily or every other day, either under anesthesia in the OR for the first few days, or in the ward, with or without sedation. Repeated surgical debridements were done as needed. Patients were fed a high-protein, high-caloric diet. Systemic antibiotics were routinely used only for the first 24–48 h, then on a case-per-case basis. This hospital has no burn unit per se, so patients were scattered throughout the general surgical ward population, on regular foam mattress beds, with hoops as needed, and daily linen change. Patients were encouraged to mobilize actively as tolerated and daily physiotherapy was provided to those with peri-aricular and/or hand involvement. When their general condition was good and all wounds clean, patients were discharged with outpatient dressing changes every day or two at the hospital for those living nearby or in a peripheral health care facility for those who did not. They would still have to come back every other week or so for a medical assessment and to re-stock on supplies. Almost no patients underwent skin grafting, because of lack of material and/or human resources. The rapidly increasing number of burn patients created unsustainable demands in OR time, in nursing time and on an often unreliable supply chain. With some initial reluctance, the treatment guidelines were changed to the open (exposure) method: the initial debridement was almost always done in the emergency room, by gentle scrubbing with saline solution and soap using a sterile gauze or sponge, with sedation as needed. The wound was covered with a thin layer of silvadene but no dressing applied. Once on the ward, patients would shower every morning and a new layer of silvadene applied. As the wound slowly dries up, silvadene is applied only on the wet areas, and discontinued after the wound has completely ''crusted up''. Diet, antibiotics, activity, physiotherapy, and discharge criteria were the same as the closed method group. Patients were instructed to continue daily bathing with soap and water, to not pick at the scab and to come back if fever or drainage appeared. This initial reluctance rapidly faded as it appeared the results were at least the same if not better than the closed method, while decreasing significantly the demands on the nursing and OR staff, and also the costs. The purpose of this paper is to try to compare in a retrospective fashion the results of both methods.

1. Materials

Between May 2003 and July 2006, 264 patients were admitted for treatment of burns, according to the following criteria: second and third degree burns of 10% TBSA or more in adults, 5% or more in children, or any second or third degree burns involving the face, the hands or the perineum. Admissions logs from the outpatient department, the intensive care unit and all surgical and medical wards were reviewed to identify all burns admissions. 20 charts were not retrieved, leaving 244 charts available for data collection. Specific data from each chart included gender, age, time between injury and treatment at our facility, previous treatment if any, % TBSA, length of stay (LOS) in days (discharge minus admission days), mechanism of injury, number of surgical procedures (i.e. done in the operating room with general anesthesia), and early outcomes such as deaths, discharges and infection. A patient's wound was considered infected if there was obvious purulent drainage or if he or she was septic for more than 48 h, with or without antibiotics, after ruling out other causes of fevers, including malaria. No post-discharge or follow-up information was available, as outpatient records are left in the patient's possession. Statistical analysis was done using Intercooled Stata 8 software, with significance set at $p < 0.05$.

158 patients were treated with the closed method until October 2005, and 86 patients were treated with the open method until July 2006. During the entire period, resuscitation and fluid management were done using the Parkland formula. As the awareness and reputation of the Emergency hospital grew in the country, both in health-related circles and in the general population, the interval between injury and admission shortened. The 86 patients treated with the open technique were admitted an average of 7.5 h after injury, with extremes of 30 min to 14 days. Of the 158 patients treated with the closed technique, 48 were admitted more than 2 weeks after injury (2–16 weeks) and were excluded from the study. The remaining 110 patients were admitted an average of 9.0 h after injury.

2. Results

Table 1 summarizes the results found for each variable in both groups. There is a marked difference in the male to female ratio, at 1.34 in the closed group and 0.62 in the open group. We have no good explanation for this difference, which we have not seen reported in the literature, and cannot speculate as to how this might bias the outcomes. Both groups showed no difference for mean age (15.9 years for closed, 16.5 years for open), median age (11.5 years for closed, 12 years for open), mean interval between injury and admission (9 h for closed, 7.5 h for open), mean TBSA (21.5% for closed, 19.5% for open), median TBSA (both 15%) or

Table 1 – Comparison of closed and open methods

	Closed method, $n = 110$	Open method, $n = 86$	p-Value
Sex (ratio male/female)	63 males, 47 females (1.34)	33 males, 53 females (0.62)	**<0.001**
Mean age	15.9 years	16.5 years	0.85
Median age	11.5 years	12 years	0.9
Mean interval injury/TX	9.0 h	7.5 h	0.7
Mean TBSA	21.5% (5–75%)	19.5% (5–80%)	0.9
Median TBSA	15%	15%	>0.999
Mean LOS	24.8 days	19.5 days	**0.02**
Deaths (%)	25 (23%)	18 (21%)	0.6
Total surgical procedures (# per patient)	184 (1.67/patient)	77 (0.89/patient)	**<0.005**
Infections (%)	19 (17.3%)	11 (12.8%)	**0.03**

Values in bold are statistically significant.

death rates (23% for closed, 21% for open). Multivariate analysis showed significant differences in mean length of stay (LOS) (24.8 days for closed, 19.5 days for open, $p = 0.02$), average number of surgical procedures per patient (1.67 for closed, 0.89 for open, $p < 0.005$), and infection rates (17.3% for closed, 12.8% for open, $p = 0.03$). Caution is needed in interpreting the infection data in particular, as strict infection criteria were not reliably and consistently applied, and there is a significant possibility of under-reporting in both groups.

Table 2 compares deaths in both groups. The only statistically significant difference is the mean TBSA (44% for closed, 34% for open, $p = 0.01$) but the median TBSA (35% for closed and 30% for open) was not found to be statistically different. The median age was slightly higher in the closed group (24 years versus 20 years), but not significantly. Burns by boiling water were slightly more common in the closed group.

3. Discussion

Even in the best of circumstances, a retrospective study, especially with a historical control group, is fraught with biases. In difficult environments such as very resource-constrained sub-Saharan countries, this is compounded by poor record keeping, recall bias and follow-up that is too short, incomplete or even worse, non-existent. Nevertheless we feel that a very conservative interpretation of this study's data can still yield useful information: in this particular group of patients, the open technique of burn wound management was at least as successful, and probably better than the closed method. The significantly shorter LOS, and the decrease need for surgical procedures in the open method group can be assumed to be beneficial: less exposure to anesthetic compounds, techniques and less than ideally aseptic environments, with less opportunity to acquire nosocomial infections. This may in part explain the apparent difference in infection rates, at least statistically. It was not possible to get accurate costing figures for inputs such as LOS, operating room time, anesthesia products or nursing staff time, which are all higher with the closed method. At equal TBSA, the costs of supplies (dressings, silvadene, antibiotics) was found to be 2–3 times less with the open technique (+/− US$ 30 per patient, versus US$ 75), which is line with other reports (2.3). It might not be unreasonable to assume that when the above variables are factored in, the cost difference between the two methods may be close to an order of magnitude. The open method thus seems more cost-efficient, while achieving at least equal if not better short-term clinical results. We feel this should be the method of choice for such resource-poor settings. It probably could also be the method of choice for conservative management of selected burn patients in rich countries.

Table 2 – Deaths

	Closed method, $n = 25$	Open method, $n = 18$
Mean age (years)	22.3	22.7
Median age (years)	24	20
Mean TBSA (%)	44	34
Median TBSA (%)	35	30
Mean interval injury/TX (h)	4.2	5.6
Mean LOS (days)	8.2	7.4
Mechanism		
Fire	3	4
Water	9	3
Oil	4	4
Chemical (kerosene, petrol, etc.)	9	4[a]
Cause of death		
Sepsis	14	12
Renal failure	7	5
Respiratory failure	2[b]	1

[a] Data reported on 15 of 18 patients.
[b] Data reported on 23 of 25 patients.

Conflict of interest

Neither author has any financial and personal relationships with other people or organizations that could inappropriately influence (bias) this work.

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