BURN INJURY AND CARE IN THE LEBANESE CONFLICT

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The first part of this presentation will deal with epidemiological aspects of combat burn injury in the 1982 Israeli-Lebanese conflict. In the second part we will try to evaluate care and treatment of the burned soldiers. Excluded from this presentation are Lebanese civilians hospitalized in several of the burn units.

MATERIALS AND METHODS

All burned soldiers were interviewed as soon as they recovered from the resuscitation period by medical (non-doctor) personnel. Details of the injury and other relevant points were recorded on a prepared questionnaire for computer workup. At a later stage the author reviewed all medical files of these soldiers to verify the medical details and extract all important facts for this presentation. Eighty-five percent of the soldiers with over 20% BSA burns or those with less extensive but deep burns were personally examined by the author. We are not permitted to disclose the actual numbers of casualties for security reasons and so tables will include details in percentages.

MILITARY ASPECTS OF THE BURNS (EPIDEMIOLOGICAL SURVEY)

The 1982 conflict was characterized by different features than the 1973 war, due to which the burn injuries were of a different nature. Less armour battles took place and more armoured troop carriers took part with the infantry fightings. Safety precautions to prevent burn injuries to tanks included: Less penetrable tanks, especially the Israeli produced Merkava tank; better and easier escape facilities; a new self-extinguishing device ignited by rising temperature and flames; and strict discipline in enforcing the use of fire proof suits and gloves.

Eight and six tenths percent (8.6%) of the injured soldiers of this war suffered burns (57% sustained in tanks) compared with 10.5% in the 1973 war. Thirty-three percent of wounded tank crew members suffered burns and 47% of tank crew members who were burned were burned to death. All of these had fatal or other disabling injuries preventing their escape. Nineth-eight percent of the burned soldiers wore fire-proof suits, either overalls or two-piece suits. None wore the facial Nomex masks which are very cumbersome to wear and fight in. Indeed, 77% of burned tank crew had facial burns, while only 12% had abdominal burns.

As for the upper limbs, 83% of tank crew members interviewed (injured) wore fire-proof gloves (Table 1). Only 25% of tank crew members who wore the fire proof (F.P.) gloves had burns of the hands and these were superficial and on small areas. On the other hand, 25% of those who did not wear gloves sustained burns of their hands. As demonstrated in Figure 1, the characteristic burn of tank crew members who wore the gloves and the F.P. overall

was a facial burn with burns of the distal 2/3 of the lower arm. The arms were burned because the sleeves of the suit pulled up while the soldier was climbing out of the burning tank. Soldiers who wore a two-piece F.P. suit did not sustain these extensive arm burns since no tension was extended on their sleeves while escaping. On the other hand, some of these soldiers had burns of the lower back and buttocks. Other areas affected by burns were the areas where the suit fits tight on the body, such as the thighs, knees, and calves. The knees were especially affected since this area of the suit is first to become oily and worn out.

In comparing the burn injuries of the 1973 and 1982 wars,[1] we found that the percentage of BSA burned was much smaller in the last war (Table 2). In 1973, 29% of burned soldiers had burns of over 40% of the body surface while in 1982 only 18% had severe burns. In 1982 only 6% had 20-39% burns as compared with 21% in 1973. In 1982, 51% had burns of less than 10% BSA, while in 1973 only 21% had minor burns. We conclude that the precautions taken to prevent burns especially in tank crew members have been efficient in minimizing the number of burned soldiers, the extent and severity of the burns and have caused a distinct change in war burn epidemiology.

The characteristic 1982 conflict tank crew burn (note lower arms and face).

BURN CARE

In regard to the treatment of the burned soldier and its results, several points have to be considered:

Most of the burns are combat injuries which are usually not pure burns, but often multitrauma problems with visceral injuries, shrapnel wounds, etc. Luckily, all soldiers were young — 19 to 35 years of age.

1. Ben Hur, N.: The anti-tank missile burn syndrome. HAREFUAH (J Isr Med Soc) 83:543, 1974.

Evacuation depended on battle field conditions. Most soldiers arrived at the field or front hospital within 1 to 3 hours of injury. A few were delayed for up to 10 hours when wounded in enemy territory. From the front hospital or sometimes from another battlefield medical facility they were flown to a burn unit 20 to 35 minutes away by helicopter flight. All received large amounts of Ringers lacate (2000-6000 ml) in the different stations until arriving at the burn unit. Not all fluid amounts were reliably recorded making assessment of resuscitation adequacy according to formulae difficult.

All wounded soldiers received one injection of 5 million units of crystalline penicillin. Forty-six percent of all burn victims were hospitalized in one burn unit (A), the nearest to the front. Of the rest of the burns, the severe ones were divided between two other burn units (C,D), and the minor burns were sent to other burn units or plastic surgery facilities.

All burn units were open units with differen degrees of sterility measures. Families of the victims were notified within hours and immediately taken to be with their kin for the duration of their hospitalization. The country of Israel is small and this was therefore easy. When healing of the burn was completed, physical, psychological, and social rehabilitation therapy was begun in two specialized centers.

Different methods of treatment were applied in the different units. Interestingly enough, the unit (A) receiving 46% of the burned soldiers used one method of burn care while the other units had a completely different view of the state of the art. We will try to compare methods and results of treatment.

RESUSCITATION (Table 3)

In general the formulae used are: the Odstock formula[2] in unit A, the modified Brooke formula (2-3 ml) in C and Jalenko formula in D. all soldiers received large amounts of Ringers Lactate in the first hours during evacuation so that no formula was used in its pure form.

In unit A the patients received large amounts of plasma on arrival and up to 6,000 ml in 36 hours. Oral fluids were also started at once. The weights of the patients were not recorded in that unit so no assessment of edema accumulation could be made. Urine flow in the first 72 hours was as low as 520 ml/24 hours.

In hospital B, there is no burn care facility and patients with burns of up to 35% of the body surface were resuscitated in the respiratory intensive care unit. A Swan-Ganz catheter was inserted and Ringers Lactate was given according to pressure measurements. Large amounts of Ringers Lactate were given and the amounts of urine reached over 8,000 ml/24 hours.

In unit C the aim was to give not more than 2 ml%/Kg. Since patient No. 6 had received 7,000 ml in less than 10 hours while in transit to the unit, this aim could not be met. Plasma was added as early as 12 hours post injury to induce urination. Patient No. 7 arrived at the unit two hours post injury and received 1.6 ml/%Kg in the first 24 hours including 1,000 ml of plasma. All patients survived the resuscitation period without any complications resulting from fluid management. One patient with a 95% burn developed

2. Griffith, R.W : A burn formula in clinical practice. Ann R Coll Surg Engl 63:50, 1981.

ATN and died after 10 days.

METABOLISM

Different measures have been undertaken to keep up with the high metabolic demands of the severe burn.

In unit A, high volumes of plasma were given in the first 36 hours (up to 6,000 ml). Beginning on post day one increasing amounts of milkshakes enriched with up to 3 eggs per 250 ml were administered, up to a total of 10 milkshakes a day given orally or through a nasogastric tube. Total calories of these shakes were 4,280 and the total protein content was 176 grams. Regular feedings were also continued.

Unit B gave no forced feeding, but a regular high-calorie diet according to the patient's will and ability.

Units C and D gave ENSURE (250 Cal. + 8.8 grams of protein) or ENSURE Plus (355 Cal. + 13 grams of protein) adding either an egg or 100 ml of milk to each portion. Eight to 10 of these feedings were given orally or through a nasogastric tube from day 2 post burn. If calorie demand was not reached with such feedings some additional I.V. hyperalimentation was administered using Intralipid and 10-20% glucose. Such intravenous supplementation was rarely necessary. The only patients in need of prolonged I.V. hyperalimentation were the one patient with the 95% burn and another patient requiring prolonged intubation for inhalation injury.

Serum albumin levels were recorded regularly in all units and are listed on Table 4. These levels were not higher in the patients receiving the egg-rich diet and, in fact, were often lower than in patients receiving the other diets. The patients' weights were regularly recorded only in units C and D in which no drop of more than 8% of preinjury weight was recorded anytime. No case of gastric bleeding was recorded.

INHALATION INJURY

Fiberoptic bronchoscoy and Xenon lung scans were not performed. Two patients with deep 3rd degree burns of the face arrived with endotracheal tubes in place in unit A and remained intubated for a prolonged period. One died (with a 95% burn) and the other had a tracheostomy performed after three weeks. Two others, hospitalized in a non-burn unit intensive care unit (B), were intubated on arrival on the grounds of what was described as respiratory distress without any objective evidence to prove its necessity. Both were detubated after 5 days and one had a residual vocal cord paralysis.

BURN WOUND MANAGEMENT

In unit A, no early tangential excision was performed. That unit operated on the principle that the patient should first be stabilized metabolically before undertaking surgery. Thus, excisions at Unit A were started after 10 days. Treatment consisted of local application of silver-sulfadiazine cream mixed with a Milton solution (Hypochorite). Most of the escahr was separated within three weeks. Excisions were started on post day 10 - 12 on small areas (not larger than one hour per procedure) which were then covered with

homografts. When this sloughed off, autografts were applied using "stamp" grafts or sometimes mesh grafts. In unit B, tangential excision was performed at post burn day 5 - 6 of all intermediate depth second and third degree burns.

Units C and D began tangential excision on post burn day 3 - 5 with immediate skin grafting of the excised areas on hands, neck, and other functionally important areas using 1:1.5 mesh graft. New functional areas and areas excised at 3 day intervals thereafter were covered with homografts (meshed 1:1.5). In unit C, homografts were changed every 5 days to prevent their take. Meshed autografts and homografts were soaked with Sulfamylon solution alternating with Povidine-iodine solution. Areas which were not excised were also soaked in the same fashion and hydrotherapy was avoided. The eschar stayed firm and did not macerate as it does after several days of ointment applications. Such treatment permitted easy tangential excision even after two weeks.

In comparing the results of delayed excision and early tangential excision, we will refer to several parameters mentioned by Burke.[3]

Survival: One patient with a 95% burn died within 10 days. One other patient with a 70% burn died several hours after his 13th surgical procedure and termed a "sudden death" in unit A. All other patients survived.

Number of operations necessary to cover all the burns: In Table 5, the number of procedures for some patients is listed demonstrating that in the units in which early tangential excision was performed less procedures were undertaken.

Functional and cosmetic results: After examining a great number of soldiers treated in the different centers, the inevitable conclusion is that the method of choice to best reach functional and anesthetic results is the early tangential excision, as is well documented in the literature. All hands that were not tangentially excised had severe hypertrophic scarring and other deformities such as Buttoniere's, Swan neck deformity, etc. as opposed to the excellent results with early excision and immediate grafting. Also, other areas of the body had more contractures of the joints. The number of procedures needed for contracture releases was also much greater in the non-excised cases.

INFECTION

The patient with the 95% burn had gram negative sepsis and one patient in Unit A with a 75% burn had one blood culture positive for Staph. sureus with clinical signs of septicemia which resolved with antibiotic treatment. One other patient had a culture positive for Acinetobacter which has become a frequent inhabitant of burn wounds in all units.

CONCLUSION

The different methods of treatment of burn patients as presented herewith demonstrate the various ideas for burn care in different centers in the world and in the literature. Resuscitation was deemed adequate in all units. Oral hyperalimentation, though administered in different ways, was rec-

3 Burck, J. Early excision of the burn wound. J Trauma Supp 21:726, 1981

ognized by all as the main factor in saving the lives of these patients. The only aspect in which the opinions differ was the care of the would itself. The conclusion of the author who has examined many of the patients from the different centers is one and clear, tangential excision is and must be applied in every possible case in order to get the best results. This, however, was not the case in all of our treatment centers.

TABLE I

HAND BURNS OF TANK CREW

	% OF ALL TANK CREW		% OF ALL TANK CREW	
	Wore Gloves	No Gloves	Wore Gloves	No Gloves
HAND BURNS	2.5%	25%	9%	75%
NO HAND BURNS	97.5%	75%	91%	25%

TABLE II

BSA BURNED IN TANK CREW

	1 - 9%	10 - 19%	20 - 39%	40 - 60%	60% +
1973	21%	29%	21%	29%	29%
1983	51%	24%	7%	14%	4%

TABLE III

RESUSCITATION OF BURNED SOLDIERS

			24 HOURS			48 HOURS		
UNIT	PT	%BURN	PLASMA	TOTAL	URINE	PLASMA	TOTAL	URINE
A	1	40	3500	7750	2300	1500	7000	2500
	2	48	1750	3500+	570	1750	8500	770
	3	72	4000	9100	—	2000	9200	2100
B	4	30	1000	4500+	4150	1250	9100	8850
	5	35	500	4600+	3200	1500	10700	6150
C	6	75	1000	11500	2400	1750	5900	2500
	7	45	1000	3800	1050	1000	3500	1400

Table III Continues on Page 16.

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HOURS

Unit	PT	%BURN	TOTAL	URINE
A	1	40	5500	2650
	2	48	—	520
	3	72	—	—
B	4	30	7300	4850
	5	35	6200	5500
C	6	75	6000	2300
	7	45	—	—

A — Odstock Formula
B — Swan-Ganz Catheter Controlled (R.L.)
C — Modified Brooke (Pat. 6 - 2.5 ml/%/Kg — Pat. 7 - 1.6 ml/%/Kg)

TABLE IV

SERUM ALBUMIN LEVEL (Gr%) IN BURNED SOLDIERS

UNIT	%BURN	Day 4	Day 6	Day 10	Day 14	Day 18	Day 25	Day 30
A	36%	2.8	2.1	2.8	3.2			
	40%	2.7	2.8	2.8	2.9			
	45%	1.9	1.9	1.8	2.1	2.3	2.2	2.5
	48%	2.0	2.2	1.9	1.9	2.5	2.7	3.2
	67%	2.2	2.9	2.4	2.0	2.1	1.9	1.9
	68%	2.9	2.2	1.9	2.1	2.5		3.5
	70%	2.2	2.3	2.2		1.8	1.9	2.5
B	35%	3.3	2.9	3.2	2.9	3.0		
	35%		3.3	3.0				
C	60%	3.2	2.7	2.6	2.9	2.9	2.8	2.9
	75%	2.1	2.9	3.0		3.4	3.1	
D	75%	3.2		2.5	2.1	2.2		2.8

A — Up to 10 milkshakes and 30 - 40 eggs/day + feeding
B — Oral high calorie diet
C — Oral or nasogastric ENSURE and 8 - 12 eggs/ day + feeding

TABLE V

NUMBER OF OPERATIONS
EXCISION OF EXCHAR AND SKIN GRAFTING

UNIT	%BSA BURNED	OPERATIONS	%BSA BURNED	OPERATIONS
A	28%	2	66%	11
	45%	3	68%	8
	48%	12	70%	13
C	30%	1	75%	7
	60%	4		
D			75%	6