Bioresearch Communications
Volume 04, Issue 01, January 2018
Journal Homepage: www.bioresearchcommunications.com

Original Article

Early Excision Burn Wound With Guidance of Methylene Blue

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ABSTRACT: Burn management is serious problem regarding mortality, morbidity and cost. It is a headache to surgeons to manage wound specially major burn wound. It is also expensive due to prolonged hospital stay and needs lot of medicine, dressing material, use of different expertise etc. So burn is a burden to our society and government. If the major burn patient is recovered earlier, it can reduced the rate of mortality, morbidity and cost that can only achieved by leaving the traditional wound management. So, early excision of burn wound with guidance of methylene blue can achieved early recovery, reduced mortality, morbidity and cost in every aspect.

Citation: Choudhury I. M., Shabnam N., Uddin K.. Early Excision Burn Wound With Guidance of Methylene Blue Biores Comm. 4(1), 449-455.

Article History
Received: 01 August, 2017
Accepted: 11 November, 2017

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INTRODUCTION

Early burn excision and skin grafting is a widely accepted procedure [7,10,11,12,13,14] . About 30 years ago, it was normal practice in the treatment of deep burn to wait until spontaneous removal of all the dead tissue and a granulating surface appeared before skin grafting was performed. Several disadvantages were associated with the approach. The wounds became colonized with microorganism, which give rise to infection or even sepsis. The patient lost a large quantity of water, salt and protein via the granulating wound with an increase metabolic rate and gross weight loss. Burn wounds are rarely of uniform depth in whole extent. Around the periphery there will be a zone of hyperemia bordering the zone of vascular stasis, which in turn, encircles tissue that has been a completely thermally coagulated. The central zone of necrosis is irreversibly damaged but the tissue viability within the zone of stasis around it can recover in appropriate circumstances. The burn wound tends to become deeper after 3-4 day's as tissue viability within the zone of stasis diminish. The thermally coagulated tissue behaves like a cutaneous gangrene. It has no blood supply, and it act as a good culture media for micro-organism, as a result bacterial proliferation occur rapidly. Neither systemic antibiotic nor topical antimicrobial agent can influence the growth of organism within dead tissue.

Demling[2] (1984) found that early excision did not have any unfavorable effect on lung function. Experimental research showed that early burn excision and closure prevented the accentuated response to endotoxin which is seen when the burn is left intact, even if is uninfected (demling 1990)[4]. Echinard et al (1982)[5] concluded that early excision reduce the catabolic response and immune depression.

Previously it was common practice to wait for spontaneous separation of all dead tissue and appearance of a good granulating surface before skin grafting was performed. Several disadvantages were associated with the approach. The wounds became colonized with microorganism, which give rise to infection or even sepsis. The patient lost a large quantity of water, salt and protein via the granulating wound with an increased metabolic rate and gross weight loss.

Excision of small areas of deep burn and their immediate coverage by skin grafting was practical by Wilms (R) in 1901[19]. The result in terms of healing was excellent. Jakson[11] performed systematic 1954. Initially surgery was carried out 6-8 hour's after injury only in those cases with less than 3% TBSA (Total body surface area). Jakson[12] gradually increased the area of excision 10% to 30% of TBSA. Macmillan in 1959[15] performed early burn excision of more than 25% TBSA.

The result in terms of healing was excellent. However, he found it difficult to asses the exact depth of deep burns. Moreover there was excessive bleeding[11,15, 19].

The extent and depth of burns are essential determinates of mortality & morbidity. Following have been defined for the determination of burn depth such as pin prick test, wound biopsy, ultrasound, vital dyes, laser Doppler perfusion monitoring (LDPM), laser Doppler imaging (LDI), magnetic resonance imaging (MRI), and thermal imaging techniques[18].

Pin prick test is very fast and easy to use but most of the time result is not accurate because initially which appears superficial partial thickness later become deep burn due to inadequate treatment & infection.

Histological dermal biopsy has been reported to diagnose dermal burn depth accurately [11,15.] Although histological dermal wound biopsy seems to be the most precise method, the technique is not without its drawback. Result varies with expertise & experience of the pathologist to distinguish live collagen to denatured collagen and living cell from dead cells. In burn wound dynamic process continues for several days, wound biopsy is not practical with regard to early tangential excision within first 5-7 days of burn injury. Also time consuming to get result.

Biopsy is expensive too. B-mode ultrasound scanning was used to assess burn depth by observing the presence of dermal boundaries. However in some controlled studies failed to show burn depth on the basis of clinical evaluation and histological parameters. The use of ultrasound in the determination of burn depth presents some technical difficulties of getting tissue contact. As a result apparent depth is likely to be underestimated by ultrasound.

Excellent results were reported in some study about the use of laser Doppler perfusion monitoring [15] (LDPM) or laser Doppler imaging (LDI) for determination of burn depth. However laser Doppler flometry or thermography, is highly dependent on certain external conditions, anxiety, stress level and the body area burned. Laser Doppler flometry is non-invasive but time consuming & expensive not possible to routine clinical use.

MRI can be used to distinguish partial thickness burns from full thickness burn. Use of MRI not practical to use routine practical [2,5]. Vital dyes such as Indian ink, blue & toluidine blue, Evans blue have been used to distinguish living and dead tissue; however they failed to sharp demarcation between dead and viable tissue.

MATERIAL AND MATHOD

This prospective study was carried out in City Hospital Ltd., Dhaka, Bangladesh between January 1999 to January 2015. Any patient of either sex with deep burn and deep partial thickness burn is included in this study. Patients those who were suffered from respiratory burn, inadequate resuscitation in first 24 hours, elderly patients, patients with serious medical illness like heart disease, chronic renal failure etc and not agreed with this procedure after proper counseling are excluded from the study. Out of 1751 patients, total 1508 patients were treated by early tangential excision under guidance of methylene blue after exclusion. In this procedure, wound was covered initially with auto graft or a skin substitutes after excision which was further replaced by auto graft 3-4 day's later, allowing patient to recover from the trauma of excision. Follow up could be done eight and half years to ten months according to time in hand after treatment.

816 male patients (54.11%) with mean age 33.91 years and 692 female patients (45.89%) with mean age 33.96 under went early tangential excision. All patients were divided into 5 subgroups according to total body surface area (TBSA) burn. In all cases initial excision was done between 3-5 post

burn day after adequate resuscitation and further excisions were done after 4-7 days interval if needed.

All relevant information was recorded methodically and meticulously as far as possible in pre designed data sheet for individual case. Statistical analysis was done by computer using statistical software package SPSS-10.0 for windows 2000.

PROCEDURE:

After adequate resuscitation, when clinical condition and biochemical parameter were stable methylene blue (5% concentrations) was applied over the burnt area to be excised and allow it to dry (fig.1). Burnt area was then dressed with 1%

Figure 1 Application of Methylene Blue on Deep Dermal Burn

silver sulphadiazine. After 24 hours, under general anesthesia, the burn area was cleaned with soap and antiseptic solution like povidion iodine or chlorhexidine. The blue-stained escher tissue (fig2.) were excised slice by slice until the

Figure 2 Excision of blue tissue from Deep Dermal Burn By Humby's knife

unstained tissue was reached (fig.3) using Watson modification of Humby's knife. In all cases adrenaline (1:500000) injected under the subescher plane and in case of limb, tourniquet was applied to reduce bleeding (fig.4)

When excision was done less than 15% TBSA, excised wound was usually covered by autologous split thickness skin graft (STSG)(fig.5). Skin usually meshed 1:3 or 1:6 depending on surface area to be covered in same stage. When 15% or more then 15% body surface area were excised,

Figure 3 After Excision of Blue Tissue from Deep Dermal Burn

Figure 4 After Excision of Blue Tissue from Deep Dermal Burn Using Tourniquet

wound was the covered with skin substitute particularly allograft, foetal membrane , sometimes collagen or even xenograft (Goat skin) were also used in few cases when there were scarcity of other skin substitutes. In some major burn where excision of total burns tissue up to healthy part of deep fascia or even part of muscle was required.

Figure 5 Mesh(4:1) Skin Graft on Wound (7th POD View)

In such case, scalpel or diathermy knife was used. The procedure only used in case of deep burn involving subcutaneous tissue or deeper layer and limit of excision was less than 10% TBSA burn.

RESULTS

This prospective study was carried out in City Hospital Ltd., Dhaka, Bangladesh from January 1999 to January 2015. Out of 1751 admitted patients, 1508 patients were treated by early tangential excision under guidance of methylene blue after exclusion of patient.

Table-I: Age and Sex Variation of Burn Patients

Age of the patients	Male		Female		Total	
	Number	%	Number	%	N	%
00-10 years	160	10.61	80	5.31	240	15.92
11-20 years	96	6.37	40	2.65	136	9.02
21-30 years	164	10.87	152	10.07	316	20.95
31-40 years	192	12.73	124	8.22	316	20.95
41-50 years	88	5.84	120	7.96	208	13.79
51-60 years	72	4.77	64	4.24	136	9.01
>60 years	84	5.57	72	4.77	156	10.34
Total	856	56.76	652	43.24		100

428 male patients (56.67%) with mean age 33.97 years and 326 female patients (43.24%) with mean age 33.36 years under went treatment. In table-I, the highest number of 96 (12.72%) male patients was found in 31-40 years age group where as 76 (10.07%) female patients in 21-30 years age group. The lowest number of 36 (4.77%) male patients was found in 51-60 yrs age group where as 20 (2.65%) female patients were found in 11-20 yrs. age group. But overall maximum patients found 21-30 and 31-40 yrs age group. In table II, shows different cause of burn of which maximum cause of burn was chemical in 98 (29.36%) patients and than petroleum in 82 (26.78%) patients in case of female. But gas and petroleum were the maximum causative agents in both (18.83%) sex where as fat burn was minimum (8.22%) causative agent. The maximum mean age in both sex (male-42.58 years & female 37.37 yrs.)

Table-II: Mean age and Sex distribution of pt. according to causes

Cause	Male			Female			Total	
	N	Mean age	%	N	Mean age	%	N	%
Flame	366	38.92	24.27	258	37.04	17.11	624	41.38
Scald	201	24.33	13.33	151	22.36	10.01	317	21.02
Electrical	167	35.29	11.07	88	29.36	5.84	290	19.23
Chem. Burn	82	48.69	5.44	195	20.40	12.93	277	18.37
Total	816	33.91	54.11	692	33.96	45.89	1508	100

were suffered from electric flash burn and the minimum mean age in both sex (male- 24.33 yrs. & female- 22.36%) were suffered from scald. The outcome of the treatment of the patient is showed in table-III. In table-IIIa, shows that 618 (81.96%) pts were survived and 136 (18.30%) pts. were died

Table-IIIa: Total Outcome of Patient (According to % of Burn)

% Burn	Operating Session	N of pt	Total Operating Session	Survive		Death	
				N	%	N	%
10-15	1	356	356	356	23.61	00	00
16-30	2	428	856	407	26.99	21	1.39
31-45	3	368	1064*	324	21.48	44	2.91
46-60	4	152	492*	96	6.36	56	3.72
>61	>5	204	656*	30	3.97	144	9.54
Total		1508	3424	1236	81.96	272	18.30

out of 754 patients. In case of 10-15% of burn, 1 (one) operating session was needed whereas more than five (>5) operating sessions were needed for >60% TBSA burn; indicates every 15% TBSA burn was needed one operating session. Total 1712 sessions were needed for 754 patients. Maximum survival rate 27.30% was found in 46-60% TBSA burn group and minimum death rate was found in 10-15% TBSA burn group where as maximum death rate (9.54%) and minimum survival rate was found in >60% TBSA burn group. In table III b shows, maximum survival rate was 9.95% in 21-30 age groups with minimum survival rate was 2.65% in >60 yrs age groups in case of male whereas maximum survival rate was 9.02% in 21-30 age groups with minimum survival rate was 1.59% in >60 yrs age groups in case of female. Table-IV, shows mean operating session and mean hospital stay of our study. Mean operating session 1, 2, 2.89, 3.23, 3.21 required respectively 10-15%, 16-30%, 31-45%, 46-60%, >60% TBSA burn; indicates increasing death rate in increased parentage of burn decreasing the operating session. Mean hospital stay was 11.24 days for survived patients but 11.11 days for total patients in case of 10-15% TBSA burn group whereas, 56.26 days for survived patients and 16.54 days for total patients in case more than 60% TBSA burn; increasing death rate in increased percentage of burn decreased hospital stay. Some late complications were found in follow-up during last one to five years, specially those patients were not obedient to follow-up, illiterate or having from low socio-economical society. We found hypertrophic scar in 178 (23-60%) patients, post burn contracture in 94 (12.47%) patients and in keloid in 40 (5.57%) patients. Hypertrophic scar were found maximum (8.49%) in 16-30% of TBSA of burn group and minimum (2.65%) in 46-60% of TBSA of burn

Table-IIIb: Total Outcome of Patient (According to age of Patient)

Age of pt.	Male						Female					
	Total		Survive		Death		Total		Survive		Death	
	N	%	N	%	N%	%	N	%	N	%	N	%
0-10	160	10.61	148	9.81	12	0.80	80	5.30	72	4.77	8	o.53
11-20	96	6.37	86	5.70	10	0.66	40	2.65	32	2.12	8	0.53
21-30	164	10.87	150	9.95	14	0.97	152	10.07	138	9.15	14	0.93
31-40	192	12.73	184	12.20	8	0.53	124	8.22	116	7.69	8	0.53
41-50	88	5.84	60	3.98	28	1.85	120	7.96	91	6.03	29	1.92
51-60	72	4.77	46	3.06	26	1.73	64	4.24	34	2.25	30	1.99
>60	84	5.57	41	2.73	43	2.86	72	4.77	37	2.46	35	2.33
Total	856	56.76	715	47.54	141	9.38	652	43.24	520	34.91	132	8.78

Table-IV: Average Operating Session and Hospital Stay

% Burn	Mean Operating Session	Mean Hospital Stay(Days)	
		Survived Pt	Total
10-15	1	11.24	11.24
16-30	2	15.74	14.86
31-45	2.89	29.36	25.85
46-60	3.23	41.52	26.22
>61	3.21	56.26	16.54

Table-IIIb: Post Operative Complications

% 0f Burn	N. of pt.		Hypertrophic Scar		Post Burn Contracture		Keloid	
	Total	Survived	N	%	N	%	N	%
10-15	356	356	97	6.45	37	2.45	11	0.73
16-30	428	407	129	8.55	24	1.59	16	1.06
31-45	308	324	108	7.16	28	1.86	29	1.92
46-60	252	96	41	2.72	17	1.13	18	1.19
>61	204	52	26	1.72	20	1.33	08	0.53
Total	1508	1235	401	26.59	126	8.36	20	5.43

group. Post burn contractures were found maximum (4.51%) in 31-45% of TBSA of burn group and minimum (0.53%) in 10-15% of TBSA (of burn group. Keloid were found maximum (2.39%) in 31-45% of TBSA of burn group and minimum (0%) in 10-15% of TBSA of burn group.

DISCUSSION

In case deep partial thickness and deep burn recent trend is to early excision and auto split skin graft. Early excision means excision of burn when resuscitation is complete, shock state is over oedema not subsided and the wound not yet colonized by micro organism. It is usually 5-7 days post burn[15]. In cases of larger burn e.g. more than 40% TBSA burn patient need more than one session at the interval of 3-4 days, time required to recover from the surgical trauma.

In addition to other factor graft take up also depend upon the excision of escher up to correct plane of viable tissue. In adequate escher excision leads to skin graft loss, which results in enlargement of the total area of open wounds and inevitable subsequent additional operations. On the other hand excess excision cause unnecessary excision of healthy tissue and considerable blood loss. To determine the exact depth of burn there are many methods like pin prick test, MRI. Laser Doppler perfusion monitoring (LDPM), laser Doppler imaging (LDI) B-Mode ultrasound and skin biopsy & histopathology, but no one is without its drawback & limitation[2].

In clinical practice most of the surgeons during burn excision mostly depend on clinical observation of punctate capillary bleeding in order to determine underlying viable tissue. When adrenaline is injected in subescher plane, particularly while tourniquet is used in the limbs then punctate capillary bleeding is not observed and difficult to find the viable tissue.

In present study, we used methylene blue to determine the correct level of burn depth. Methylene blue was applied 24 hours before the excision. The mechanism underlying this procedure is the metabolism of methylene blue in viable tissue, where it is converted to leuko methylene by enzyme reductase. Leuko methylene is colorless. Celekozb et al[2] also used methylene blue and kayfinant et al. ed Indian ink to predict burn depth. Literally early excision done usually within 7th post burn day. In our center, we extend the time even 16th post burn day, depending upon the larges body surface area (TBSA) burn and development of infection. Streptococcus infection was considered as absolute contraindication of excision & grafting[925,]. Infection with other microorganism with low colony count & with sensitive antibiotic consider as relative contraindication. In this case need to open the dressing early. We found that early tangential excision in patients with 40% or less had significantly better graft take up & recovery than patients with more than 40% TBSA burn similar finding seen by levine et al[1] and engrave et al[8]. In true sense when burn more then 15-20% TBSA then several session of surgical excision essential at the interval of 3-4 days, need to recover from trauma. We mention it as sequential excision time[3].

Application of methylene blue & injection of adrenaline in sub eschar plane reduce the blood loss. Particularly in limbs where tourniquet is used, blood loss in minimum, in trunk for excision about 15% usually 2 units of whole blood is necessary. Whereas without this technique for 15% TBSA burn excision, 8 unit of whole blood, 6 unit of fresh plasma & 6 unit of platelet is required[23]. Blood loss usually more after 7 days, because of increasing blood flow which parallels the inflammation, is present in the viable tissue beneath the eschar[8]. During this time on an average the volume of blood transfused during the first operation is 51.7 ml ± 36.7 ml per 1% of eschar excision and during second operation it is 88.9 ml ± 44.7 ml per 1% of eschar excised[24]. Arzinger-Jonash H, Riedeberger recommended to reserve 500 ml of conserved blood for each 5% of excision surface[22].

Skin take up rate is high in case of burn less than 40% TBSA. But take up is less when burn area is more than 40% TBSA. Similarly take up rate high when excision done within 7th post burn day take up rate is less after 7th post burn day. Similar finding was seen in cebkozj. et al [2]. Hospital stay & surgical session is less in case of burn less than 15% TBSA and gradually increase with increase surface area burn.

Comment:

Early or sequential excision of deep partial thickness & deep burn under guidance of methylene blue reduce loss of blood unnecessary excision of healthy tissue and reduce number of excision, healing excise up to correct level. Increase graft takes up & increase survival & reduces hospital stay.

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