

BURNS TREATED WITH COLLAGEN MEMBRANES

PRELIMINARY REPORT

Dr. Strusi, E. P., Dr Mohadeb, C.

*Centro de Asistencia Médica Integral al Quemado – Humberto I 1670, Buenos Aires

SUMMARY

In order to improve epithelization and to speed up the healing process of patients with burns, several variations were introduced in habitual treatments.

From the experimental results obtained from rats and human beings it is to be noted that the use of collagen membranes helps drying up and drainage of wounds, it contributes to the possibility of keeping the wound exposed even under unfavorable surrounding conditions with less risk of local contamination, and it helps to lessen the hydroelectrolytic loss and the consequently it shortens epithelization period. It should also be noted that the new epithelium was characterized for being more even, smoother and firmer.

These results were evaluated by comparison with traditional or conventional methods.

INTRODUCTION

The historical evolution of the care of exposed surfaces, in the case of burns, has led to the use of various materials: natural, synthetic and mixed, too, in order to use them as a temporary cutaneous cover. (1, 2)

Among the natural materials are: collagen, (3,4,5,6,7,8,9) autologous or heterologous skin, (10, 11, 12) and amniotic membrane from different origins (13, 14); among the synthetic materials are polyethylenes and mixed ones, (16, 17) in products of different types. When applying any of them, the attention was focused on achieving an "ideal" dressing that would allow the best local treatment of burned areas as to: drying and drainage of the wound, shortening local process, speeding up and bettering or improving the quality of the reepithelization, thus lessening the chance of possible complications.

MATERIALS AND METHODS

Membrane: It is obtained from cattle collagen, being the result of direct extraction of connective tissue in young animals under conditions which keep its molecular structure unaltered. The extraction is made at a low temperature and under strict aseptic conditions, as otherwise this process might cause thermal, mechanical or enzymatic (through microorganisms) decay. By means of this technique we can obtain a collagen gel that may be considered a purified skin extraction. After successive clotting and drying baths the skin like membrane is "reformed": in sterile surroundings it maintains the same physical and chemical characteristics of the biological tissue.

Summing it up, the membrane is a reconstituted collagen, of high structural stability; it is obtained from a gel so that its amino-acid components keep the axial periodicity which characterizes native collagen, and its same permeability and insolubility.

GROUPS OF EXPERIMENTATION

a) Animals: We used 20 adult rats, CH bb THOM, divided into 4 groups of 5 animals each, to which burns were inflicted as follows: intermediate or AB, with boiling water (90° C 30") (photo1) and with fire applied directly, deep burns or B (Bunsen burner, 30") (photo2) so that approximately 15 to 22 % of body surface of the rats was exposed (their backs had been shaved previously). All burns were treated with hydrogen peroxide 10 vol. and in Group 1 (with AB type burns) we applied the membrane previously moistened with physiological solution; the same procedure was applied to Group 3 (type B burns). No dressing were applied to rats in Groups 3 and 4 (control groups). We followed the development of the healing process during 30 days, on groups with membrane dressings and on control groups checking on the epithelization process and the animals' body weight.



PHOTO 1. Burns made with boiling water (90° C, 30")
intermediate or AB burns



PHOTO 2: Burn made by direct fire



PHOTO 2 bis: Shows an applied membrane.



PHOTO 3:

23 days evolution. Total epithelization with an almost complete hair growth



PHOTO 4:

8th day evolution. Fire burn with membrane. Epithelization signals can be seen.



PHOTO 4 bis:

23 days evolution. Fire burn. Epithelization with membrane is shown.



PHOTO 5:

8th day evolution. Fire burn without membrane. A deep bed sore with a limited tendency to epithelization can be seen.



PHOTO 6. 18 month old patient, 48 hours after burn. Type AB-A and AB-B burns.
Treatment and application of collagen membrane.



PHOTO 7. Same patient as on Photo 6, day 8 of healing process. Surgical removal of membrane shows an even and smooth epithelium. The membrane's intense coloration is due to previous swabbing with solution of Rifampicine.



PHOTO 8.

Same patient as on pictures 6 and 7, on day 28 of healing process.

(b) Human Beings: 63 patients, ranging in age from 15 months to 82 years old were treated during 23 months (Chart N° 2). Burned areas were classified thus: Type A: superficial ones; Type AB: intermediate burns, and Type B (18), deep burns. Patients were classified in Groups I, II, III, and IV (19, 20) according to the percentage of exposed skin, the depth of the burn, age, and the presence of either previous or overlapped pathologies. This work was carried out differentiating burned areas according to topography (Chart N° 3) and according to the depth of the burns (Chart N° 4). Collagen membrane was used in zones Type A and AB, over a total of 77, whereas on control areas -48- we applied an occlusive dressing (greased gauze) as shown on (Chart N°5) We tried to make a comparison between zones of equal depth and the same topography on the same patients, so as to avoid the

influence of individual factors that might modify results. Wherever possible we compared only zones of equal depth in different patients.

MODE OF ACTION ON BURNED AREAS

On zones A and AB we carried out a careful cleansing with physiological solution and with soapy iodine as well as a thorough phlyctenolysis. In those cases where collagen membranes were applied, the membrane was previously soaked in a solution of Rifocin, it was then adapted to the burn surface avoiding any folds and the whole was dressed accordingly. In those areas with very little mobility the membrane was applied as described before, but no dressing was applied over it. In the control group we used only one sheet of membrane, soaked in a Rifocin solution, with the usual occlusive dressing. Treatment of the burns was made between 48 to 72 hours after, in all cases; it was easier to see the membrane treated areas than the ones treated with greased gauze, due to the characteristic transparency of the collagen membrane. None of the dressings was replaced, unless we suspected local contamination. Before applying the dressing again the wound was swabbed with physiological solution and with a Rifocina solution

MODE OF ACTION IN SKIN DONOR AREAS

73 1/3 thick skin donor areas were treated. We compared 41 donor areas where membrane was used with 32 donor areas where conventional methods were used (Chart N° 6). The skin was taken with a Finocchieto razor or a Paget dermatome, followed by hemostasia by means of a gauze soaked in hydrogen peroxide 10 vol. In all cases, in the group where membranes were used and in the control group, we used the same technique as for areas A and AB, but 72 hours after. The burns were dabbed with a solution of Rifocin and kept without dressings until total epithelization.

OBSERVATIONS

The signs and symptoms used to evaluate comparative results were:

- a) allergic reaction, either local or total
- b) epithelization, measured in days
- c) drying of the burned area or skin donor area
- d) pain, itching, infection (Chart N° 10)
- e) superficial clot (donor area)

No bacteriological or histological studies were included.

RESULTS

a) Animals: In the rats from Groups 1 and 3, where membrane was applied, there was less loss of post-traumatic body weight during the course of this work. This would suggest that in spite of the size of the exposed area, there was less loss of transcutaneous fluid in these groups than in Groups 2 and 4

(Chart N° 1). Locally, on AB surfaces, the membrane stuck until it slowly became unstuck whilst total epithelization was completed with further hair growth: in 15 days in Group 1 and in 25 days in Group 3 (photos 3 and photo 4) ; epithelization thus took longer in rats to which membrane was not applied: 25 days for group 3 and 30 days for group 4 (photos 5 and 6)

b) Human Beings: Allergic reaction, local or general lack of tolerance: None of these reactions was observed in the 3 groups under study (group A, AB and donor areas). Epithelization measured in days (Chart N° 7 and Chart N° 11) Type A burns treated with membrane completed epithelization in 8,71 days whereas in control groups it took 12,3 days (respective percentages). Intermediate or AB burns treated with membrane completed epithelization in 11,4 days whereas control groups did so in an average of 16,1 days. Donor areas treated with membrane completed the process in 9,2 days whereas control did so in an average of 13,7 days

Drying and drainage of burned surface: In zones A and AB: Given the porousness of the membrane we obtained a good adherence and drainage of the wound, and consequently its drying up; in 43 cases out of 67 it was not necessary to change the membrane. In 20 cases the membrane had to be placed anew due to an accumulation of purulent liquid clearly seen through the membrane (Chart N° 8). In donor areas We obtained good adherence and drainage in 30 out of 51 cases treated; the membrane stayed until epithelization was completed and there were no complications. In 2 cases the membrane had to be replaced due to the appearance of hematoma; in 5 cases because it was suspected there was contamination, and in 4 cases because the membrane degenerated in the first 72 hours.

Of the 32 zones treated with conventional methods, 14 showed no complications whatsoever; the dressing had to be changed in 9 cases because of contamination which appeared during the first 96 hours, in 3 cases because of surface clotting and in 6 cases because the dressing became unstuck during the treatment.

Symptoms, pain and itching: Although it is extremely difficult to evaluate these symptoms (because of their very subjective character) especially in children, all the observations coincide in affirming there was less pain and itching in those zones treated with membrane than in zones treated with a greasy dressing (Chart N° 10).

CONCLUSIONS

Collagen is the supportive structure of connective tissue. Chemically, it is a glucoprotein, with a rather unusual aminoacid composition; it does not contain aminosugars (it only has two types of carbohydrate residues, glucose and galactose). It is from this material that the skin like membrane (or dermis like membrane) (used in the treatment of burns in this work) was extracted. In our study we compared development, reepithelization period, pain, itching and other parameters studied on the application of either collagen membrane or greasy dressings. We must stress the fact that the fundamental effectiveness of the collagen membrane as transitory cutaneous cover is that in most of the cases we dealt with it was not necessary to replace it until total epithelization was completed.

This is attributable to the following characteristics:

- a) Adhesiveness: it kept the membrane in situ without a dressing in areas with little mobility
- b) Transparency: it allowed direct observation of the areas concerned in all the zones treated
- c) Permeability: it allowed drainage of liquids exuded and consequently drying of the area, and it also made it possible to dab the surface of the membrane with antiseptics and thus keep the wound in aseptic conditions through dialysis

Thus the collagen membrane acts like a protective barrier against bacterial and/or mycotic contamination. When looking for an ideal biological dressing we must underline the lack of reactions of intolerance either local or general, as well as the marked shortening of the reepithelization period in Type A and AB burns and in donor areas. The hastening of the epithelization process was evaluated in Type A burns: 4 days; type AB burns, 5 days and donor areas an average of 4,5 days. Apparently this is due to the contribution of dermical collagen substrata which makes new fibers align themselves according to their function of support and ferule, like a reticulate mesh and this helps the formation of a granulated tissue and reepithelization in a faster, more even and more orderly way.

Our clinical experiences are not enough to allow us to state that the use of this biological dressing modifies the incidence in the appearance of hypertrophic or cheloneous scars in patients with a tendency towards these or in hyperactive zones, but we do affirm that the use of this temporary cutaneous cover opens excellent perspectives in the future treatment of burns.



PHOTO 9. Electrical burn, type AB-B, after 72 hs. Conventional treatment. Possible need for graft, treatment and application of collagen membrane.



PHOTO 10. Application of membrane, burned area can be seen clearly through it thanks to its transparency.



PHOTO 11. Same patient on day 7 of healing process. Good epithelization can be seen with only one more deeply burned area which improved with the use of collagen membrane and did not require graftng



PHOTO 12. Same patient as on picture 6. Donor area treated with collagen membrane. Picture taken on day 20.



PHOTO 13. 32 year old patient, on day 8. Chronological difference in healing process between membrane treated zone and the one where a conventional treatment was used.



PICTURE Nº 1 - 5 year old patient with type AB and ABB burns.

PHOTO A: 6 hs.after



PICTURE Nº 1

PHOTO B: Application of collagen membrane.



PICTURE N° 1

PHOTO C: Day 10 of process showing epithelization and membrane coming off.



PICTURE N° 2 5 year old child with AB-B burns (thorax and abdomen).

PHOTO A: Hour 0. Treatment and application of membrane.



PICTURE Nº 2

PHOTO B: A) 72 hs. after we can see membrane has adhered well and allows one to see burns through it.



PICTURE Nº 2

PHOTO C: Day 13 of process. Good epithelization. Membranes are dried and are coming off spontaneously.



PICTURE Nº 3 3 year old child with type AB burns by fire.

PHOTO A: First aid, large edema and typical bleeding.

PHOTO B: 72 hs. after. No contamination, edema has diminished and the burn can be clearly seen.



PICTURE Nº 3

PHOTO C: Day 8. Membrane drying and peeling off. Beneath it, epithelization of burn.





PICTURE N° 4 Hand burned by electric shock.

PHOTO A: 24 hs. after, large edema typical of type AB inter-mediate burn.

PHOTO B: A) Day 7 of treatment with with membrane. Deep ABB zone can be seen.



PICTURE N° 4

PHOTO C: Replacement of membrane.

PHOTO D: Shows evolution of healing process. Epithelization completed in 15 days.



PICTURE Nº 5 Burn by fire. Intermediate type AB.

PHOTO A: 24 hs. after with greased dressing.

PHOTO B: Application of collagen membrane.



PICTURE Nº 5: PHOTO C: Day 5 of process.





LÁMINA Nº 6: PHOTOS A and B: Same patient as on picture Nº5 on day 11 of healing process



PICTURE Nº 6: PHOTO C: Day 15 of process with complete epithelization and hair growth

CHART Nº 1: Rat treatment

Group	Nº of rats	Type of burn		Days of epith.		V.P. weight	
		Boiling water	Fire	With membr.	without membr.	t	4º day
1	5	X		15		252	245
2	5	X			25	264	223
3	5		X	25		267	244
4	5		X		30	268	202

CHART N° 2: DISTRIBUTION OF PATIENTS

PATIENTS	N°	%
Children	11	17,46
Women	26	41,27
Men	26	41,27
TOTAL	63	100

CHART N° 3: DISTRIBUTION BY BURNED AREAS

A R E A	N°	%
Head	17	10,5
Face and neck	20	12,4
Hands	18	11,2
Thorax Ant. & back	21	13,05
Abdomen	12	7,45
Lower extremities	32	19,9
Upper extremities	35	21,75
Genital region	6	3,75
TOTALES	161	100

CHART N° 4: DISTRIBUTION OF BURNED AREAS ACCORDING TO DEPTH, QUANTITY AND PERCENTAGE

Type of burns	Superficial A	Intermediate AB	Deep B	TOTAL
N° of Areas	45	70	46	161
% of areas	27,95	43,48	28,57	100

CHART N° 5: NUMBER OF AREAS TREATED

Burned area / Treatment	Type A	%	Type B	%
With membrane	25	55,60	42	60
With greasy gauze	20	44,40	28	40
TOTAL	45	100	70	100

CHART N° 6: DONOR AREAS

	N° of cases	%	Epithelization (days)
With membrane	41	56,16	9,2
With greased dressing	32	43,84	13,7
TOTAL	73	100	

CHART N° 7: PERCENTAGE OF DAYS SAVED IN EPITHELIZATION PROCESS

	DAYS OF EPITHELIZATION		
GROUPS	With Collagen Membrane	With greased dressing	% days saved
1	8,71	12,3	29,18
2	11,4	16,1	29,19
3	9,2	13,7	32,84

**CHART N° 8: DEVELOPMENT OF COLLAGEN MEMBRANE
TREATED AREAS**

Burned areas treated with collagen membrane	Good drainage and drying. NOT REMOVED	Degradation in 72 hs. Replaced once	Removed once because of contamination
67	43	20	4
%	64,18	29,85	5,97

**CHART N° 9: DONOR AREAS TREATED WITH COLLAGEN MEMBRANE AND
GREASED DRESSING**

DONOR AREAS					
Treatment	Cases	Good healing process until epithelization	Removal because of hematoma	Removal because of infection	Removal because of degradation
With collagen membrane	41	30	2	5	4
%		73,17	4,88	12,19	9,75
With greased dressing	32	14	3	9	6
%		43,75	9,38	28,12	18,75

CHART N° 10: DEVELOPMENT OF HEALING PROCESS: pain, itching

BURNS	Cases	%	PAIN		ITCHING	
			Slight or moderate	Intense	Slight or moderate	Intense
Treated with membrane	67	%	56	11	61	6
			83,6	16,4	91	9
Treated with greased dressing	48	%	31	17	35	13
			64,6	35,4	72,9	27,1
DOHOR AREAS						
Treated with membrane	41	%	38	3	39	2
			92,7	7,3	95,1	4,9
Treated with greased dressing	32	%	25	7	22	10
			78	21,9	68,8	31,2

TABLA N° 11: EVOLUCIÓN POR: días de epitelización y complicación evolutiva

	Quemadura superficial TIPO A		Quemadura intermedia TIPO AB		Zonas dadoras (1/3 espesor)	
	GRUPO 1		GRUPO 2		GRUPO 3	
	Con membrana de colágeno	Con apósito graso	Con membrana de colágeno	Con apósito graso	Con membrana de colágeno	Con apósito graso
Epitelización en días	8,71	12,3	11,4	16,1	9,2	13,7
N° de casos	37	20	30	28	41	32
Complicaciones exudado pus	1	4	3	7	5	9
Degradación Remoción	6		12	12	4	
Coágulo superficial					2	3
Desprendimiento falta adhesión				12		6
Sin complicaciones	30	16	15	9	30	14

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