EXPERIMENTAL STUDIES ON THE INFLUENCE OF CONSTANT TEMPERATURE AND HUMIDITY OF THE AIR DURING TREATMENT OF EXTENSIVE AND DEEP SKIN POSTBURN LESIONS

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Extensive burns, especially in children in which the skin resources are greatly limited, pose difficult treatment problems. The universally accepted concept that skin plasty is the most important link in the complex of therapeutical measures, gradually begins to lose its significance, parallel to the increase of the severity of involvement and to the reaching of a certain limit. A number of authors have established 20—30% involvement of the body surface as an uppermost limit for the indications of autografting methods of treatment (Verholetov V. O., 1961; Bürkle de la Camp 1959, Arjev T. Y.). On the basis of personal experience comprising 256 hospitalized children with burns and 153 plastic interventions (both auto- and homografts), we established 40—45% surface of deep burns and 60—65% of the total area involved as a limit for operative treatment indications. Beyond this survival limit it is absolutely impossible to consider autoplastic coverage of the defect, whilst the homografting methods very quickly exhaust their potential. The attempts of some authors to shift these limits by resorting to the so-called prophylactical necrectomies and plastic procedures, have by no means proved as yet their right for existence and have hardly gained popularity. This motivated some authors to become reconciled with the doom of patients with severe involvement of the skin, and to declare the problem of skin burns, all things considered, as a prophylactical one. Fortunately, a scientific substantiation of the above attitude has not been found as yet, and many investigators and clinicists continue their research in this field, particularly as regards functional replacement of the skin. (Elman R. 1944; Nicholas S. Gimbel et al 1966; Polk H. S.; Raghupati N. 1968; Shilman A. G. 1960; Volpe A. S. 1949; Veinstein V. G. 1965; Shankyo V. M. 1966; Kuznetzova A. N. 1966 and others).

In the present work we set out to study, on experimental material, the influence of the microclimate — constant temperature and humidity of the air — during treatment of extensive and deep skin burns, proceeding from the significance, especially for the child organism, of the two basic functions of the skin — thermoregulating and water balance regulation. METHOD: the experiments were conducted on male albino rats, of equal age and approximately equal weight. To create the necessary microclimate around the animal, we made use of ordinary incubators for the growing of immature children (type Inka). The burn injury was caused on the back of the animals by means of alcohol lamp flame. By means of securing con-

stant amount of the alcohol in the cup and equal duration of the burn (2 minutes, without preliminary depilation of the back hairs) the lesions sustained were practically monotype (equal).

The experimental work was conducted on two groups, comprising 132 and 76 rats each (a total of 208 rats), in which the percentage of mortality was determined as well as the term elapsed until lethal outcome, the changes in the blood (hemoglobin, leukocytes, and lymphocytes), the term of demarcation and its nature. The first group of experiments (controls) is made on 132 rats, treated under ordinary conditions outside the incubator. All the manipulations (burn injury, blood obtaining, plaster-cast dressings) were carried out after beforehand ether narcosis of the rat. The first blood sample was obtained from the base of the tail, and all the subsequent — by means of gradual trimming of its end. The blood samples were taken just prior to burn, at 12 and 48 hours, 7 and 12 days and at the end of the observation period (20—26 day). The animals of the second groups (76 rats) were subjected to the same investigations and observations, with the difference, that they were treated under the conditions of the microclimate described above.

The results of our observations are illustrated in Table 1 through 4.

The higher incidence of lethal outcomes in the early postburn hours among the rats treated in incubator is explained by the fact of the heavier

Table 1

Comparative data concerning lethality and term of ensuing death in experimental animals with burns, treated under ordinary and constant microclimate conditions

Animal group	Total No rats	Deaths No	%	Term of ensuing death							
				immed. after burn	%	12 hrs after burn	%	24 hrs after burn	%	4—8 days after burn	%
I. Ordinary conditions	132	82	62.1	14	10.6	10	7.5	38	28.9	20	15.1
II. In incubator	76	60	78.8	12	15.8	12	15.8	31	40.7	5	6.5
Total	208	142	68.2	26	12.4	22	10.6	69	33.2	25	12

course of the shock established in this particular group. Probably, the conditions of the incubator in this respect appear to be unfavourable. Of no less interest is also the fact that the incidence of lethal cases shows a substantial reduction among the rats in the incubator towards the 4—8 day (6.5% against 13.5% for those in the control group).

The following tables 2, 3 and 4 illustrate the changes in the blood of the two experimental groups of animals. (The data are elaborated statistically by means of the variational and alternative analysis with statistical reliability 95%; vz. Med. Statistics, D. Svetliev, D. Paskalev, 1968.)

Table 2

Comparative data concerning hemoglobin changes in experimental animals with burns, treated under ordinary and constant microclimate conditions

Time of investigation	Ordinary conditions	In the incubator
Before burn	81.50±1.58	81.25±2.11
48 hrs after burn	73.50±1.43	73.67±5.39
7 days after burn	71.80±2.10	80.69±1.94
12 days after burn	76.43±2.04	77.83±1.52
20 days after burn	76.24±1.45	79.00±2.99

Table 3

Comparative data concerning leukocyte changes in experimental animals with burns, treated under ordinary and constant microclimate conditions

Time of investigation	Ordinary conditions	In the incubator
Before burn	6944.64±231.71	7400 ±316.37
48 hrs after burn	6929.3 ±200.45	7128.13±223.52
7 days after burn	6505.56±138.71	7175 ±318.94
12 days after burn	6803.81±153.83	6800 ±270.74
20 days after burn	6867.65±179.90	7180 ±278.94

It is evident from Table 2 that the values of hemoglobin are conserved rather constant in the second group (treated in the incubator). The leukocytes in both groups are preserved virtually constant which is an indication for a weaker reaction of the rats against the inflammatory agent. The number of lymphocytes, however, similar to the hemoglobin, obviously maintains rather stable values in the animals treated under conditions of microclimate (Table 4).

Table 4

Comparative data concerning the leukocyte count in various terms after the burn in experimental animals, treated under ordinary and microclimate conditions

Time of investigation	Group I (control)	Group II (in incubator)
Before burn	60.69±2.68	60.07±1.81
48 hrs after burn	59.1 ±1.15	59.44±0.92
7 days after burn	58.5 ±1.02	60.81±1.02
12 days after burn	58.0 ±1.25	60.33±1.12
20 days after burn	60.4 ±0.83	61.4 ±1.92

The results of the investigations on the local changes within the wounds were very demonstrative. In the group of animals treated in the incubator, full demarcation takes place within shorter terms, whilst secondary necrotization of the tissues is insignificant (Table 5).

Table 5

Necrotic tissues' demarcation term

Type of demarcation	Group I (control)	Group II (in incubator)
Partial demarcation	13.6 days	13.4 days
Full demarcation	18 days	16.2 days

In the Clinic, the microclimate method with constant temperature and humidity of the air was regularly applied in newborn children, admitted with various burns, usually sustained in the maternity houses (heating cushions, basins with hot water). Very indicative is our patient cited below: Case report — DKK, 22 hours, case history No 6215/7. 4. 1968, born in Chernookov, district of Tolbuhin. During an attempt for resuscitation, the child was mistakenly dipped in a pail of hot water. At the department it was admitted in heavy shock, with extensive burns, involving almost the entire body surface, except for the face, neck and the anterior surface of the thorax, mainly of II and III degree. There were also regions with III degree burns in both feet, along the posterior aspect as of the leg, and in the fingers of both hands. The heavily reduced diuresis was restored only on the third day, regardless of the energetic rehydratation therapy. Throughout the entire period of time the child was cared for in the incubator, at humidity 95% and temperature 27 degrees, without applying dressings on the body. The temperature, pulse and heart activity were maintained in a satisfactory condition, the child itself was calm, with good turgor and apetite, reacting with crying and movements at each attempt for manipulations around it. Regardless of the severe toxoinfectious period ensuing, the wound surfaces underwent strikingly rapid epithelization, the deep areas inclusive. Plastic procedures or additional physical therapy and orthopaedic measures were unnecessary. The scars resulting were soft and delicate, allowing for full-range movements. The follow-up examination of the young patient one year after the burn trauma shows excellent result, both cosmetic and functional.

Although the studies (experimental and clinical alike) do not justify the making of a definitive conclusion, owing to the limited number of cases, the data obtained give us sufficient reason to assume the method of treating burn patients under conditions of microclimate, with constant temperature and humidity, as a most prospective one, providing for partial functional facilitation of the child's organism, deprived of part of its skin coverage.

REFERENCES

1. Верхолетов, В. О. О практической ценности некоторых методов определения площади ожога, Ожоги. Тр. научн. конф. ВМОЛА Л. 1960, 115.
2. Вольпе, А. С. Экспериментальные исследования по вопросу о действии тепла при раннем ожоговом шоке». Автореф. канд. дисс., 1949.
3. Вайнштейн, В. Г. и соавт. Гомотрансплантация кожи в условиях изоляции от внешней среды (експер.) Прот. секц. пласт Хир. общ. Пир. 19. IV. 65 34-е засед. — *В. хир. им. Гр.,* 1965/8, 153.
4. Данилов, М. Г. Об изменении тканневого дыхания при раннем ожоговом шоке. Л. 1950, 70.
5. Шанько, В. М. Влияние предварительных местных температурных воздействий на течение термического ожога, 98. Ожоговая болезнь. Киев, 1966.
6. Кузнецова, А. Н. и соавт. О причинах кислородного голодания организма при ожоговом шоке, Ожог. болезнь, Киев 1966, 27 стр.
7. Bürkle, de la Camp — Langenbecks. *Arch. f. klin. Chir.,* 1955
8. Elmann, R. Physiologic problems of burns. *J. Missouri,* Med. ass., 1944, 44, 1.
9. Meadl, R. G. Plast. Reconstr. S. 1958; 21:263.
10. Nicholas, S. Gimbel a. Walter Farris. Skin grafting (The influence of surface temperature on the epitelisation Rate of Split Thickness skin Donor Sites, *Arch. Surg.,* Vol. 92, April, 1966, 4, 554—557.
11. Polk, H. S. Jr. Warm moist air for burns. *Lancet,* 1:1152, 25 May, 1968.
12. Raghupati, N. First Aid Treatment of burns: efficacy of water cooling, *Brit. J. Plast. Surg.,* 1968, 21/1, 68—72.
13. Shilman, A. G. Ice water as a primary treatment of burns *J. Am. M. Ass.,* 1960, 173:1916.
14. Topley, E. *J. clin. path.,* 14:295, 1961.

ЭКСПЕРИМЕНТАЛЬНОЕ ИЗУЧЕНИЕ ВЛИЯНИЯ ПОСТОЯННОЙ ТЕМПЕРАТУРЫ И ВЛАЖНОСТИ ВОЗДУХА ПРИ ЛЕЧЕНИИ ОБШИРНЫХ И ГЛУБОКИХ ПОРАЖЕНИЙ КОЖИ, ВЫЗВАННЫХ ОЖОГОМ

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РЕЗЮМЕ

В стремлении расширить предел жизненной совместимости при обширных и тяжелых ожогах, особенно в детском возрасте, когда кожные ресурсы довольно часто оказываются недостаточными, автор предлагает создание микроклимата из постоянной температуры и влажности вокруг пострадавшего, как метод частичного замещения некоторых основных функций обоженной кожи (терморегуляторной и в отношении водного обмена).

Опытом было охвачено 208 крыс, распределенных в две группы — контрольная из 132 крыс и группа крыс и инкубаторная, состоявшая из 76 крыс. Устанавливается, что летальность у крыс, находившихся в условиях микроклимата, несколько ниже, особенно в поздние часы после ожога (4—8 день). Уровень гемоглобина и лимфоцитов сохраняется сравнительно в тех же цифрах в первой группе. Число лейкоцитов и в обеих группах сохраняется почти постоянным, что объясняется известной особенностью реакции у крыс на воспалительные процессы (повышенная резистентность).

Отторжение некротических тканей наступает в сравнительно короткие сроки. Уменьшается частота случаев вторичного омертвения тканей и углубления поражения. В клинике этот метод применялся на новорожденных детях с обширными ожогами. Описывается случай ожога новорожденного, поступившего через 22 часа после несчастного случая и имевшего обширные ожоги, превышавшие 40% веса тела. Лечение прошло успешно.

Метод лечения тяжелых ожогов кожи в условиях микроклимата — постоянная температура плюс необходимый процент влажности — рекомендуется в качестве перспективного метода, который способствует быстрейшему заживанию и выздоровлению, лишенного частичного кожного покрова организма ребенка.