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# Evaluation of parenteral and topical hydrocortisone combined with exposure treatment of severe burns

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# AN EVALUATION OF PARENTERAL AND TOPICAL HYDROCORTISONE COMBINED WITH EXPOSURE TREATMENT OF SEVERE BURNS

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## INTRODUCTION

The treatment of burns has been a problem faced by every generation of medical practitioners. Perhaps no one subject has called forth more research and resulted in a larger number of methods of treatment. Despite the great advances made in the treatment of severe burns with the introduction of electrolyte and fluid replacement, blood transfusions, pressure dressings, skin grafting and antibiotics, we still find this as a major medical problem. There are many deaths and a very prolonged period of recovery for those who do survive, with the latter imposing a tremendous financial burden on these patients. Also the large number of complications which the doctor must meet and the tremendous amount of care these patients must have makes every practitioner look for and investigate better methods of management.

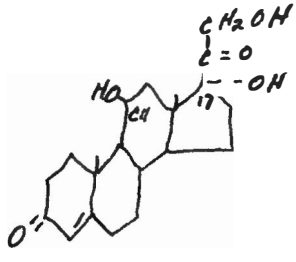
Not long after initial reports by Selye (1) on the, "Stress Reactions in Humans", physicians began to recognize stress as an important facet of many diseases and traumatic conditions. The subject of burns received early attention, as the answer to the high mortality rate in severe burns was still incomplete. Selye and Kendall (2) soon showed the part played by the adrenals in this reaction. Crassweller, Farmer and Franks (3), in 1949, began investigation on the use of adrenal hormones in treating animal burns. There soon followed clinical trial of these drugs

by this group and Evans (4), Whitelaw (5), Adams (6), Baxter (7), Trusler (8), and others. Lastly, in 1954, there appeared detailed evaluations of adrenal function in severe burns by Savitt (9) and Wilson (10). It is with these factors in mind that investigation was started to correlate and evaluate the varied reports in the literature on the value of parenteral ACTH and Hydrocortisone in treating severe burns. Secondly it is sought to determine if topical Hydrocortisone is of value in treating these burns. Finally the results obtained by the Exposure Method of treatment, used in the clinical cases, is presented.

## CHEMISTRY AND PHARMACOLOGY

To start with let us briefly review some of the chemistry and modes of action of these drugs. Since they are relatively new entities we find a great deal of variation in the literature regarding their action and in general only bread statements and theories are given. Lukens (11) in his recent book, "Medical Uses of Cortisone", reviews the literature quite thoroughly, and is the basis for most of the information in this section.

All the drugs used all into the category of steroids and have a similar basic chemical structure, as shown in Fig. 1.




Hydrocortisone

Cortisone is the same only has a double bond Osygen at C-11.

Fig. 1

There are a good number of other hormones secreted by the adrenals, but since these are the main ones used clinically and the important ones as regards activity in this field, discussion will be limited to these. Since ACTH has been used here a brief note on its action is included.

First one must recognized that these drugs are hormones and thus their excretion is controlled by many factors. A generalized scheme proposed by several investigators is given in Fig. 2.

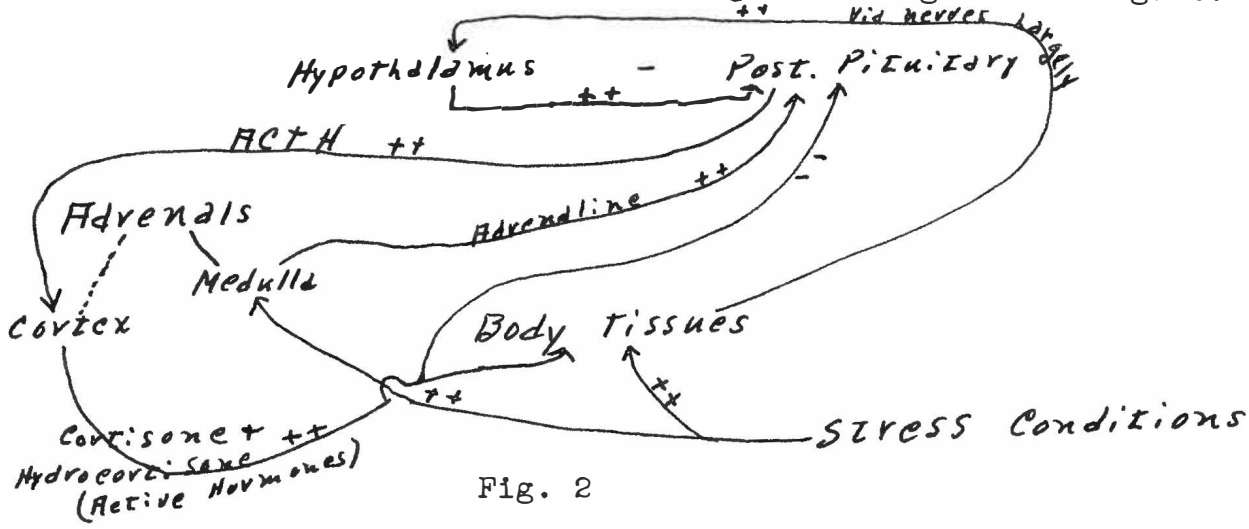



Fig. 2

With this plan one can look at each drug involved in our experiments and see how they fit into the pattern.

The basic original drug in research in this field was Cortisone. In recent years Hydrocortisone has become more prominent and is now regarded as the main drug as regards action in this field, and is secreted in a ratio with Cortisone of about 2/1. For all practical purposes one finds their actions almost identical, only Hydrocortisone is twice as potent a drug. With this in mind one can then list the actions of these two drugs in one group:

1. Stimulates gludoneogenesis and tends to inhibit CHO utilization.
2. Increases uringry nitrogen excretion.

3. Small effect on inorganic ions.
   Na and Cl retention
   Increased K excretion

4. May cause diuresis or antidiuresis depending upon the state of the subject.

5. Inhibits excretion of ACTH by the posterior pituitary.

6. Tends to be anti-inflammatory.

7. May impede wound healing.

8. Tends to inhibit thyroid.

9. Tends to inhibit protein synthesis.

10. Has a catabolic type of action.

11. Tends to cause euphoria.

12. Factor in laying down body pigment.

13. Decreases circulating eosinophils and lymphocytes.

Here then we have some of the main and known properties of Hydrocortisone and Cortisone. One must admit though that in this field by no means are all the actions and results and how they are obtained understood. Indeed in a good many instances quite unexpected and seemingly contradictory results are obtained with these drugs. It is this factor which has led to so much controversy over these drugs, and their empirical usage in so many instances.

ACTH is another drug used in this field. So far its only known action is that of stimulating the adrenal cortex to liberate the hormones produced there. In the literature there are many results attributed to the use of this drug, but one must assume these accrue from the action of the adrenal hormones released. Its exact action in the adrenals is not fully understood, but since it works in catalytic concentrations it is assumed its

action must be by catalysis of compounds produced here allowing the active breakdown products to escape into the blood stream. For the factors controlling its release refer to Fig. 2.

These drugs are not without some toxic effects. Here is where Hydrocortisone has some advantage in that these do not appear as readily when this drug is used. These effects are: 1. Moon facies, acne, hirsuitism and cutaneous striae. 2. Hidden infections. 3. Suspension of menses and change in libido. 4. A Cushings type of fat distribution. 5. Rarely poor wound healing and thromboembolic phenomenon. 6. Convulsions. 7. Mental changes ranging from euphoria to psychosis.

Numerous as these toxic symptoms may sound it is seldom they become a problem except in long term hormonal theraphy. The bright point here is that they all disappear quite rapidly when theraphy is stopped. One word must be added on the effect any medium to long term of theraphy may have on the adrenals when the drug is stopped. Here unless it is stopped gradually and the adrenals allowed to recover their function, one is quite likely to get a certain degree of adrenal exhaustion. Usually this is not serious, but if the body is put under stress during this period the results and reaction of the body can be way out of proportion in seriousness to the stress imposed.

Finally there are a few contraindications to the use of these drugs which must be noted: 1. Any patient with a peptic ulcer. 2. Tuberculosis. 3. Hypertension when renal damage is present. 4. Frank or latent diabetes. 5. Patients with evidance of mental disorders. 6. Chronic cardiacs where sodium retention may be serious. 7. Elderly patients where osteoporosis may occur.

PARENTERAL USAGE OF CORTISONE AND ACTH

Cortisone and ACTH have only been used in the treatment of severe burns in the past five years. In that time however there has been enough work done to allow one to draw some pretty concise conclusions on its actual value. Since these have been used with greatly varying indications and in various periods of the treatment of burns, one must first clearly divide the phases of burn theraphy. McLaughlin & Neis (12) do this in their article and this division will be used herein: 1. Shock phase (0-36 hrs). 2. Tosic phase (36 hrs. up to 7 dys.). 3. Recovery phase (End of toxic phase tell fully recovered).

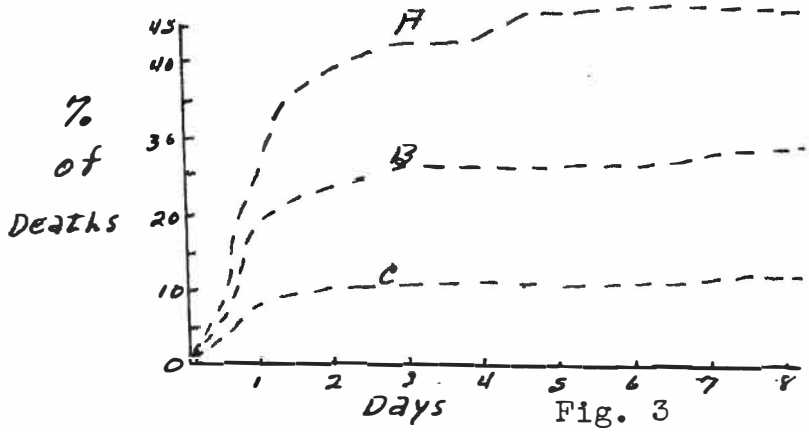
The first experimental work utilizing this approach was that of Crassweller, etc. (3) in 1949. They became interested in this when they noted the similarity of the effects of ACTH and Cortisone and what occurred in burns as shown in Chart I.

| Effect | ACTH | Cortisone | Burns |
|---|---|---|---|
| Nitrogen Balance | Negative | Negative | Negative |
| 17-Ketosteroid exc. | Increased | Decreased | Decreased |
| CHO Metabolism | Hyperglycaemic | Hyperglycaemic | Hyperglycaemic |
| Na Balance | Retention followed by exc. | Retention followed by exc. | Blood Na drops slightly |
| Cl Balance | Same as Na | Same as Na | Same as Na |
| K Balance | Negative | Negative | Variable |
| Eosinophils | Reduced | Reduced | Reduced |
| Ascorbic Acid in Adrenal Gland | Reduced in Cortex | Reduced in Cortex | Reduced in Cortex |
| Adrenal gland Changes | Hypertrophy of cortex with depletion of lipoids | Atrophy of cortex with depression of function | Hypertrophy of cortex with depletion of lipoids |

Chart I

They felt this similarity might represent a deficit of this substance, especially in the toxic phase where many deaths were

still occurring despite seemingly good treatment. They burned white mice and gave one group Cortisone, electrolytes and plasma, a second group everything but Cortisone and a third group no treatment. They got the results shown in Fig. 3. They considered these quite significant and that a clinical trial of the drug was warranted.




A. 41 Untreated Control mice

B. 69 mice just given I.V. Fluids and Plasma

C. 69 mice given I.V Fluids, Plasma and Cortisone.

Fig. 3

The next research work was done by Raker, etc. (13), in 1951. They found that the fluid lost in burn patients was due to increased capillary permeability and they by a series of experiments sought to see if ACTH would effect this. They used dogs and cannulated the leg lymphatics and then burned the legs. To one group they gave ACTh and to another did not. They found no difference in the per cent of protein in the lymphatic fluid or in the volume of this between the treated and untreated. They also measured the protein in fluid from blisters caused by burns in patients given ACTH and those not Given the drug. They failed to find any significant difference. They concluded ACTH did not decrease fluid loss in burns. They did mention though that the adrenals are hyperactive after burns and perhaps the ACTH did not increase the output of hormones from a maximally functioning gland and that Cortisone may have some value to supplement this.

The third project was that of Reichman, etc. (14). His group burned a large series of Albino rats and had different groups treated with ACTH, Cortisone, DCA and controls. They found no increase survivals with ACTH. There was some increase with Cortisone and DCA. When these latter were combined with adequate shock theraphy a significant increase in survival rate over just shock theraphy alone was noted.

With the impetus of these research project findings and the swing of the pendulum, as regards Cortisone, to try it in any stress situation; it was only natural a goodly number of investigators should try using these drugs clinically. From 1951 tell the present numerous articles have appeared with reports on the use of these and the benefits and difficulties encountered in their usage. These are briefly summarized in Chart II on page 9.

A few brief comments on these results can help in correlating them and then a few deductions can be made. Throughout these series of cases there was considerable variation in when and the amount of the drug used. In most series it was not used in the initial shock phase, for early reports found little benefit in its use here and treatment here revolves around the use of electrolytes, blood, etc. Some authors thaught it might've aided shock by reducing fluid loss, but this has since been pretty well disproved. It did, however, when used appear to reduce the pain and need for narcotics. An almost unanimous finding was the effect of this drug on pyrexia. Here it quickly brought this down unless one had a frank sepsis. Concomitant with the fever in most cases one was dealing with poor appetite and emotional instability. These drugs also had a favorable effect on this.

| EFFECT | Crass-weller (21) | White-law (5) | Evans (4) | Adams (6) | Baxter (7) | Wright (16) | Trusler (8) | Eisen-hardt (17) | Ger-hardt (18) | Tru-man (19) | Pierce (20) | Raker (13) | Savitt (9) | DeKruif (15) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature | A | A | A | A | B | C | B | A | A | A | B | A | B | A |
| Appetite and Nutrition | A | A | B | A | A | B | B | A | A | B | A | A | B | A |
| Fluid Requirements | C | A | B | A | B | C | B | A | A | B | B | B | B | C |
| Emotional Status | A | A | B | A | A | A | B | D | A | B | A | B | B | A |
| Pain and Need For Narcotics | B | A | A | B | B | B | B | A | B | B | B | B | B | C |
| Nitrogen Balance | A | A | C | A | B | B | A | A | A | B | A | A | A | A |
| Shock | C | A | B | B | A | A | C | C | C | B | C | B | B | C |
| Granulation Tissue Formation | B | A | A | C | A | B | B | A | A | A | A | C | B | A |
| Epithelization | C | A | B | C | A | B | B | C | C | A | A | C | B | A |
| Graft Takes | A | B | A | C | B | B | A | B | C | B | B | A | B | C |
| Infection | C | C | B | B | B | D | B | D | B | B | C | C | B | C |
| Eosinophils Initial | F | B | F | B | B | F | F | B | B | B | B | B | F | B |
| Eosinophils After R | F | B | F | B | B | G | F | B | B | B | B | B | G | B |

A: Drug Helped as regards this factor
B: Author did not record any effect on this factor
C: Drug had no effect on this factor
D: Drug was detrimental as regards this factor
F: Eosinophil level fell
G: Eosinophil level fell then rose in 3 to 8 days

Chart II

These were also often big factors in the recovery phase and here it helped the appetite and by doing so brought the nitrogen balance in the body into better equilibrium even if a slight increase in urinary nitrogen loss was found.

Of greatest importance would be any effect noted on granulation tissue, re-epithelization and the take of grafts. It would appear that Cortisone may aid some in keeping granulation tissue to a minimum. It does not appear to effect epithelization to any great extent in the dosages used. However, some authors find they can increase the rate of graft takes by useing this drug prior to grafting in cases where grafting has been quite prolonged. It also appears that with antibiotics, which were accepted as part of the treatment, Cortisone does not increase or mask the rate of infection in the dosages used.

Finally one has the factor of the eosinophil level and the excretion of 17-ketosteroids as reflecting adrenal function to evaluate in these cases. Savitt (9) and Wilson (10) have made very good separate studies of these factors in severe burns. They found that in a certain number of cases adrenal deficiency, as reflected by a low and then suddenly rising eosinophil count, does occur. In these cases they consider it essential to give Cortisone to keep the patient going in the face of adrenal exhaustion.

## RESEARCH PROJECT

With the foregoing facts in mind as regard actions and effects of Cortisone and Hydrocortisone, and a few unpublished favorable reports on the use of topical Hydrocortisone, experi-

ments were set up to evaluate the effects of this drug on burns. These took two different lines, namely: 1. Animal experiments. 2. Evaluation in a limited number of clinical trials combined with Exposure treatment of the burns.

METHODS:

The first part of this project consisted of laboratory experimental work involving the use of white rats. A reproduciable standard burn was achieved by useing a temperature controlled iron and applying this to shaved areas on each side of the back of the rats. This gave us two very similar burns on the same rat. These burns were triangular in shape and approximately 2 cm. on each side. These were all deep 2nd or 3rd degree burns as shown by microscopic sections. Twenty-seven rats were then burned giving us 54 similar burns. To the right side a Hydrocortisone or Hydrocortisone and Neomycin ointmint was applied and on the left side the ointmint base was applied. These were applied twice daily thereafter for 21 days.. There was no other treatment to the burns locally. Systematically the rats were allowed to drink water ad lib and to eat their regular bube feed. No antibiotics were given. The burns were studied grossly and evaluated by three independent observers at 14 and 21 days. Photographs of typical burns, with each method of treatment, were taken initially, at 14 and at 21 days. At the end of 14 days five of the burns were biopsied and H & E stained slides were made from this material and studied microscopically. At 21 days all the burns were biopsied and slides prepared and evaluated.

The second phase of this project consisted in the use of the

topical Hydrocortisone ointmint on a limited number of burns under treatment in local hospitals at this time. The method used here was to take selected areas from typical 2nd and 3rd degree burns and divide these areas into two parts. To one area the ointmint was applied twice a day and to the other area no ointmint was applied. This was possible to do because of combining this with the Exposure treatment of these burns. As a consequence one must consider the aims of Exposure treatment of burns in interpreting the results. These burns were again followed by periodic gross evaluation and serial photographs. No biopsies were taken.

Evaluation of the Exposure treatment of burns was also carried out at this time for it definitely seemed to offer benefits as regards speeding up, making easier, and less expensive the treatment of severe burns. The essentials of this method of treatment are quite simple and herein liew the great possibilities of this method. The procedure here is that when the patient is first brought to the hospital he is taken immediately to surgery. Here analgesice for pain and routine anti-shock treatment is instituted. The burn is evaluated and gross contaimination removed by minimal debridemont with sterile saline irrigations. The patient is then transported to his room and put on sterile sheets. Blood, electrolytes, fluids, analgesics, etc. are continued as indicated. On the second day oral fluid and in some cases nasal gavage feeding of protein hydrolysates are started. The topical Hydrocortisone ointmint was started at this time. At this time devices for elevating burned extremities are devised. With this a dry eschar usually forms in 48 to 72 hrs. and is the sought after end. From here on early ambulation is carried out

with the patient caring for himself, as regards bathroom care, eating, etc.; as much as possible. Debridemont is carried out by tub baths and the use of hexachlorophene soap. At no time were the hands immobolized or dressings applied. If any break in the eschar appeared a strip of moist saline gauze is applied and kept moist and allowed to become a part of the eschar. At 12 to 21 days the 2nd degree burns will be healed and the eschar peals off and on 3rd degree burns it becomes contracted and tight. At this time any necessary grafting procedures are started. For this the patient is taken to surgery and the eschar dissected off and a split thickness graft applied. Pressure dressings were usually applied to these. From here on treatment is the same as in any burn with grafting as rapidly as possible and every effort made to keep the nutritional status good and avoid any infections. These burns were also followed by serial photographs and results compared to burns under routine closed treatment.

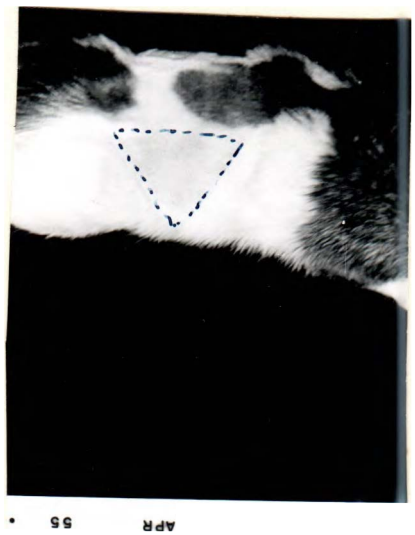
RESULTS:

The results obtained in the animal experiments are as follows. Of the rats in this series three died within the first six hrs. of burning and were discarded from the series. Cause of death in these was not determined, but assumed to be due to effects from burning. The gross evaluations at 14 and 21 days is given in Chart III.

| Treatment | # in Series | Healing Same | | Healing faster on Rt. Side | | Healing faster on Lt. Side | |
|---|---|---|---|---|---|---|---|
| | | 14 | 21 | 14 dy | 21 dy | 14 dy | 21 dy |
| Hydrocortisone and Neomycin | 12 | 3 | 1 | 7 | 5 | 2 | 6 |
| Hydrocortisone | 12 | 2 | 3 | 8 | 7 | 2 | 2 |

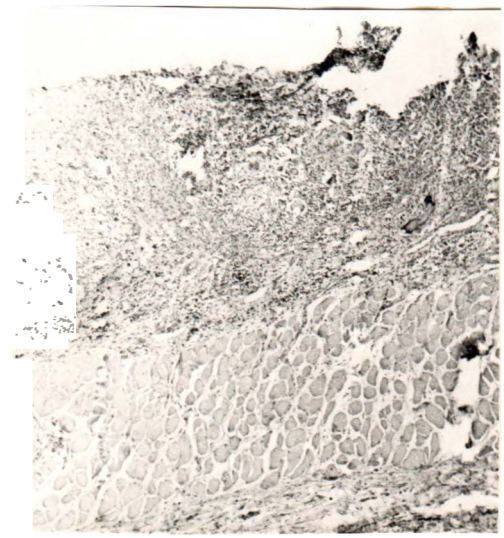
Chart III

The pictures of these burns also failed to show any consis-tent gross difference between the rate of healing on the treated and untreated sides. Typical pictures of these burns at 14 and 21 days are shown in Fig. 4.



Burn on Rat at 14 Days

Fig. 4



Photomicrograph of typical Burn (3°) At 21 days.

Microscopic study of sections taken from the burns at 14 and 21 days were studied from the following four point of view: 1. Degree of burn. 2. In lammation. 3. Granulation tissue re-sponse. 4. Epithelization. Granulation tissue was classified from minimal to exuberant. The degree of reepithelization was deter-mined by linear and perpe dicular growth measured microscopically. Results are shown in Chart IV.

| | Degree of Burn | Inflamma-tion | Epitheliza-tion | Granulation Tissue Response |
|---|---|---|---|---|
| Hydrocortisone and Neomycin | Deep 2nd + 3rd° | moderate | moderate | minimal |
| Control | Deep 2° + 3° | minimal | moderate | moderate |
| Hydrocortisone | Deep 2° + 3° | minimal | moderate | minimal |
| Control | Deep 2° + 3° | minimal | moderate | moderate |

Chart IV

In the severe burns where topical Hydrocortisone was applied to areas of the burn, results were felt to be detri.ental. In these areas the eschar did not form as fast, the areas did not dry up as quickly and there was increased maceration. The latter it was felt would definitely increase the incidence of infection and the chance of c~nverting 2nd degree to 3rd degree burns.

At no time was any effect on minimizing granulation tissue for-mation or speeding up of epithelization demonstrable. The effect of this drug on the take of grafts was not studied. A typical photograph is shown in Fig. 5.

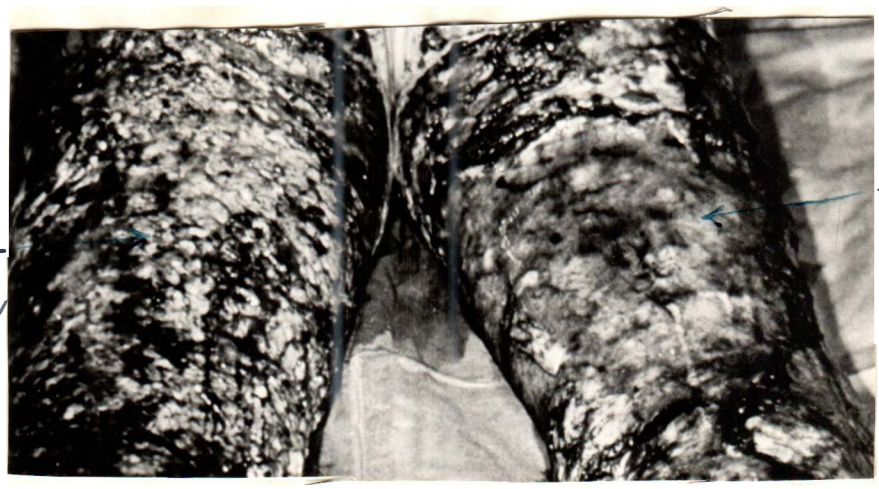



Fig. 5

The results obtained with the Exposure Method of treatment were very good and in most respects quite similar to those obtained by Wallace (22), Pulaski (23), Blocker (24), and Pemrick (25) in their individual studies. In these cases the burn shock responded in the same manner as in closed treatment. It was not found to require any mor fluid or analgesics in this phase and mortality figures are quite similar to the closed treatment. However, it is felt that after 48 hrs. and the eschar has formed,

less fluid is lost and there is less pain as reflected in decreased need for analgesics. Edema was found to be no worse in these patients and not a serious problem. Extremities were left open with good results. A position of function is assumed and early motion facilitates loss of edema and helps to minimize the loss of function. The tub baths with hexachlorophene soap served to keep the patients adequately debreded and infection at a minimum. With the above and the use of antibiotics, infection was no serious problem. Pyrexia was minimal. Odour was for all purposes eliminated. In most cases these patients were ambulant in a few days and could do much to care for themselves, such as feeding and bathroom care. All these factors contributed to keeping the morale of the patient at a much better level. One must, however, give an adequate explanation of what is going on at the burn site to the patient.

With this management by the 14 to 21 day the 2nd degree burns were universally healed and the eschar sloughs leaving the healed burn site. In several cases what appeared to be 3rd degree burns were found to be healed under the eschar. The 3rd degree burns have an adherent tough eschar. Any necessary grafting was started at this time by dissecting off this eschar and applying split thickness grafts. The surface under the eschar is ideal for grafting and the rate of graft takes was very good. These grafts were first applied to the hands and over any joints involved, then the rest of the body is covered as needed. Pressure dressings were applied in most cases to the grafts, but some grafts left open and only sutured in place on immobile surfaces took very well. It was felt by this method, and as shown by

Pulaski (23) in his large series, that fewer grafts are neede and healing time is definitely shortened. During the hospital stay of the patient the nursing care is less, simpler and pleasanter. Finally the cost is also reduced by fewer trips to surgery for redressings, bandages, anesthetics, technical help, etc. These factors would seem to make this method a definite step forward in the treatment of burns and indeed the only pheasible method when dealing with mass burn casualties.

Some limitations of this method were also found. First, it is strictly a hospital procedure. Being such it is poorly suited for small area burns where the patient might return to normal activity after application of a dressing. The many problems of positioning, maceration, etc. encountered with circumferential burns of the torso makes it poor for this group of patients. Finally it is not ideal for patients while they are being transported over co siderable distances. However, when these latter patients are gotten to the hospital the method can be used effectively. Outside of these , all other types of burns have been treated and handled quite successfully by this method of treatment.

## DISCUSSION:

First of all as regards parenteral Hydrocortisone or Cortisone. These drugs would definitely seem to have a place and value in treating burns. They do not replace any of the accepted measures such as electrolytes, fluid, blood transfusions, etc., but are rather supplemental to these and an aid in treating some

of the complications which arise during treatment. Certainly in any patient where one sees or suspects the onset of adrenal insufficiency one is obligated to give this to support the adrenals and the body. Here these drugs rather then ACTH are the drugs of choice. An additional indication along these lines, about which investigators are becoming more cognizant every day, is the administration of these drugs to any burn patient who has had previous Cortisone treatment. The reports of poor stress response in patients who have had previous Cortisone are becoming all to common, thus the giving of these drugs prophylactically in these cases is advocated.

These drugs also have value in treating some of the complications of burn treatment. They are of definite value when one encounters pyrexia without frank sepsis. Their action here is somewhat vague, but apparently quite effective. They also are of definite value when nutrition and emotional instability occur. By helping these, especially in the recovery phase, one may overcome the big problem of poor nutrition and a negative nitrogen balance. Also to be considered here is the effect on keeping granulation tissue minimal. Surely in prolonged cases anything offering any benefit in doing this should be worthy of trial. Finally in the prolonged cases one may get poor takes of grafts. When this occurs one also is warranted in giving these drugs for periods before and after grafting. These combined with the usual accepted measures appears to definitedly improve the per cent of takes of grafts as shown by Pierce (21).

We find very little to sug est any value to topical Hydrocortisone ointmint in the treatment of burns. The gross impressions are

certainly not consistent enough to indicate any real value. This was only further born out by the microscopic sections which showed essentially the same picture in treated and untreated burns. Finally the clinical trial failed to show any good effects and was actually detrimental in some respects. One can only conclude that this drug is either not effective when applied topically or has no advantageous local action. Again one might wonder if a systemic reaction concommitant with the local action might not be necessary to gain an effect. Since adsorption of these drugs is nil this would be lacking. Certainly one has the detrimental effect, reported by many previous investigators, of an ointmint applied to the local wound which increases maceration, poor eschar formation and increase the rate of infection. So one must conclude this drug in its topical form is of no value in treating severe burns.

Finally, turning to the Exposure treatment of burns ones first impression is: "Can anything this simplified and different still be as effective in treating burns". Surely if the results obtained thus far, in the fairly large number of cases already treated by this method, can be maintained this method certainly has an important place in burn theraphy. Naturally the first place where the big advantage and idealness of this method is evident is that of where you half to deal with large number of burn cases at one time. Surely with all of todays atomic weapons and the number of major disaster, such as the Cocanut Groove and Texas City fires, which have already occurred, this problem is a real one and not just one for speculation. In these cases,

where supplies and technical help are very limited, this method is the only one that approaches solving these problems and being an effective way to handle these situations.

From the results obtained thus far it would appear this method also has a definite place in the treatment of the individual burn case. Before turning to these let it be said once again that this method is not a replacement for good electrolyte, fluid, blood transfusion, antibiotic, analgesic, etc. treatment, but rather an adjunct to these. Going through the course of treating a burn the definite advantages and the limitations can be pointed out.

Certainly any burn that can be completely exposed is an ideal candidate for this method of treatment. In the shock phase the method used plays very little part in success or failure, but rather good anti-shock theraphy is needed. Perhaps some advantage is gained here in that no prolonged debridemont is necessary initially and no additional stress is added by the application of a pressure dressing with perhaps the use of an anesthetic. In addition in these first days the burn can be reevaluated and the actual extent of it figured up accurately, rather then just getting one initial impression and then covering it up. There also seems some merit in that after the eschar has formed there is less fluid lost and consequently fewer transfusions needed. There also does not appear to be any more pain as inferred by some critics.

During the next two weeks, depending upon the extent and seriousness of the burn, definite advantages accrue. With the formation of the eschar one has a dry wound rather then the damp

macerated wound often found under a dressing. This would certainly seem a factor in preventing infections for the latter is certainly an ideal place and enviorment for one do develope in. Another factor in cutting infections down is the use of tub baths with hexachlorophene soap scrubs and obtaining good debridemont with this method. Finally one may note any infection as it developes and adequately open and remove this site and get treatment started, with adequate sensitivity studies, before you have any mass sepsis. This method also allows the patient more freedom, so he may be up and ambulant a great deal more then by the closed method. This allowing him to take care of his own bathroom care, eating and the absence of the foul odor of the closed system raises the morale and the emotional outlook of these patients a great deal. These factors also tend to increase the food intake which is very important in any long term burn case.

The results with leaving the hands open were good, even if seeing them edematous is a bit frightening. With motion and elevation the edema soon leaves and good function is maintained. Toward the end of 3 wks. one is able to watch each day and see which areas are 2nd degree and are going to heal and which are 3rd degree and going to require grafting. It is also becoming more evident that by avoiding maceration one can prevent the turning of deep 2nd degree burns into 3rd degree burns which will require grafting. One also has a uniform, ideal surface for the take of grafts when the eschar is dissected free which is quite important. With the above advantages gained early and persisting tell recovery, we have a patient better prepared to go into and through the recovery phase of burn treatment.

The final advantage, which is a big factor in these types of cases, is that of the reduction in cost possible with this method. Certainly if one can avoid some of the costly and painful redressings which require trips to surgery, anesthetic, dressings and the surgeons time, one can reduce the cost a good deal. Additionally if one can get the patient well quicker and avoid the need for grafting in some cases by not converting 2nd to 3rd degree burns one is also going to reduce cost. Finally the need for nursing care is reduced and much simpler making another addition along these lines.

One should not conclude that this is by any means a panacae in burn treatment. It has its limitations, as noted in the section on results, and these must be observed in order to maintain the standard of results obtained thus far. Finally one must realize that the complications of burn treatment such as: Initial shock, oliguriz and renal shutdown in the toxic phase, and poor nutrition and take of grafts in the recovery phase, can still occur. However, with this method these would seem to be kept at as low a level as possible and that there are some good advantages to be gained.

## SUMMARY AND CONCLUSIONS

A review of the chemistry and pharmacology of Cortisone and Hydrocortisone is given. The history and value of parenteral use of these drugs in the treatment of severe burns is reviewed. Definite values accruing are:

1. Necessary treatment for any cases where adrenal insufficiency occurs.
2. ill counteract pyrexia when frank sepsis is absent.

3. Needed in cases where the patient has received previous courses of Cortisone theraphy.
4. Aids appetite, nitrogen balance and emotional status where these are problems.
5. May reduce granulation tissue formation and aid in some cases the take of grafts.
6. Does not increase the rate of infection in dosages used.

Original experimental laboratory work useing rats and clinical trial of topical Hydrocortisone ointmint is presented. The results of this work indicate that topical Hydrocortisone is of no value in treating severe burns.

The Exposure method of treating severe burns is reviewed. Definite advantages have been found with this method. These are:

1. Only effective method of handling mass casualties.
2. Reduces initial care of the patient and may reduce fluid loss after the eschar is formed.
3. Reduces maceration.
4. Lowers the rate of infection.
5. Avoids turning 2nd degree into 3rd degree burns.
6. Minimizes offensive odors.
7. Early ambulation with the patient able to help himself more. Gives better emotional status.
8. Better appetite with consequently better nitrogen balance.
9. Avoidance of frequent painful dressings with need for anesthetics.
10. Availability of burn for observation and evaluation.
11. Ideal surface for grafting with a good take of grafts.
12. Reduced and simpler nursing care.
13. Reduction in the cost of treating a burn case.

Some contraindications to this method are:

1. It is strictly a hospital procedure, thus is not good in small burns where closed treatment would allow the patient to return to normal activity.
2. Circumferential burns of the torso where all of the burn cannot be exposed.

3. Poor for transporting burn patients.

Finally it must be realized that with this method one can still have the usual complication of burn treatment.

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