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# Homeostatic Assessment In Burns By Radioactive Isotopes

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## INTRODUCTION

IT IS well established that in the initial phases after thermal injury, severely burned patient show clinical manifestation of shock. Burns shock differs from other traumatic shock that in burns the loss from circulation is more gradual, continuous and in significant quantities for 36—48 hours. The central feature of shock is hypovolumia due to loss of plasma, electrolytes and red cell mass through damaged capillaries at the site of burns. The extent of the loss is, however, unpredictable due to haemoconcentration. This is one of the chief causes of unsuccessful therapy in these patients Table I.

During the gradual onset of shock due to a burn (usually over a period of a few hours) the compensatory mechanisms of the body are able to come fully into play. Vasoconstriction in the splanchnic area is the most important of these compensatory mechanisms and this may reduce the capacity of the circulation sufficiently to keep up the peripheral blood pressure but at the same time there may result serious and even dangerous reduction of the blood flow to the viscera. Vomiting due to diminished blood supply to the stomach and intestines is common, and for the same reason the kidney and less commonly the liver, the pancreas and other organs may sustain severe and permanent damage even though the blood pressure has never fallen below dangerous level. For many years it was customary to attribute these events of first few days to "AUTO-TOXAEMIA OF BURNS", but as knowledge of these underlying factors has increased it has been possible to explain these disturbances in terms of alterations in the dynamics of the circulation Table I.

The most popular trend for combating the shock is by a formula which is most widely employed as a guide, but none of these account for the fluid loss at the depth of the wound. In this context the concept of the burn as a three-dimensional wound, by ARTZ is worth recalling. Accordingly, a successful fluid therapy must account for the fluid loss, not only from the surface area (which is two-dimensional picture) but also from the tissue damaged in depth, i.e., in terms of tissue volume damaged. This necessitated some quick, accurate and reliable methods for measuring the blood volume and thereby checking the adequacy of fluid therapy based on any of these formulae Table II. Of these various methods to estimate the blood volume the radioactive isotopes give the quick and reliable readings. This is our preliminary study with RIHSA technique of assessing the ,dequacy of fluid therapy, because timely and adequate replacement of fluids and Red Cell Mass can save the damage to vital organs presenting itself as so called "Auto-Toxaemia."

## MATERIALS AND METHOD

This study has been carried out so far in six severely burnt patients admitted in our Department. These cases had 20-40% of body surface area burnt. They were apparently healthy with no history suggestive of any cardiac or other systemic disease. They belonged to age groups of 17—50 years and were all females. They were given fluid therapy according to Brook's modification of Evans formula, through a vein-section. Routine is as follows :—

1. 2 c. c. per kilogram of body weight for each 1% of body surface area involved for the first 24 hours.
2. 1 : 3 ratio of colloids : Glucose saline.
3. 1 : 3 to 5 ratio of Blood : Dextravan.
4. In addition to above 1500—2000, 5% Glucose as daily requirement.

The adequacy of fluid therapy was checked by RIHSA technique which carry following advantages :—

I. It can be done at bed side.
II. Ready availability of labelled compound.
III. Simple technique.
IV. Rapid estimation with considerable accuracy.
V. No elaborate laboratory facilities required except basic counting equipment.
VI. Results available in 20—30 minutes.
VII. Repeated estimations possible.
VIII. Results are not interfered with lipaemia or haemoglobunaemia.
IX. Theoretical hazards of total body irradiation from repeated doses is negligible, as the isotope is employed in tracer dose ranges. It, therefore, remains as the most useful method to have an approximate idea of blood volume in surgical emergencies.

## TECHNIQUE

This method required accurate timing and meticulous technique. Since Radio-iodinated human serum albumin is diffusable, specimens of blood must be withdrawn as soon as possible after mixing it in the blood.

(a) RIHSA is made up to the concentration of 10—15 UC per ml. in sterile normal saline solution and this is used as a working solution.

(b) A dose of RIHSA (usually 10—15 UC) is withdrawn from the working solution bottle and expelled in to 1000 ml. flask (being careful to keep the needle and syringe sterile). To the RIHSA add water up to the mark.

(c) Exactly the same amount is again drawn in to the same needle and syringe from the bottle containing the working solution of RISHA. Inject this in to the patient vein being careful not to inject subcutaneously.

(d) After 10 minutes, a 5ml. sample of blood is drawn from the opposite arm without stasis and put 3ml. of it in the heparinized tube and 2ml. of the blood is put in to a container containing dry anti-coagulant suitable for haematocrit determination.

(e) Centrifuge the first specimen, remove 1ml. plasma and place in a test tube. Place 1ml. of standard in a second test tube. A background count is made well before reading the samples.

(f) The plasma and the standard are each counted for five minutes. The back-ground count is substracted to obtain the correct counts per minute Table III.

## CALCULATIONS

Plasma Volume :

$$\frac{\text{ccpm of Std X Vol. of Std}}{\text{ccpm of the Pt.s plasma}}$$

Total Blood Vol. :

$$\frac{\text{Plasma Vol.}}{\text{1.0 corrected haematocrit.}}$$

Red Call Mass =

Total Blood Vol.—Plasma Vol.

(Corrected Haematocrit=

Pt.s Haematocrit × 0.91)

## RESULTS

The control studies were also carried out in the Department by RISHA technique on 30 adults of the age group of 26—72 years. There were 20 males and 8 females. The distribution of average values according to sex is shown in Table IV.

It will be seen that the normal mean value af T.B.V. is 79 ml./kg. in females and 83 ml./kg. in males, P.V. is 52 ml./kg. in males and 51 ml./kg. in females.

The comparative values in burn cases are shown in Table V.

It will be seen in the table that the T.B. V. & P.V. is comparatively lesser in majority of the burn cases as compared to the normal.

## DISCUSSION

The study of blood volume after Brooks interavenous fluid therapy in our series revealed consistant hypovolumia, suggestive of inadequate fluid therapy. Probably none of these formulae have taken into consideration, the fluid loss at the depth (3rd dimension) which is quite significant. There is on the average a deficiency of 400 to 500 ml. of fluid in most of the cases. Therefore, any of these formulae employed for calculating the amount of fluid requirement seems to be invalidated in the context of present study. These formulae, therefore, are only rough guide for the magnitude of the fluid loss, though it is essential to have such a formulae to start the fluid therapy. Further fluid therapy should be planned after assessing the clinical status, urinary output and serial laboratory methods available in the Institution.

**Table I.** *Burns Shock*

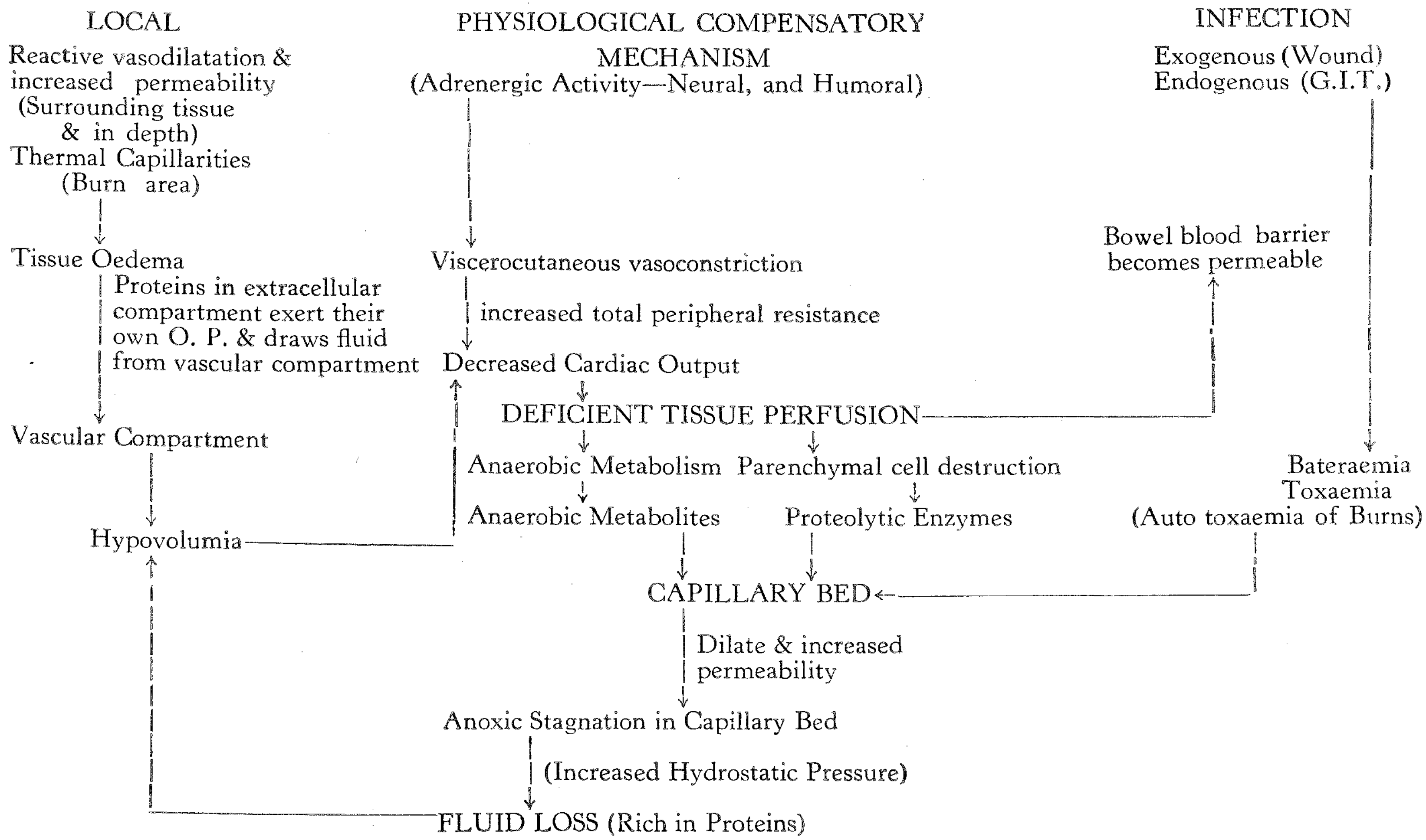

**Table 2.** *Methods used for assessing blood volume commonly used standard methods of measuring blood volume depend on estimating the dilution of carefully measured amounts of either days or radioactive isotopes.*

1. DYE METHOD — ( T 1824 OR EVANS BLUE )
2. RADIOACTIVE ISOTOPES — ( R. B C. CR 51, RIHSA I 131, Fe 59 )
3. SEMI-AUTOMATIC INSTRUMENTS —VOLEMETRON<br>—HEMOLITRE<br>—BLOOD VOLUME COMPUTER

**Table 3.** *Showing Formula For Calculation Blood Volume by R.I.H.S.A. Method*

$$\text{PLASMA VOLUME} = \frac{\text{CC PM OF STD. x VOL OF STD.}}{\text{CC PM OF PT.'S PLASMA}}$$

$$\text{TOTAL BLOOD VOLUME} = \frac{\text{PLASMA VOL.}}{\text{1.0 — CORRECTED HEMATOCRIT}}$$

( CORRECTED BEMATOCRIT = PT.'S HEMATOCRIT x O.91 )

RED CELL VOLUME = T.B.V. — P.V.

**Table 4.** *Showing normal blood volnme values*

| Sr. No. | SEX | T.B.V. ml/kg | P.V. ml, kg. |
|---|---|---|---|
| 1. | MALE | 83.0 | 52 0 |
| 2. | FEMALE | 79.0 | 51.0 |

**Table 5.** *Showing comparative values of blood volume in burn cases with normal*

| SL. NO. | AGE | SEX | STUDY GROUP | | NORMAL | |
|---|---|---|---|---|---|---|
| | | | T.B.V. ML /KG. | P.V. ML./KG. | T.B.V. ML /KG. | P.V. ML./KG. |
| 1. | 26 Yrs. | F | 72.8 | 48.6 | | |
| 2. | 17 ,, | F | 76.6 | 47.0 | 79.0 | 51.0 |
| 3. | 15 ,, | F | 72.0 | 45.0 | | |
| 4. | 23 ,, | F | 88.3 | 55.8 | | |
| 5. | 52 ,, | F | 74.7 | 47.7 | | |
| 6. | 28 ,, | F | 75.9 | 52.6 | | |

REFERENCES :

1. King, E.R. and Mitchell, T.G. : A Manual for Nuclear Medicine, 1961, p. 44, 49.
2. Berman, T J. and Fulton, G.P. : Shock and Hypotension, 1965, p. 198, 213.
3. Hopkins R.W., Sabga, G., and Simeone, E.A. J. Amer. Med. Ass., 1965; 191. 731.
4. Janoff, A. : Internal. Anesth. chin, —1964; 2 (2) 251.
5. Lillehei, R. C. : Surgery, 1957; 43, 1043.
6. MacLean, L.D., Duff J.H., And Perely M. : Surg. Gynec. Obstet 1965,120, 1.
7. Page, I.H. : Fed. Proe 1961; 20, 75, Suppl. No. 9, Vol. III.
8. Zweifach, B W. : Functional Behavior of the Microcirculation, 1961.
9. That, A.P., Willon; R.F., and Andve, S : Shock and Hypotension, 1965, p. 609.
10. Davis J.W.L. : Blood Volume Studies —"Radioisotopes in Medical diagnosis" —1966.
11. Hobbs, J.T. : Brit. Med. J., 1965, 1, 1374.