

Osmotic treatment of hyphaema

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Hyphaema, both traumatic and post-operative, is often encountered in clinical practice; its frequency and complications have been described by Thygeson and Beard (1952), Loring (1958), Goldberg (1960), Henry (1960), and Liebman, Pollen, and Podos (1962).

The wide range of therapeutic procedures recommended indicates that no specific treatment has so far been discovered. Miotics (Rychener, 1944) or cold and hot compresses (Kushner, 1959) have been suggested. Sinskey and Kricheskey (1959) observed that neither miotics nor mydriatics had any detectable effect on the absorption of Cr⁵¹-labelled red cells injected into the anterior chamber of rabbits. Anterior chamber irrigation with proteolytic enzymes has given favourable results (Podos, Leibman, and Pollen, 1964; Sinskey and Kricheskey, 1962; Pierse and Legrice, 1964; Scheie, Ashley, and Weiner, 1961).

Osmotic agents, such as urea and mannitol, have been used in cases of hyphaema in human beings (Kwitko and Costenbader, 1962; Kjeldsen, 1965). Cole and Byron (1964) obtained good results by treating hyphaema with a combination of enzymatic irrigation of the anterior chamber and intravenous administration of urea. These reports, though indicating the beneficial effect of osmotic agents, call for a proper evaluation by a controlled study, and we have therefore studied the effect of urea, sucrose, sorbitol, and glycerol on the resorption of hyphaema.

Material and methods

Under local anaesthesia (Anethaine 1 per cent.) 0.1 ml. of P³²-tagged blood was injected into the anterior chamber of 52 rabbit eyes with a 23-gauge needle attached to a tuberculin syringe. In each case the rabbit's own blood was used and the injection was made through a valvular opening made by the needle, after withdrawing the aqueous. Immediately after this injection of blood, the radioactivity of the eye was measured with a β -counter unit. A special adapter (Fig. 1, opposite) was fitted to the end of a Geiger-Muller counter to keep constant the surface area of the mica sheet and its distance from the anterior surface of cornea.

After the initial reading (at "0" hour) the radioactivity was measured 4-hrly on the first day, 6-hrly for the next 2 days, and 12 hrly for the next 2 days.

The animals were divided into the following groups:

GROUP 1 (10 eyes) CONTROLS No treatment.

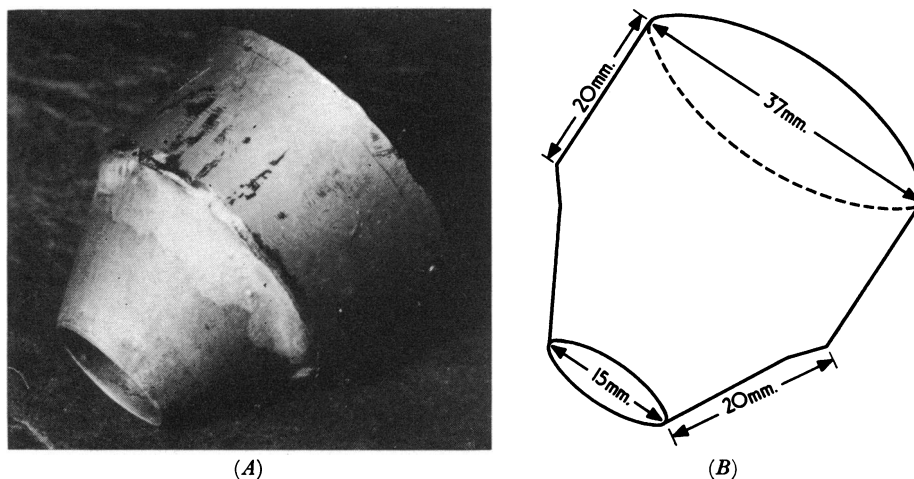


FIG. 1 *Special adapter for Geiger-Muller counter.* (A) Photograph. (B) Drawing

GROUP 2 (10 eyes) A slow intravenous injection, 1 g./kg. body weight, of a 20 per cent. solution of urea in distilled water. The first injection was given after measuring the initial radioactivity at 0-hour, daily injections were given for 4 consecutive days.

GROUP 3 (10 eyes) A slow intravenous injection of 12 ml. 50 per cent. sorbitol. The schedule of injections was the same as in Group 2.

GROUP 4 (10 eyes) 15 ml. 25 per cent. sucrose was injected as in Group 2.

GROUP 5 (12 eyes) Six were given 10 ml. 50 per cent. glycerol orally, and six 50 per cent. glycerol intravenously, 1 g./kg. body weight, daily for 5 days.

Each group was watched for evidence of any toxic effects of the drugs, such as loss of appetite, diarrhoea, changes in general behaviour, etc.

Technique of radioactive tagging

5 ml. blood were withdrawn through a heart puncture and mixed with 1.2 ml. 3.8 per cent. sodium citrate solution. The blood was centrifuged at 3,000 r.p.m. for 30 minutes. 1 ml. packed cells so obtained was then incubated for 2½ hours at 37°C. with the following mixture:

| | |
|--|---------|
| Isotonic saline | 1 ml. |
| 0.1 M glucose solution | 0.1 ml. |
| Radioactive sodium— hydrogen orthophosphate | 0.1 ml. |

After incubation, the red cells were washed three times with 10 ml. isotonic saline. The washed cells were then mixed with 0.5 ml. plasma to constitute whole blood.

Results

The injected blood gradually clotted and in a day or two thick clots were seen without any fluid. The blood completely disappeared from the control eyes within 16 to 23 days and from the treated eyes in 10 to 17 days.

A curve was plotted for each group by counting the remaining radioactivity at fixed intervals. The mean percentage of radioactivity remaining in each group of eyes was

plotted against time in hours. The curves so obtained were compared with that of the control group (Fig. 2). The Table indicates the percentage radioactivity remaining in each group at 12-hrly intervals.

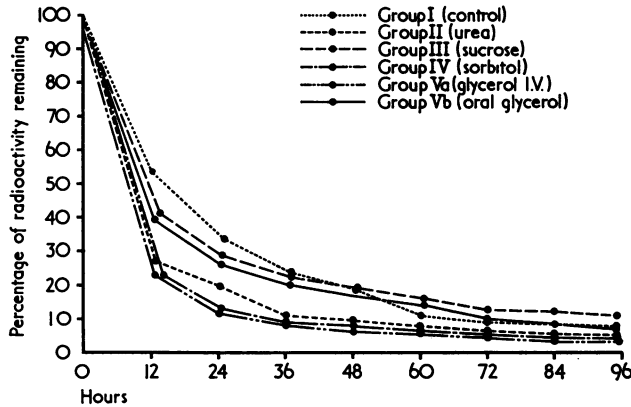


FIG. 2 Average radioactivity remaining in different groups at various intervals

Table Mean percentage radioactivity remaining at 12-hour interval in different groups

| Group | 12 hrs | 24 hrs | 36 hrs | 48 hrs | 60 hrs | 72 hrs | 84 hrs | 96 hrs |
|---------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|-----------------|
| I (Control) | 53.0 (±3.360) | 34.0 (±3.435) | 24.0 (±4.205) | 17.0 (±0.772) | 10.5 (±1.005) | 9.0 (±0.809) | 8.0 (±1.353) | 7.0 (±0.783) |
| II (Urea) | 27.0 (±2.636) | 19.0 (±1.866) | 10.0 (±1.588) | 9.0 (±1.327) | 7.5 (±0.720) | 6.0 (±0.652) | 5.5 (±0.639) | 4.0 (±0.422) |
| III (Sucrose) | 42.0 (±4.615) | 28.0 (±3.549) | 21.8 (±2.104) | 18.0 (±2.104) | 14.0 (±1.517) | 12.0 (±1.131) | 10.5 (±2.032) | 9.0 (±1.694) |
| IV (Sorbitol) | 24.0 (±3.152) | 10.0 (±1.477) | 8.0 (±1.364) | 7.3 (±0.832) | 6.0 (±0.784) | 5.5 (±0.506) | 5.5 (±0.459) | 5.5 (±0.527) |
| V (Glycerol) | | | | | | | | |
| Intravenous | 25.5 (±2.687) | 14.0 (±1.556) | 9.5 (±1.312) | 9.0 (±0.738) | 8.0 (±0.894) | 7.3 (±0.228) | 7.1 (±0.713) | 6.0 (±0.641) |
| Oral | 40.0 (±4.243) | 26.5 (±2.800) | 19.9 (±0.881) | 17.0 (±0.906) | 15.0 (±1.068) | 10.9 (±1.269) | 8.5 (±0.822) | 8.0 (±0.573) |

Figures in parentheses indicate standard deviation

It was observed that the remaining radioactivity in the treated eyes was significantly lower than that in the control eyes, indicating an acceleration in the rate of absorption of the injected blood. Statistically, the difference was significant at the 5 per cent. level for

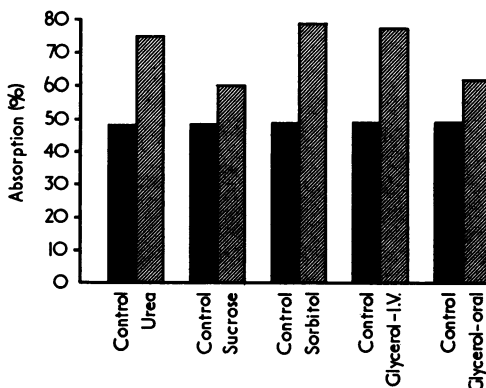


FIG. 3 Average radioactivity remaining in different groups at end of first 12 hours

all the readings in each group except Group 3 (sucrose) in which there was no significant difference after the first 24 hours. This effect was much more marked in the animals treated with intravenous urea, sorbitol, and glycerol. It was further observed that the maximum effect of the drugs used was seen in the first 12 hours (Fig. 3).

No side-effects of the drugs were seen in any of the animals.

Discussion

The observations of earlier workers that the administration of intravenous urea (Cole and Byron, 1964; Kwitko and Costenbader, 1962) and mannitol (Kjeldsen, 1965) assisted the resorption of hyphaema have been confirmed in the present study. A parallel effect was also achieved by intravenous glycerol. Oral glycerol and intravenous sucrose also accelerated the absorption of hyphaema, but the effect was not so marked as with other agents. It is likely that the change in osmolarity produced by the oral glycerol or intravenous sucrose was not so striking because glycerol is released slowly into the circulation from the gastrointestinal tract and sucrose has a lower molecular weight.

The exact mechanism by which the osmotic agents effect the rate of resorption of hyphaema is not clear. They probably work by lavage of Schlemm's canal. These agents produce a state of hypotony which is followed by the resumption of normal production of intraocular fluids. The increased circulation thus induced helps to wash the blood out of the anterior chamber, the whole process following the sequence of events seen in the surgical procedure of paracentesis. The induction of hypotony may further help by dilating the exit channels through which the cells can pass more quickly.

It was further seen that the first dose produced the greatest acceleration in the decrease of radioactivity. This was probably due to the state of the blood in the anterior chamber. The blood was washed out more quickly with the help of the drugs while it was in a fluid state. As time passed the injected blood became more and more thickly clotted. These agents are most useful in cases with fluid blood in the anterior chamber. When the blood is clotted anterior chamber irrigation with fibrinolytic enzymes (Cole and Byron, 1964) is the best form of treatment.

Summary and conclusions

- (1) Hyphaema was simulated in 52 rabbit eyes by injecting P³²-tagged autogenous blood into the anterior chamber.
- (2) The effect was studied of various osmotic agents on the absorption of the hyphaema so produced.
- (3) The intravenous administration of urea, sorbitol, and glycerol accelerated the rate of resorption of hyphaema—the maximum effect being seen in the early period before the injected blood became clotted.
- (4) Oral glycerol and intravenous sucrose were less effective than the other agents.
- (5) The acceleration of resorption produced by these osmotic agents is possibly due to lavage of Schlemm's canal and hypotonic dilatation of the exit channels.

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