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A COMPATIBLE SOLUTION FOR ADMINISTRATION WITH BLOOD

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It is generally accepted that the addition of blood to a solution of 5 per cent dextrose in water causes such blood to clump. In spite of this, it has been the practice of many to employ 5 per cent dextrose in water in operating rooms as a vehicle when administering blood for the following reasons: (1) the belief that saline solution should be restricted unless specifically indicated; (2) caloric requirements are more readily met by dextrose than by saline solutions, and (3) there seemed to be little evidence that 5 per cent dextrose in water and blood was detrimental to the patient, when such solution was used in combination with blood administration.

Because of several bizarre transfusion reactions and reports in the recent literature (10), a belief is developing that 5 per cent dextrose in water as a vehicle for blood may be hazardous.

The use of 0.85 per cent saline solution as a vehicle, although it solves the problem of clumping, is disadvantageous because:

1. Some patients do not need, or indeed some may be harmed by saline solution, for it has been shown by Trout (8) that operative patients have a decreased urinary output and a tendency to retain sodium. Coller *et al.* (1) concluded that isotonic saline or Ringer's solution should not be given during the day of operation or during the subsequent first and second postoperative days because of salt intolerance after operation. It was their belief that fluid requirements should be met by the use of glucose solutions. Cooper, Iob and Coller (3) found that the degree of retention of sodium chloride was directly related to the magnitude of the operation. Retention of sodium chloride is more likely to occur when production of urine is suppressed. Rhoads, Van Slyke *et al.* (6) showed a decrease in formation of urine in dogs under anesthesia. Pringle, Maunsell and Pringle (5) demonstrated that ether depressed formation of urine. Waters and Schmidt (9) had shown that cyclopropane had a similar effect. Coller *et al.* (2) determined that the effect on the kidney was extrarenal. Hardy (4) confirmed the findings of Coller and showed the relationships between

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anesthesia, surgery and the production of eosinophils. Patients undergoing operative procedures had a decrease in eosinophils, indicating adrenal activity with a concomitant retention of sodium. This phenomenon had previously been shown by Selye (7).

2. The procedure was awkward. Our experience had been to start an intravenous injection of 5 per cent dextrose in water. If the need for blood arose, a saline solution replaced the dextrose solution to prevent the phenomenon of clumping. The saline was permitted to flow for several minutes before the blood was administered. Following completion of the administration of blood, saline was again allowed to flow for several minutes and the dextrose solution again started. This procedure proved unsatisfactory, first, because of the necessity of changing solutions, and second, because of the added salt retention from the saline. Furthermore, the procedure was wasteful, expensive and time-consuming.

Our attempt, then, was to search for a solution, the administration of which would not cause clumping if given with blood and yet would keep the administration of sodium chloride at a minimum, and at the same time satisfy some of the patient's caloric requirements. It had previously been shown that blood did not clump when added to 5 per cent dextrose in normal saline solution. Wilson (10) demonstrated that the clumping caused when blood had been added to 5 per cent dextrose in water could be reverted by the addition of small amounts of salt. We investigated the effects of various concentrations of dextrose in saline and blood (table 1).

TABLE 1

VARIOUS CONCENTRATIONS OF SOLUTIONS STUDIED

To 10 cc. of each of these solutions 1 cc. of blood had been added

Dextrose, per cent	Saline, per cent	Blood
0	0.85	No clumping
0.5	0.76	No clumping
1.0	0.68	No clumping
1.5	0.59	No clumping
2.0	0.51	No clumping
2.5	0.42	No clumping
3.0	0.34	No clumping
3.5	0.25	No clumping
4.0	0.17	No clumping
4.5	0.08	No clumping
5.0	0.09	No clumping
5.0	0.0	Clumping

It was observed that clumping was absent in all solutions except 5 per cent dextrose in water. With this knowledge, a solution containing 0.09 per cent saline in 5 per cent dextrose was selected, because it provided a maximal amount of dextrose and a minimal amount of salt. We demonstrated the lack of clumping in this solution both macroscopically (fig. 1) and microscopically (fig. 4).

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With the above laboratory evidence we found that a solution of 0.09 per cent salt in 5 per cent dextrose provided an agent which was sufficiently safe to use clinically. The use of such a solution as a substitute for saline results in the patient receiving but 0.9 Gm. of sodium chloride per liter, in contrast with 8.5 Gm. which would be received from 1000 cc. of normal saline solution.

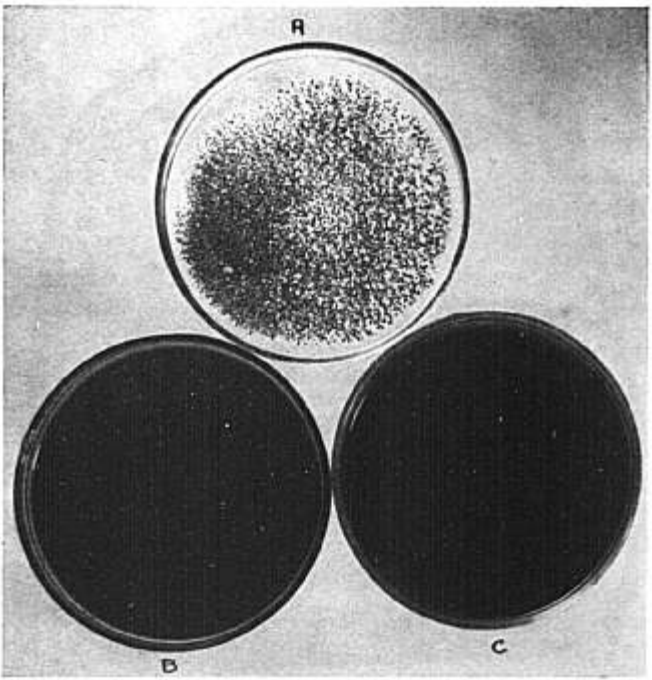

FIG. 1. One cc. of blood added to various solutions: A. Clumping of blood in a solution of 5 per cent dextrose in water. B. No clumping of blood in saline solution. C. No clumping of blood in a solution of 0.09 per cent salt in 5 per cent dextrose.

We have employed this solution with considerable satisfaction. The patients have received the required amounts of water and calories, and we have spared them from unnecessary intake of sodium chloride. Because of this we believe this solution is valuable and recommend its use. However, we do not neglect to employ saline solutions when indications warrant their administration.

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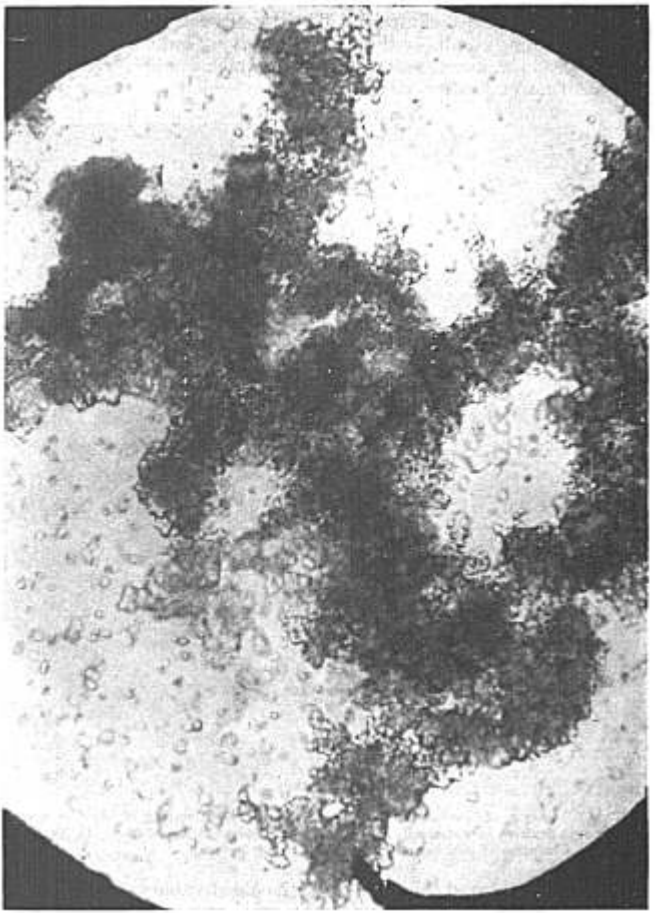

FIG. 2. Photomicrograph showing clumping of blood in a solution of 5 per cent dextrose in water.

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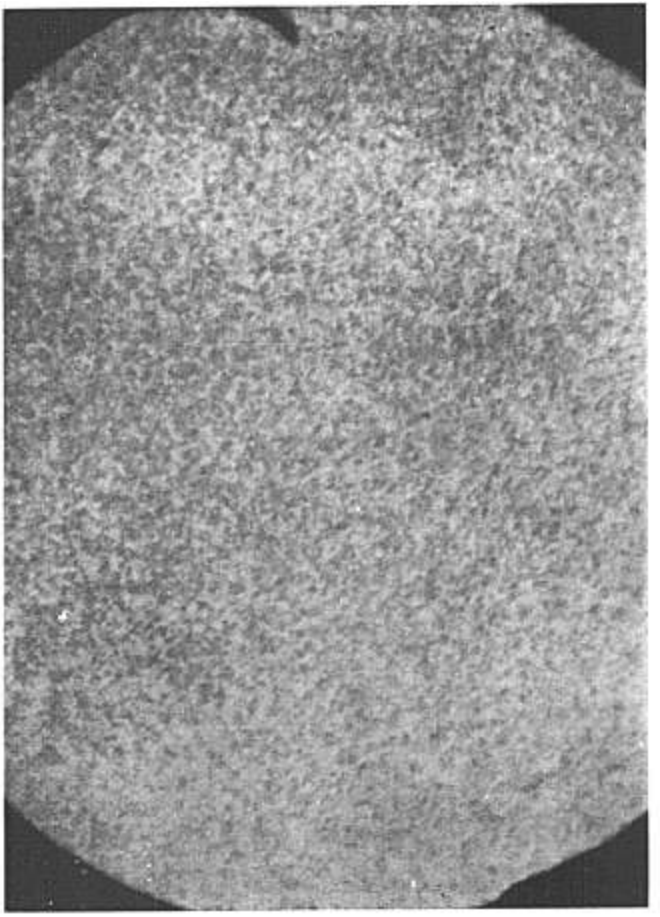

FIG. 3. Photomicrograph showing no clumping of blood in saline solution.

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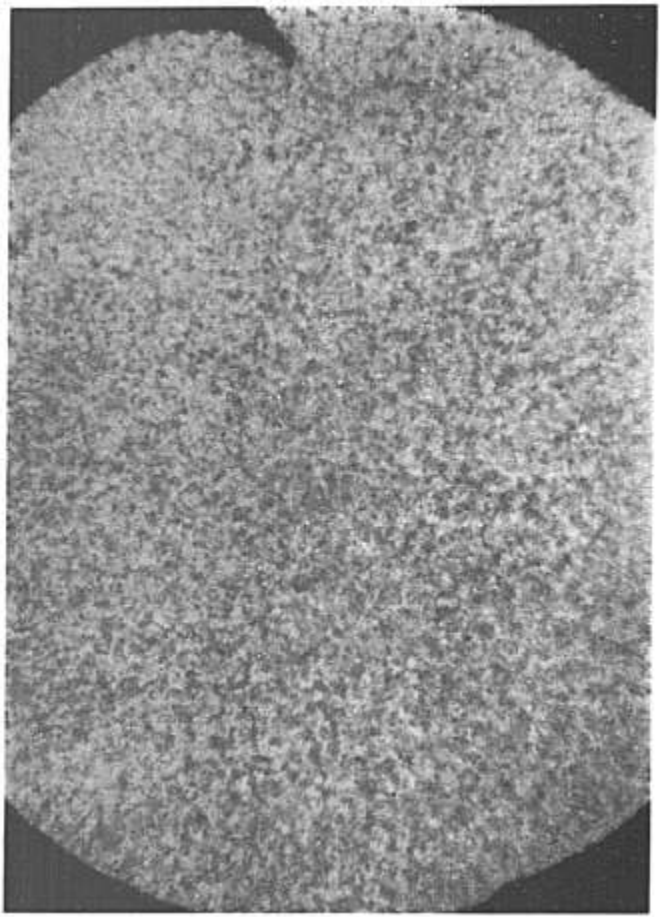

FIG. 4. Photomicrograph showing no clumping of blood in a solution of 0.09 per cent salt in 5 per cent dextrose.

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SUMMARY

An intravenous solution is presented which has the following advantages: No clumping is caused when it is administered with blood. The patient's caloric requirements can be better met than with saline solution and the patient is spared the extra burden of sodium chloride.

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