

REDUCTION OF SHUNT CLOTTING BY LOW MOLECULAR WEIGHT DEXTRAN*

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Introduction

The treatment of uraemic patients by regular haemodialysis is frequently complicated by clotting of the artificial arteriovenous shunt. Such episodes induce anxiety in the patients, prevent their rehabilitation and impose a great burden on the attending team. Repeated clotting reduces the efficiency of the dialysis and usually leads to an irreversible shunt obstruction.

Clotting of the shunt may be secondary to a local infection or due to mechanical imperfections of the tubing. However, in most of the cases clotting occurs spontaneously with no apparent cause. With the possible exception of long-term anticoagulation (Wing *et al.*, 1967), no specific or efficient measures for the prevention of clotting have been described.

In view of the antithrombotic and rheological properties attributed to low molecular weight dextran (Bryant *et al.*, 1963; Gelin, 1962), it was decided to assess its value in the prevention of clotting in the indwelling A-V cannulae of patients treated in our Dialysis Unit.

MATERIAL AND METHODS

Five patients, in whom shunt clotting had occurred repeatedly with no manifest cause, were selected for the study (Table I). All of them had attended the regular haemodialysis programme at least 3 months before the observation period. Treatment was similar for all the patients and consisted of 12 to 14 hours of dialysis, twice a week, utilizing Kiil dialyzers. The patients were ambulant during the observation period and were free of complications other than clotting. The shunt used was a modified Scribner teflon-silastic type. No metal rings were used and the external bridge was an extension of the silastic tube with a short teflon segment connecting both sides. When clots appeared, they were removed by aspiration and irrigation, assisted by a small-bore polyethylene tube. The reported observations were made during the 'life time' of the same shunt in all the patients.

TABLE I
Clinical data on the reported patients

| Patient | Sex | Age | Diagnosis |
|---------|-----|-----|---|
| R.F. | F | 41 | Polycystic kidneys |
| J.N. | M | 26 | Chronic glomerulonephritis |
| N.P. | F | 30 | Chronic pyelonephritis (?), Fabry's disease (?) |
| T.Y. | F | 40 | Chronic pyelonephritis; St. post-bilateral nephrectomy |
| M.L. | M | 32 | Chronic glomerulonephritis; St. post-bilateral nephrectomy |

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Twenty-five grams of low molecular weight dextran ('Rheomacrodex', Pharmacia, Sweden) were given intravenously after each dialysis, as a 10% solution in glucose. The administration of dextran was withheld from time to time for periods varying in duration from 3 to 8 weeks. A clotting episode was recorded as such only if blood flow through the shunt was completely obstructed, when a visible clot was evident and when after declotting the flow was fully restored at least for 12 hours.

Plasma levels of dextran were determined on blood samples obtained before dialysis by the phenol-sulphuric acid colorimetric method for determination of sugars, as described by Dubois *et al.* (1956). A calibration curve was prepared by the same method for various concentrations of glucose and the appropriate readings were subtracted from each dextran determination after the glucose levels had been determined on the same sample by the glucose-oxidase method.

RESULTS

The cumulative observations extend over $4\frac{1}{3}$ patient-years, during which 445 dialyses were performed and 123 clotting episodes were recorded. Table II summarizes the occurrence of clots during dextran treatment and during withholding of dextran in each patient. For a better comparison the frequency of clotting episodes ('clotting rate') was calculated as clots per week. Comparing the clotting rates during dextran periods with those during control periods for each patient, it is found that clotting episodes were 2.7 to 14.2 times more frequent when dextran was not given.

TABLE II
Clotting of shunt during dextran administration and during control periods

| Patient | Duration in days | | No. of clots during | | 'Clotting rate' clots/week | |
|---------|------------------|-----------------|---------------------|-----------------|-------------------------------|-----------------|
| | Dextran periods | Control periods | Dextran periods | Control periods | Dextran periods | Control periods |
| R.F. | 160 | 20 | 12 | 8 | 0.53 | 2.80 |
| J.N. | 207 | 48 | 3 | 6 | 0.10 | 0.88 |
| N.P. | 195 | 27 | 32 | 12 | 1.15 | 3.10 |
| T.Y. | 543 | 42 | 20 | 22 | 0.25 | 3.66 |
| M.L. | 157 | 163 | 1 | 7 | 0.04 | 0.30 |
| Total | 1262 | 300 | 68 | 55 | 0.37 | 1.28 |

In order to quantitate the beneficial effect of dextran, its plasma levels were determined in predialysis blood samples. A definite reciprocal correlation could be demonstrated between dextran blood concentration and frequency of shunt clotting (Fig. 1).

DISCUSSION

The administration of low molecular weight dextran reduces significantly the frequency of shunt clotting in patients treated by regular haemodialysis. This clot-preventive effect of dextran parallels its concentration in the blood as apparent from Figure 1. However, above the concentration of about 8 mg/ml, no additional decrease in clotting rate could be found. This blood level of dextran can be easily achieved in patients without renal function, but it should be mentioned that after each dialysis a new dose of dextran has to be given. Usually, a dose of 25 g is sufficient to maintain satisfactory blood levels. Somewhat larger doses may be needed in patients who still have residual renal function and excrete urine.

No complications or untowards effects of dextran treatment were noticed. Mild sensation of chest compression was reported occasionally by some of the patients. This could be pre-

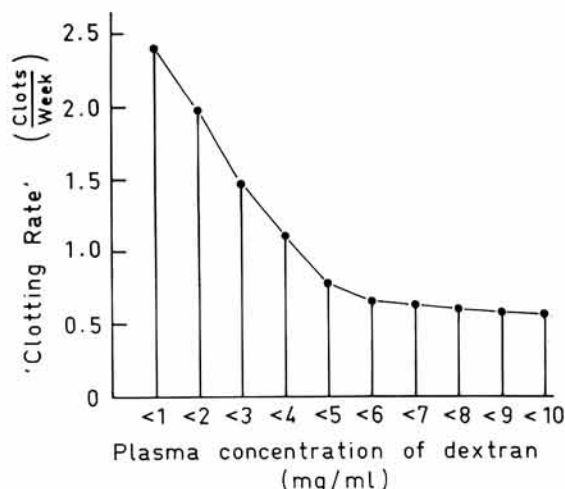


Fig. 1. Clotting rates of A-V shunts as related to blood concentration of low molecular weight dextran (cumulative observations in 5 patients).

vented by slowing the flow rate of the dextran infusion. One shunt infection occurred during the dextran period and was treated with antibiotics, without occurrence of clotting of the shunt. No bleeding or haemorrhagic phenomena were observed.

One patient (R.F.) developed pericardial effusion. This is a known complication in patients undergoing repeated haemodialysis (Beaudry *et al.*, 1966). In our unit two more patients, not treated with dextran, had this complication. In the patient R.F. a biopsy specimen from the pericardium revealed chronic fibrous and fibrinous pericarditis. It is therefore not probable that the pericardial effusion, though haemorrhagic, was due to the administration of dextran. When the patient had to be operated (pericardio-pleural fenestration) the treatment was stopped, but at a later stage dextran administration was resumed with no ill-effects.

The preventive effect of dextran is comparable with that of long-term anticoagulant treatment with warfarin, as described by Wing *et al.* (1967). The use of dextran avoids the haemorrhagic complications reported by these authors, and needs less supervision than the anticoagulant treatment.

We have become convinced that the administration of dextran is effective, simple and safe, and it is now used routinely in all of our patients when clotting starts to become a problem.

Summary

The beneficial effect of low molecular weight dextran ('Rheomacrodex') in the prevention of shunt clotting was studied in 5 uraemic patients treated by regular haemodialysis. Clotting rate could be reduced markedly by the administration of 25 g of Rheomacrodex after each dialysis.

Dextran seems to be a safe and effective agent for the prevention of shunt clotting in patients undergoing chronic dialysis.

REFERENCES

- BEAUDRY, C., NAKAMOTO, S. and KOLFF, W. S. (1966): Uremic pericarditis and cardiac tamponade in chronic renal failure. *Ann. intern. Med.*, 64, 990.
 BRYANT, M. F., BLOOM, W. L. and BREWER, S. S. (1963): Experimental study of the antithrombotic properties of dextran of low molecular weight. *Ann. Surg.*, 29, 256.

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- DUBOIS, M., GILLES, J. K., HAMILTON, P. A., REBERS, P. A. and SMITH, F. (1956): Colorimetric method for determination of sugars and related substances. *Analyt. Chem.*, 28, 350.
- GELIN, L. E. (1962): Rheologic disturbances and the use of low viscosity dextran in surgery. *Rev. Surg.*, 19, 358.
- WING, A. J., CURTIS, J. R. and DEWARDENER, H. E. (1967): Reduction of clotting in Scribner shunts by long-term anticoagulation. *Brit. med. J.*, 3, 143.