DEMONSTRATIONS
HEPARIN CONCENTRATION IN REGIONAL HEPARINISATION 
DURING HAEMODIALYSIS

M. KESSEL, A. KUCHENBUCH and A. TOURKANTONIS*
I. Medical Clinic, Dialysis Unit of the Free University of Berlin, Germany

In order to evaluate the effect of regional heparinisation (Gordon et al., 1956 a, b; Anderson and Kolff, 1959; Darby et al., 1960), during haemodialysis in patients in danger of bleeding, the heparin concentrations in the patients’ arterial blood and the blood from the dialyser were determined (Hiepler, 1959).

Regional heparinisation (Kessel et al., 1962): Two separate, variable speed infusion pumps** for:

Heparin°: 40000 I. U. in 100 ml 5% levulose
Protamine°°: 500 mg in 100 ml 5% levulose
Rate of infusion:
Heparin: 1.5–0.1 ml/min = 4.68–0.312 mg/min
Protamine: 1.5–0.2 ml/min = 7.5–0.1 mg/min

![Fig. 1. Example of a regional heparinisation in which the heparin concentrations are too high. Due to the heparin infusion which was too great during the first hours, a low concentration of heparin in the arterial blood was achieved only after 2½ hours. The variation of the concentration during the further course of the dialysis is caused by the occasional increase in the heparin infusion, as is shown by the lower part of the illustration.](image)

* Therapeutic University Clinic, Athens, Greece. Stipend Holder of the Free University of Berlin and the Berlin Senate.
** Unita I, Braun A. G., Melsungen, Germany.
° Liquemin R, Deutsche Hoffmann-La Roche A.G., Grenzach, Germany (1 P. U. = 7.8 int. standard heparin)
°° Protamine R, Deutsche Hoffmann-La Roche A.G., Grenzach, Germany
The rates of infusion are varied without previous testing of the neutralisation ratios, according to 1/4 hourly determination of the clotting times. At the beginning of dialysis, heparin is infused at ca. 4 mg/min, which is immediately reduced when an extracorporeal circulation of 200 ml/min is reached. Then protamine infusion is begun at 2.0–2.5 mg/min, while heparin infusion is continued at 0.5–1.0 mg/min. During the further course of the dialysis, the rate of heparin infusion is varied, while the rate of infusion of protamine sulfate is held constant (Kuchenbuch and Kessel, 1965) (Fig. 4).

Fig. 2. Complication in regional heparinisation due to arterial hypotension during dialysis. Because of arterial hypotension, the extracorporeal rate of flow of 200 ml/min was first reached after 50 min after the beginning of dialysis, and protamine was first infused after this point. With a very high rate of protamine infusion, the heparin concentration was successfully reduced. There was no uterine bleeding.

Fig. 3. Complication by shock shortly after the beginning of dialysis. Ten minutes after the dialysis was begun, acute shock occurred, so that the extracorporeal circulation decreased rapidly and finally stagnated. The further infused protamine accumulated in the venous catheter and completely neutralised the heparin present: coagulation. After alleviation of the shock condition and resumption of the extracorporeal circulation, the initially high heparin concentrations decreased through high protamine infusion.
Fig. 4. An example of a regional heparinisation which proceeded well. Low heparin concentrations in the patient's and dialyser blood. The rate of infusion of protamine remained constant, and regulation was through variation of the rate of heparin infusion.

Fig. 5. Average heparin concentrations and dosages in 5 regional heparinisations which proceeded well.

Fig. 6. Comparison of the heparin concentrations in regional heparinisation (5 dialyses with Alwall's dialyser), and in continuous heparinisation with an infusion pump (12 dialyses with Alwall's dialyser + 15 dialyses with twin coil kidney (Travenol)). Average values.
The course and success of regional heparinisation are primarily dependent upon the original heparin dosage (Fig. 1), and on complications during the haemodialysis, especially a decrease of the extracorporeal circulation (Figs. 2 and 3). In dialyses which proceed well, heparin concentrations of 10 µg/ml or less in the arterial blood are achieved. In the dialyser blood, the concentrations are, on the average, around 5 µg/ml higher (Figs 4 and 5).

The comparison with other methods of heparinisation (Lindquist et al., 1964; Tourkantonis, 1965) shows that heparin concentrations in the arterial blood which are just as low are achieved in continuous heparinisation using an infusion pump (Fig. 6).

REFERENCES