Reduction of Blood Loss in Coil Dialyzers With a Horizontal Position of the Coil

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REDUCTION OF BLOOD LOSS IN COIL DIALYZERS WITH A HORIZONTAL POSITION OF THE COIL

At the end of each coil dialysis treatment, there is always some residual blood left in the coil and in the extracorporeal tubing which cannot be completely washed out. (1) This is a problem and may be one of the factors contributing to the anemia of patients undergoing longterm hemodialysis. It can be reduced, however, by operating the coil in a horizontal position —which allows more thorough rinsing with a lesser volume of rinsing fluid. The present study was undertaken to determine the volume of blood remaining in the horizontal coil and tubing at the end of dialysis, and to compare it with residual volume using vertical coils. The technique used to rinse back the residual blood into the patient via the venous cannula is described.

METHODS AND MATERIAL:

For the past six months, attention has been directed toward reducing the amount of blood which remains in the extracorporeal circuit at the end of dialysis.

Fourteen chronic renal failure patients on long-term, tri-weekly hemodialysis were chosen for this study. A total of 88 coils were examined, 44 of which were positioned horizontally and 44 vertically. The duration of dialysis was 4 to 6 hours, with 175 to 250 ml/min blood flow rate. Ex-03 coils were employed in all instances. All horizontal and some vertical coils were used in a totally recirculating tank dialyzer; the remaining vertical coils were used in an RSP dialyzer.

At the end of each dialysis, the arterial blood line was clamped and cut near the patient's arterial cannula. While dialysate flow continued, the arterial blood line was unclamped until it was cleared of blood. When the arterial line was clamped again, a rinsing volume of about 400 ml was allowed to flow into the blood circuit in both horizontal and vertical coil positions, as determined by the total flow meter. Dialysis was discontinued when the venous line was clamped. The extracorporeal circuit volume was checked by collecting the volume of the venous and arterial lines and by direct opening of the coil dialyzer. The rinsing fluid, extracorporeal volume and blood loss from all patients was recorded (Fig. 1).

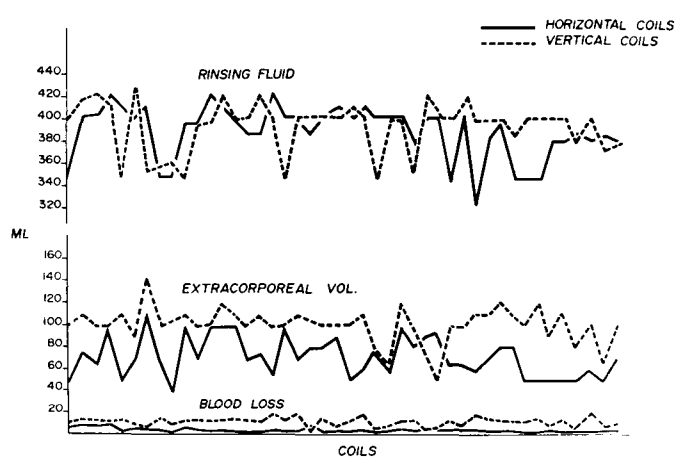

Fig. 1: Diagram showing the amount of rinsing volume, extra-corporeal circuit's volume and blood loss in both vertical and horizonta-ly placed coil.

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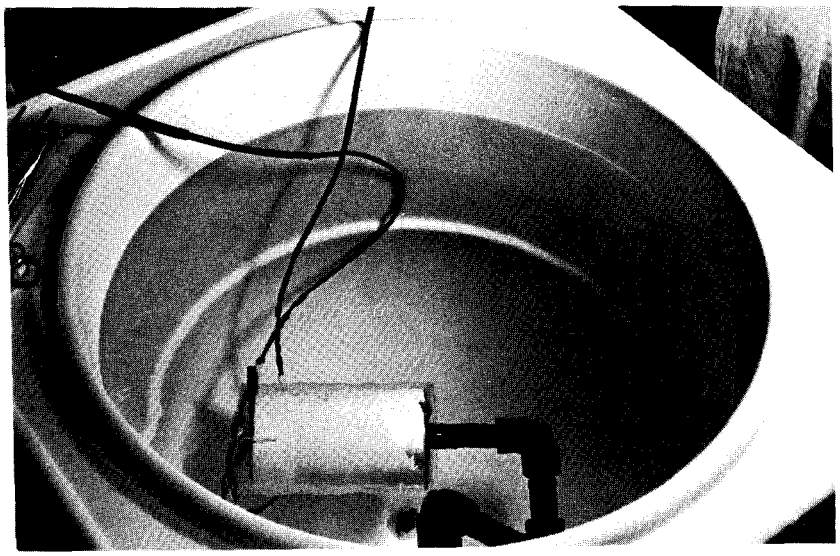

Fig. 2: The horizontally positioned coil in recirculating tank dialyzer.

A method was devised to determine the amount of blood remaining in the blood circuit at the end of dialysis. This determination is based on the patient's hematocrit at the end of hemodialysis, the hematocrit of extracorporeal volume, and the amount of extracorporeal volume. The amount of blood loss was calculated by the following equation:

$$\text{blood loss} = \frac{\text{Hct of extracorporeal circuit volume} \times \text{extracorporeal circuit volume}}{\text{Hct of the patient}}$$

RESULTS:

Four hundred ml saline was used as rinsing fluid for both the horizontally and vertically positioned coils. Residual volume in horizontal coils was 72.8 (± 1.8) ml, and in the vertical coils, 99.7 (± 1.7) ml. Using the above equation, mean blood loss in coil's positioned horizontally was 3.53 (± 1.96) ml or compared to a mean of 10.94 (± 2.8) ml for vertical coils.

DISCUSSION:

At the end of each dialysis, a relatively large volume of blood remains in the dialyzer and the extracorporeal circuits. (2, 3, 4, 5) This loss of blood with each dialysis contributes to the anemia of the patient on intermittent long-term hemodialysis. The blood residue which accumulated in the vertical coil results from the sedimentation of the cellular elements along the lower edge of the cellulose tube. When the coil is operated in the horizontal position, (Fig. 1), however, the blood flow is upward and downward, and there is less chance for stagnation (1). The coil is in a good position for rinsing. During rinsing, if the venous line is clamped intermittently below the bubble catcher in order to increase intracoil pressure, only about 300 ml of saline is needed for complete rinsing (compared with 500 to 600 ml conventionally needed for vertical coils). Alternate saline-air-saline rinse can reduce residual blood to almost nil. However, this technique is not, in our opinion, a safe one for home patients to attempt.

Fig. 2 shows the rinsing fluid, coil volume and blood loss in this study of 88 coils, (44 in a vertical position and 44 in a horizontal position). In many of the dialyses, the blood loss with the horizontal coil was less than 5 ml, and in a few cases, was as low as 0.5 ml. In the vertical position, however, blood loss was usually 10 ml or more, and in a few cases, was more than 15 ml. In the dialyses in which the intracoil pressure was increased by clamping below the bubble catcher, less rinsing fluid was needed and less extracorporeal volume resulted. A comparison of blood loss using the horizontal coil position with blood loss using a modified two-layer kiil dialyzer also reveals the advantages of the horizontal coil. The mean volume of blood remaining in the kiil dialyzer and extracorporeal circuit was 12.6 ml. The quantity of rinsing fluid used at the end of dialysis was 1 liter of normal saline (2).

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