

Arteriovenous haemofiltration in hypervolaemia

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SUMMARY Arteriovenous haemofiltration was used for removal of fluid overload in a 9 month old burned infant with diuretic resistant hypervolaemia. After 60 hours of arteriovenous haemofiltration hypervolaemia had disappeared. Arteriovenous haemofiltration proved to be a safe and simple extracorporeal method of managing severe fluid overload.

The occurrence of massive tissue oedema in burned and non-burned regions after a thermal injury is well known.¹ Development of considerable oedema can result in serious morbidity, such as pulmonary oedema.

We report the use of arteriovenous haemofiltration for fluid removal in a severely burned 9 month old infant who developed diuretic resistant pulmonary oedema and hypervolaemia.

Case report

A 9 month old infant with a major burn (30% of body surface area, second degree) developed pronounced oedema in burned and non-burned tissue during the initial fluid resuscitation with crystalloid solutions. Pulmonary and upper airway oedema and hypoproteinaemic pleural effusions necessitated intubation and mechanical ventilation. After correction of hypoproteinaemia pleural effusion and pulmonary oedema disappeared but upper airway oedema persisted. Extended intubation was therefore necessary. High caloric parenteral nutrition (120–140 kcal/kg/day) was begun after partial reabsorption of the oedema. On the seventh day after the burn progress was complicated by candida sepsis. Once again pronounced general and pulmonary oedema developed due to capillary leak syndrome and cardiovascular instability. Body weight increased from 9 to 11 kg. As fluid restriction and both inotropic (digoxin, dopamine, and dobutamine) and diuretic (furosemide and spironolactone) treatment failed to improve cardiovascular function and renal perfusion, and thus the hypervolaemia persisted, we used arteriovenous haemofiltration to remove the fluid overload.

Technique. The right femoral artery and vein were cannulated by the Seldinger technique and short catheters (Vygon Introducat Desilet Soft 1.8×2.2×100 mm) inserted. A 0.25 m² haemofilter (Amicon D20) with original arterial and venous lines was used. The extracorporeal volume was about 50 ml. The haemofilter system was primed with 1 litre of normal saline containing heparin 5000 IU. After opening the extracorporeal circuit 50 IU/kg heparin was infused into the arterial line to prevent clotting of the haemofilter. Thereafter heparin was infused continuously at a rate of 10–20 IU/kg/h. For control purposes partial thromboplastin time was measured three times a day and the infusion rate

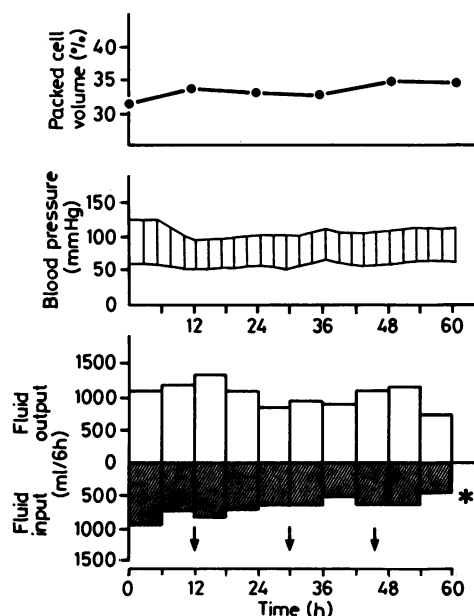


Figure Net fluid removal using arteriovenous haemofiltration for 60 hours. Arrows indicate new filters. Asterisk indicates extubation. Total fluid output was 8590 ml, total fluid input was 7073 ml, and net fluid removal was therefore 1517 ml. Body weight decreased from 11 kg at 0 hours to 9 kg at 60 hours.

was decreased until partial thromboplastin time was twice as high as normal. The ultrafiltrate collection bag was fixed 40 to 80 cm under the haemofilter at the bedside. The haemofilter was exchanged once the filtration rate had dropped to 60–70% of the initial mean value. Reinfusion of the extracorporeal blood volume minimised blood loss during filter exchange.

Ultrafiltrate substitution fluid was replaced into the venous line of the extracorporeal system. The potassium free standard solution consists of sodium (142 mmol/l), calcium (2.0 mmol/l), magnesium (0.75 mmol/l), chloride (103 mmol/l), and lactate (44.5 mmol/l). A negative fluid balance of 20–30 ml/hour was aimed at.

Result. At an ultrafiltration rate of 100–200 ml/hour a desired negative fluid balance of 20–30 ml/hour was obtained and high caloric parenteral nutrition (120 kcal/kg/day) was introduced simultaneously. Haemofilters were exchanged three times. After 60 hours of arteriovenous haemofiltration a net fluid removal of 1.5 litres had been achieved (Figure). Pulmonary and local oedema had disappeared and cardiac size had returned to normal. The patient could be extubated, and diuretic and positive inotropic treatment was stopped.

Discussion

Ultrafiltration treatment of severe fluid overload was first described in 1974 by Silverstein *et al.*² Kramer *et al* first mentioned the technique of arteriovenous haemofiltration in 1977,³ and Lieberman *et al* used this technique in a small preterm infant with fluid overload accompanying acute renal failure.⁴ Arteriovenous haemofiltration is an extracorporeal therapeutic system by which fluid and solutes can be removed from the body by convective transport. A low resistance hollow fibre haemofilter highly permeable to water is used for this ultrafiltration. Without using a blood pump the blood passes through the haemofilter driven only by the arteriovenous pressure gradient.

We used arteriovenous haemofiltration for fluid removal in a burned hypervolaemic infant with pulmonary oedema. As slow and continuous fluid removal was achieved no untoward side effects such as pronounced changes of the haemodynamic situation were observed. Disturbances in serum electrolyte concentration or serum osmolarity were not encountered.

Haemofilter function can be maintained effectively for 24 to 48 hours with the continuous low dose heparin infusion of 10 IU/kg/h recommended for anticoagulation of the extracorporeal circuit in arteriovenous haemofiltration.⁵ As happened in our patient haemofilter clotting may occur earlier when arteriovenous haemofiltration is used for fluid removal. Adding a prediluting fluid, however, can prolong haemofilter life.⁵

Arteriovenous haemofiltration has proved to be a safe extracorporeal therapeutic system that can be installed easily and rapidly in young infants. Monitoring is simple and necessitates no special training of staff. Furthermore, young patients show good clinical tolerance.

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