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Outcome of Continuous Arteriovenous Haemofiltration (CAVH) in One Centre

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ABSTRACT

Continuous arteriovenous haemofiltration (CAVH) has been adopted as the treatment of choice for acute renal failure (ARF) in critically ill patients in the intensive care units of Uppsala University Hospital since 1982. To know the outcome of CAVH during the last one and a half year this retrospective study was done on those patients seen in July 1987-December 1988. Forty patients aged 2 months-84 years (mean 57 years) were included. Treatment duration was 1-31 days (mean 10 days, patients with treatment duration less than 24 h were excluded). The majority of ARF causes were due to major surgery because there are two big cardiothoracic and vascular surgical centres with a high turnover in this hospital.

In this study CAVH was found useful in the management of ARF in critically ill patients within the limits of its capacity of urea clearance. There is a notable improvement in the number of survivors in this study (55%) when this is compared to a previous study (45%) in a similar group of patients and in the same centre.

INTRODUCTION

Prior the introduction of continuous arteriovenous haemofiltration (CAVH) by Peter Kramer in 1980 (3), conventional haemodialysis (HD) or peritoneal dialysis (PD) had been used for the treatment of acute renal failure (ARF). In spite of the improvement in survival of ARF patients after the advent of HD and PD the mortality rate is still high (5). Furthermore, dialysis-related symptoms, e.g. arterial hypotension, often complicates haemodialysis in critically ill patients of whom the majority has unstable circulation. Our trials with PD as an alternative method for the treatment of ARF were not encouraging. We found PD poorly efficient regarding fluid and uremic control in hypercatabolic patients. That was often due to abdominal problems like dialysis fluid leakage.

CAVH has been introduced in Uppsala University Hospital since 1982 because it is an inexpensive and simple method which gives fairly good uraemic control and haemodynamic stability of the patients provided that the treatment is initiated early (1, 3). Critically ill patients with ARF often have other problems like volume overload. At the same time they are in need of parenteral nutritional support which can be solved by CAVH.

In this retrospective study there is a short review of the outcome of CAVH treatment in Uppsala Centre during the last one and a half year in order to evaluate the most recent results with this method of blood purification.

MATERIAL AND METHODS

Forty critically ill intensive care patients out of 47 were included in this study. Thirty-one were males and nine were females. Average age was 57 years (range 2 months - 84 years). Seven patients were excluded because they received treatment for less than 24 hours. The majority of the patients had ARF following major surgery. Other complicating factors encountered were multiorgan failure or septicaemia that necessitated the use of artificial respirator, aortic balloon pumps or the administration of fat emulsions and/or vasopressor drugs (see Table 1).

Table 1. Number of patients, sex, age and the complicating factors in each group of ARF causes

ARF cause	*Total Nº of patients*	*Males*	*Females*	*Age*	*Inotropic drugs*	*Respirator*	*Aortic balloon pump*	*Septicaemia*
		(n)	*(n)*	*(average yrs)*	*(n)*	*(n)*	*(n)*	
Postcardiac surgery	22	18	4	4.5-74 (55)	16	10	7	3
Postgeneral surgery	13	11	2	0.17-84 (60.5)	8	8	1	2
Medical	4	1	3	19-63 (49)	2	1	1	1
Major burn	1	1	-	45	1	1		1
Total	40	31	9	(57)	27	20	9	7

METHODS

Kramer's first principle (3) has been followed in this study. Blood being pumped by the blood pressure gradient via an arteriovenous shunt which is interrupted by a capillary haemofilter. The ultrafiltration (UF) rate was regulated by the level of the UF collection bag. The substitution fluid (haemofiltration solution HF21) was administered via a port along the venous line. Short tubings (35-50 cm) were used. The infusion rate of the HF solution was regulated by an infusion pump. In the majority of these patients (58%) polysulfon filters (Amicon D30) were used.

Vascular access. In the majority of patients (82%) Buselmeier shunt was preferred because it is easy to manage by the nurses if any complication occurs (Table 2). Other alternatives were femoral catheters (13%) and Quinton-Scribner shunt (5%).

Table 2. Type of vascular access used during the treatment of ARF patients

ARF causes	*Type of vascular access*		
	Buselmeier shunt (n)	*Femoral catheter (n)*	*Quinton-Scribner shunt (n)*
Postcardial surgery	18	3	1
Postgeneral surgery	12	1	
Medical	2	1	1
Major burn	1	-	
Total	33	5	2

Anticoagulation. A bolus dose of heparin was usually given as 10-40 IU/kg body weight. Then heparin infusion (25000 units/500 ml NaCl) was given in a dose of 5-15 units/kg body weight. This was regulated by an infusion pump and it was frequently readjusted by following the APTT values (usually kept around 50 seconds; reference range 25-39 seconds). Anticoagulation was omitted in case of risk of bleeding. Otherwise prostacycline (Flolan®) was another alternative in such cases, e.g. in one patient with ulcerative colitis, hepatic involvement and oesophageal varices, prostacycline was used in a dose of 5-8 ng/kg body weight/min.

Substitution fluid. The substitution fluid commonly used was haemofiltration solution (3000 cc plastic bags). It contains sodium 140 mmol/l, calcium 1.6 mmol/l, magnesium 0.75 mmol/l, potassium 1 mmol/l, chloride 100 mmol/l and lactate 45 mmol/l. In patients with hyperkalaemia the same solution but without potassium was used.

Nutritional fluids in the form of amino acids (0.8-1.2 g/kg body weight/day), carbohydrates (1000-3000 Kcal/day), fat emulsions (500 ml Intralipid® 100 ml every second day = 1000 Kcal) and multivitamine infusions were given. In diabetics soluble insulin was added to glucose (30% concentration) to avoid hyperglycaemia.

RESULTS

Figure 1 shows the causes of ARF as a percentage of the total in Uppsala Centre. The majority was the group following post cardiac surgery (55%), 32.5% was the group following general surgery (abdominal surgery, abdominal aortic surgery, etc), 10% was ARF due to medical causes (rhabdomyolysis, septicaemia, paracetamol poisoning etc) and 2.5% was due to major burns. It is noticed here that the major cause of ARF was post cardiac surgery and that was due to the high turnover in such a large cardiothoracic surgical centre.

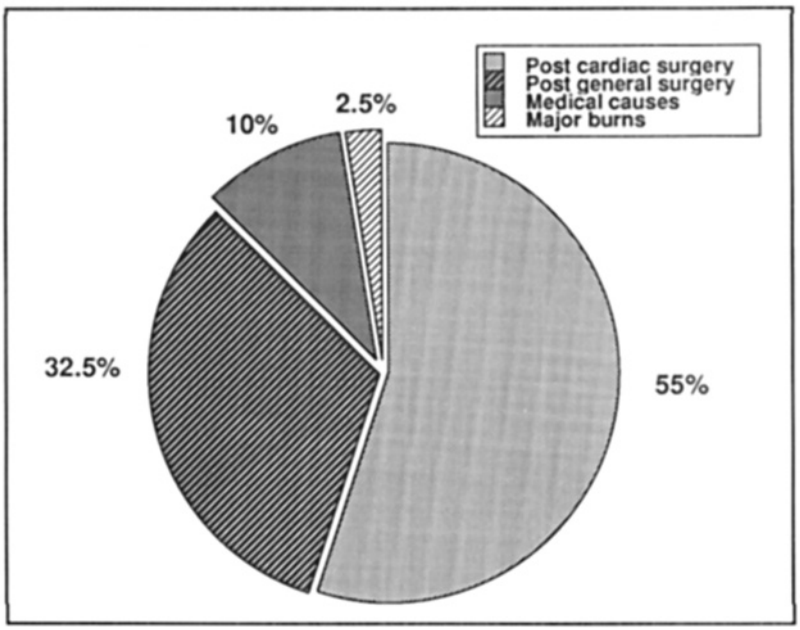

Figure 1. The frequency distribution of the causes of ARF in Uppsala Centre as a percentage of the total (40 patients).

Table 3 shows the percentage of survivors in each group of ARF causes (50% was in post cardiac surgery, 62% in post general surgery, 50% in medical group and 100% was in the major burn).The majority of the survivors were in the younger age group (average 46 years) when compared to the majority of deaths which occurred in the older age groups (average 63 years). Old age in itself is a risk factor which can affect the outcome of ARF. Table 3 also shows the total survivors' percentage (55%).

Table 3. Percentage and number of survivors in each group of ARF causes and a comparison between the survival and death ages

ARF causes	*Nº of patients*	*Nº of survivors*	*Percent of survivors*	*Mean survival age (yrs)*	*Mean death age (yrs)*
Postcardiac surgery	22	11	50	46	63
Postgeneral surgery	13	8	62	53	68
Medical	4	2	50	40	58
Major burn	1	1	100	45	0
Total	40	22	55	46	63

Complications. No complications were seen apart of filter clotting which was due to low blood pressure or low APTT in certain patients.

DISCUSSION

The total survival percentage in this study is 55. In a previous study in this centre and in a similar group of patients the survival percentage was 45 (4). Previously reported complications (like bleeding due to disconnection of the lines) were not seen because all the filters and the tubings used were supplied with Luer-locks. The use of short tubings reduced the incidence of clotting. In certain patients with a serum urea level of 45 mmol/l or more intermittent haemofiltration was used to achieve better uraemic control. Continuous arteriovenous haemodialysis (CAVHD) which has been documented as superior to CAVH in the control of small molecules (2) has recently been introduced in this centre. CAVHD was effective in such hypercatabolic states, otherwise CAVH still remains the treatment of choice in ARF especially with volume overload.

This improvement in the outcome of CAVH treatment in ARF patients could also be attributed to the good clinical experience of the doctors and nursing staffs involved in handling such critically ill patients.

Conclusion. It is difficult to state that CAVH had improved the state of survival in this study because other supervening factors like multiorgan failure or the patient's original disease were the major cause of death. It could be concluded that CAVH is a useful method of treatment in ARF in critically ill patients, but within its limit of urea removal capacity.

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