

Pump assisted continuous veno-venous hemodiafiltration in the treatment of acute renal failure*

Mediha BORAN¹, M.Kamil GÖL², Sedat KALAYCIOĞLU², İzak DALVA³, Oğuz TAŞDEMİR², Selahattin ÇETİN³, Kemal BAYAZIT²

hemodialysis and Transplantation Unit, Cardiovascular Surgery Clinic, and
³Urology Clinic, Türkiye Yüksek İhtisas Hospital Ankara, TURKEY

In the intensive care units of cardiovascular surgery and urology departments of Türkiye Yüksek İhtisas Hospital, during the period of February-July 1994, total 9 cases (3 female and 6 male), with acute renal failure underwent pump assisted continuous veno-venous hemodiafiltration. Patient's ages ranged between 24-60 years (mean: 40.6 years). The causes of acute renal failure were surgery for double valve insufficiency in two patients, surgery for ascending aort aneurysm in 1 patient, surgery for descending aort aneurysm in 1 patient, cardiomyoplasty in 1 patient, septic abortus in 3 cases and congestive heart failure in 1 case. Blood flow was set to 10 ml/min, venous pressure was between 50-80 mmHg, dialysate flow was 0.85-1.0 L/hour, substrate liquid flow was 1-2 L/hour heparin infusion was 7.9-14.8 IU/kg/hour. Fourteen kits were used for 9 patients. Mean utilisation time for one filter was 42.4 hours. During the treatment, the least ultrafiltrate gained was 12 L and the maximum was 24 L. During the first 24 hours of treatment, blood urea levels decreased by 50% and during the following hours 30% decrease was obtained. In conclusion, pump assisted continuous veno-venous hemodiafiltration with a single venous puncture and by a double lumen venous catheter is an alternative extracorporeal treatment method in acute renal failure which can be used in postoperative patients and septic patients with this complication, Turk J Med Res 1995, 13(1): 31-33]

Key Words: Hemodialysis, Acute renal failure

Continuous arterio-venous hemofiltration in the treatment of acute renal failure is an attractive option (1-4). However, its dependency on spontaneous blood flow, lesser urea clearance in cases with hyper catabolic state and high blood levels of urea (5), the hard gained balance between the parenteral nutrition and liquid extraction (3), frequent clotting of the filters and the specific risk carried by the arterial intervention caused pump assisted continuous veno-venous hemodiafiltration (PACWHDF) comes into consideration in daily use.

In this study, we have examined the early results of PACWHDF on cases with postoperative acute renal failure in patients of intensive care units of cardiovascular surgery and urology clinics.

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Correspondence: Mediha BORAN
Hemodialysis and Transplantation Unit
Türkiye Yüksek İhtisas Hospital,
Sıhhiye 06100/Ankara, TURKEY

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MATERIALS AND METHODS

PACWHDF has been used in 9 patients, 3 females and 6 males, in the intensive care units of cardiovascular surgery and urology clinics between February-July 1994. The ages of the patients ranged between 24-60 and the mean age was 43.8 years. Acute renal failure (ARF) has developed in 5 cases after various cardiac surgical procedures (double valve replacement in 2 cases, surgery for ascending aortic aneurysm in 1 case, surgery for descending aortic aneurysm in 1 case, cardiomyoplasty in 1 case). In 3 cases septic abortus was the reason for ARF and in 1 case, congestive heart failure was the causative factor (Table 1)-

In PACWHDF program applied to cases, blood flow rate was (QB) 100 ml/min, venous pressure was between 50-80 mmHg, dialysate flow (QD) rate was 0.85-1.0 L/hour, replacing liquid flow rate was 1-2 L/hour and heparin dose was 7.9-14.8 IU/kg/hour (Table 2).

During the applications of PACWHDF 14 kits were used for 9 patients. Mean utilisation time for 1 filter was 42.4 hours (24-72 hours) (Table 3).

Table 1. Etiology of the acute renal failure

Etiology	Number of cases	Result
Double valve replacement	2	Dead
Ascending aort aneurysm repair	1	Dead
Descending aort aneurysm repair	1	Dead
Cardiomyoplasty	1	Dead
Septic abortus	3	NRP
Congestive heart failure	1	NRF*

*Normal Renal Function

Table 2. Protocol for pump assisted continuous veno-venous hemodiafiltration

Blood flow rate	100 ml/min
Venous pressure	50-80 mmHg
Dialysate flow rate	0.85-1.0 L/Hour
Replacing liquid flow rate	1-2 L/Hour
Heparin dose	7.9-14.8 IU/kg/Hour

Table 3. The results of the pump assisted continuous veno-venous hemodiafiltration application

Patients	Duration of the therapy hours	Number of filters used	Total ultrafiltrate extraction
Case 1	144	2	8300 ml
Case 2	24	1	6200 ml
Case 3	96	2	5500 ml
Case 4	108	2	6000 ml
Case 5	53	2	7200 ml
Case 6	24	1	7600 ml
Case 7	96	2	6500 ml
Case 8	24	1	8200 ml
Case 9	24	1	7900 ml

RESULTS

PACWHDF has been applied to patients in changing intervals between 24-144 hours, mean application time was 65.8 hours (Table 3). Daily ultrafiltrate extraction from the patients changed between 5.5 l/day-8.3 L/day (mean- 7040 ml/day) (Table 3). Total amount at the end of the PACWHDF changed between 12L to 24L

Decrease in serum urea levels was achieved by 50% in the first 24 hours, and in the days following, the decrease was around 30% (Figure 1).

Out of 9 cases that PACWHDF therapy was applied, the cases that had ARF after septic abortus and congestive heart failure survived the treatment and their renal functions returned to normal levels soon after, but the postoperative cardiac surgery cases failed to respond to this form of therapy and were lost due to multiorgan failure. The overall mortality rate was 55.5% (Table 1).

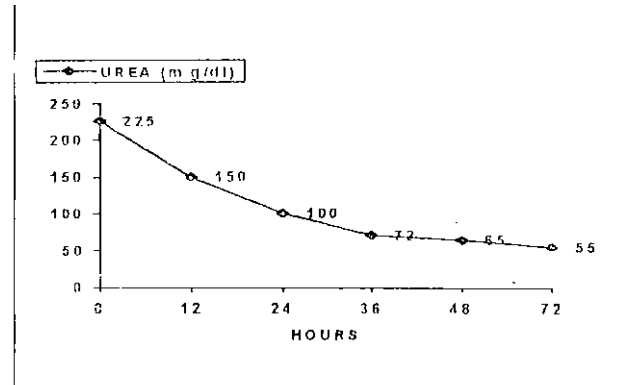


Figure 1. Mean blood urea levels of the cases during the application of pump assisted continuous veno-venous hemodiafiltration

DISCUSSION

The dependency of continuous arterio-venous hemofiltration to spontaneous blood flow causes the effective blood flow rate to decrease in the state of hypotension (1-3). However with PACWHDF, the freedom from the patients' blood pressure makes it possible to control the blood flow rate (6). Also, it is an advantage for PACWHDF to be applied with only 1 venous puncture and catheterisation that avoids the specific risks of arterial interventions, while arterio-venous hemofiltration needs both arterial and venous puncture and catheterisation. Its dependency on spontaneous blood flow, cause frequent filter clotting and clogging during the applications of continuous arterio-venous hemofiltration (1-3). Pump assistance in PACWHDF helps to avoid this complication. In our study, 14 kits were used for 9 patients, with a mean utilisation time for 1 filter of 42.4 hours. Canaud et al (6) reported the use of 16 kits in 10 cases with 63.2 hours of mean utilisation time for 1 filter. In another study, the same period was found as 69 hours (7). It has been observed that, due to low urea clearance in hypercatabolic state, serum urea levels tend to stay high if treated with continuous arterio-venous hemofiltration (5). This is not to be met in cases treated with PACWHDF because of its pump assistance modality.

We observed 50% decreases in serum urea levels in the first 24 hours and 30% decreases in the proceeding days. In other studies, the decrease has been found to be between 50-70% (6-8). In contrast with the continuous arterio-venous hemofiltration, during PACWHDF treatment the balance between ultrafiltrate extraction and replacement liquid substitution can be achieved with ease (6). While the daily ultrafiltrate output was found to be mean 7.04 L in our study, the other works on the subject reported values between 11.4 L/day to 21.4 L/day (6).

In the postoperative septic cases, the development of acute renal failure is usually the precursor of

forthcoming mult; organ failure (9). Pathogenesis of postoperative sepsis has not been defined clearly yet, but it is known that cytokines, such as tumor necrosis factor-a (TNF-a) is found in up to 66.6% of cases, and interleukin 1 beta (IL-1 β) is found in 55%, indicating an important role (9). With PACWHDF clearance of TNF-a was reported to be 30.7 L/day (14.1 mg daily excretion), and IL-1 β clearance to be 36.1 L/day (1 mg daily excretion) (9,10). The clearance of cytokines from the circulation forms one of the major advantages of the PACVHDF treatment in septic patients, which helps the clinical condition to improve. However, the 55.5% mortality rate in our study and mortality rates reported in other studies, such as 70-74% (6,8) suggest that, the success rate in cases with multi-organ failure seem hard to be improved. Clinical success rates have been reported to be as high as 100% in cases with only one organ or system failure, whereas this rate might fall to rates such as 10% in cases with 3 or more organ or system failures (8). For this reason, the timing of this treatment is of major importance.

This study presented here is not enough to draw straight conclusions on the matter. The number of the cases included in this study is not large. Further studies on the matter with different causes of acute renal failure should be performed. Within the light of the literature and the results obtained in our small series, PACWHDF treatment can be preferred because of its ease of use with one double-lumen venous catheter and its ease of control, in postoperative cases that develop acute renal failure due to septic insult, that are dependent on ventilator and positive inotropic agents, who carry the higher risk of developing multi-organ or system failure.

Akut böbrek yetmezliğinde pompa destekli sürekli venö-venöz hemofiltrasyon uygulaması

Türkiye Yüksek İhtisas Hastanesi, Kardiyovasküler Cerrahi ve Üroloji yoğun bakım ünitelerinde Şubat-Temmuz 1994 arasında akut böbrek yetmezliği tanısı alan 3'ü kadın toplam 9 olguda pompa destekli sürekli venö-venöz hemofiltrasyon (PACVHDF) uygulanmıştır. Hastaların yaşları 24-60 arasında olup yaş ortalaması 40.6 idi. İki hasta çift kapak yetmezliği, bir hasta asending aort anevrizması, bir hasta desending aort anevrizması ameliyatı, bir hasta kardiyomyoplasti uygulaması sonrası, üç hasta septik abortus sonrası ve bir hasta da konjestif kalp yetmezliği nedeni ile akut

böbrek yetmezliği gelişmiştir. Uygulanan program kan akımı 100 ml/dk, venöz basınç 50-80 mmHg, dializat akımı 0.85-1.0 L/saat, replasman sıvı akımı 1-2 L/saat, heparin 7.9-14.8 IU/kg/saat olacak şekilde ayarlandı. Dokuz hastaya 14 kit kullanıldı. Bir filtrenin kullanım süresi ortalama 42.4 saat idi. Tedavi süresince hastalardan toplam en az 12 L, en fazla 24 L ultrafiltrat çekildi. Üre düzeylerinde ilk 24 saatte %50, bundan sonraki saatlerde %30 oranında azalma sağlandı. Sonuç olarak PACVHDF kullanımı tek venöz girişimle, çift lümen kateterle gerçekleşen, postoparatif akut böbrek yetmezlikle birlikte olan multi organ yetmezliği ve septik şok gelişen olgularda tercih edilen bir yöntemdir. [Turk J Med Res 1995; 13(1): 31-33]

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