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Sustained Low-Efficiency Dialysis in the intensive care unit: a single centre experience

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ABSTRACT

Introduction: Renal dysfunction in the critically ill patient is a serious clinical situation with high mortality. A new approach in renal replacement therapy is slow extended dialysis, which combines the advantages of continuous renal replacement treatment and intermittent haemodialysis. This study reports our first year of slow extended dialysis at our institution.

Patients and Methods: Retrospective study of the clinical files of patients who were started on slow extended dialysis in our centre from October 2006 to September 2007. For each patient the following data were registered: age, gender, diagnostic group, severity of disease (SAPS II), comorbidities, causal factors and stage of acute kidney injury, length of intensive care unit stay, mortality rate and renal outcome. Slow extended dialysis consisted of a minimum of 6h of haemodialysis at least 6 days a week.

Results: We performed 329 slow extended dialysis treatments in 43 patients during this 12-month period. Mean patient age was 60±15 years and 60% were male. Sepsis was the major cause of Intensive Care Unit admission (n=27; 62.7%). Twenty-one patients (48.8%) had pre-existing renal chronic disease and 10 patients (23.2%) end-stage renal disease. Ischaemic acute tubular necrosis was the major mechanism of kidney injury (81.8% of patients). All patients started slow extended dialysis in the failure stage of the RIFLE classification. Mean time of slow extended dialysis was 8.1±8.2 days. 25.5% (n=11) of the patients recovered renal function; 18.6% (n=8) developed end-stage renal disease and the mortality rate was 46.5%. Although inferior to the average SAPS II predicted death rate (53.7%), the difference was not statistically significant (p=0.140).

Conclusions: Slow extended dialysis constitutes a safe and effective alternative to classic dialysis strategies in the critical ill patient and it will probably become a first choice technique over the next decade. A successful implementation relies on a synergic cooperation between intensive care and nephrology medical and nursing staffs, with clear perception of the role played by each party.

Key-Words:
Acute Kidney Injury (AKI); Intensive Care Unit (ICU); renal failure; Sustained Low-Efficiency Dialysis (SLED).

INTRODUCTION

Renal dysfunction in the critically ill patient is a serious clinical situation with high mortality. Three different types of renal replacement therapy can be offered to these patients: continuous renal replacement therapies (CRRT), intermittent haemodialysis (IHD) and hybrid techniques[1].

There are both advantages and disadvantages to CRRT and IHD. Continuous therapies are preferable for volume control with increased cardiovascular stability; they allow removal of large quantities of fluids without a great haemodynamic impact due to a slower rate of fluid removal[2,3]. They also provide an excellent azotaemia and solute control even in severely catabolic patients[4]. The main disadvantages are their high cost and the frequent interruptions required by out-of-unit procedures which lead to a reduction in dialysis dose. IHD allows for a greater volume removal with shorter treatment times but haemodynamically unstable patients are not able to tolerate the higher ultrafiltration rates. Moreover, as solute and fluid control is only periodic, there is always a greater risk of solute disequilibrium and water shifts with clinical consequences.

A new approach in renal replacement therapy is sustained low efficiency dialysis (SLED)[5,6], which combines the advantages of CRRT and IHD: low ultrafiltration rates maintaining haemodynamic stability; low efficiency solute removal, minimising solute imbalance; long treatment times, providing high delivered dialysis dose; intermittent treatments. This technique provides a valuable alternative to the classical dialysis strategies offered to the intensive care patient. It uses adapted IHD equipment, including machinery, haemodialysers and extracorporeal blood circuits.

This study reports the first year of SLED at our institution.

PATIENTS AND METHODS

All critically ill patients requiring renal replacement therapy have been considered for SLED from October 2006. Patients who were persistently hypotensive demanding increased vasopressor support were preferentially treated with CRRT. On the other hand, once patients attained haemodynamic stability, without inotropic or vasopressor support, tolerating augmented blood flows and ultrafiltration rates IHD was initiated.

Before implementing the programme in the intensive care units (ICUs), several training sessions for the ICU nursing staff were given by a nephrology nurse. Treatments were predominantly nocturnal, allowing out-of-unit procedures, much more common during the day. Patients were proposed for SLED by the intensive care doctor and the nephrologist assumed medical responsibility for SLED. SLED prescription and objectives, namely ultrafiltration volume, were discussed and decided between nephrologists and ICU physician. Nephrology nurses were responsible for the provision, initiation and termination of each SLED session. They did not need to be in the ICU, but were on-call 24 hours per day for bedside advice or assistance to the ICU nurse taking care of the patient during SLED treatment. ICU nurse/patient ratio was not affected by the introduction of SLED technique. Each nephrology nurse could only be responsible for three concurrent treatments at any one time. ICU nurses were responsible for monitoring the treatment, flushing the system and handling routine alarms.

SLED treatments were performed using the Gambro 200S dialysis machine and F5 low-flux polysulfone (Fresenius Medical Care) haemodialyser and consisted of a minimum of 6h of haemodialysis (usually between 8 and 12 hours) at least 6 days a week. Countercurrent dialysate flows were routinely set to 300ml/min. Dialysate composition varied according to clinical needs. Most commonly the dialysate solution contained Na^+ 135-140 mEq/L, Ca^{2+} 2.5 mEq/L and HCO_3^- 26-30mmol/L. Blood flows were set at 200 ml/min. Ultrafiltration goals were determined by clinical needs. Angioaccess was provided by catheterisation of a central vein by the ICU team, usually the femoral vein. In the absence of contraindication, low dose unfractionated heparin was concurrently administered in all treatments to prevent extracorporal circuit clotting (usually at a rate of 500U/h).

Data were retrospectively collected from the clinical files of all patients who initiated SLED in our centre between October 2006 and September 2007. For each patient we registered the following data: age, gender, diagnostic group (sepsis, postoperative sepsis, no sepsis), severity of disease (SAPS II), comorbidities, causal factors and stage of acute kidney injury (AKI) according to the RIFLE classification, length of ICU stay, mortality rate and renal outcome. Differences between mortality and predicted mortality according to SAPS II score were evaluated by chi-square analysis. A p-value less than 0.05 was accepted as statistically significant.

To access procedural simplicity, we registered the number of extra calls (all calls besides those for initiation and termination of SLED) to nephrology nurses for technical support during SLED treatments.

RESULTS

A total of 329 SLED treatments were performed in 43 patients over this 12-month period. Mean patient age was 60±15 years and 60% were male. Sepsis was the major cause of ICU admission (n=27; 62.7%), presenting postoperatively in 12 patients. The mean SAPS II score was 59.0 and the predicted death rate 53.7%. The most prevalent comorbid disease was hypertension. In terms of previous renal history, 17 patients (39.5%) had pre-existing chronic renal disease and 10 patients (23.2%) end-stage renal disease (ESRD) (Fig. 1).

In patients with AKI (n=33), ischaemic acute tubular necrosis (ATN) was the major mechanism of kidney injury (81.8% of patients); one patient had a crescentic glomerulonephritis with rapidly progressive renal insufficiency; one patient had rhabdomyolysis-induced AKI (Table 1). All of these patients started SLED in the failure stage of the RIFLE classification (GFR criteria: serum creatinine × 3, or serum creatinine ≥ 4 mg/dl with an acute rise › 0.5 mg/dl and/or urine output criteria: ‹ 0.3 ml/kg/hour × 24 hours, or anuria × 12 hours).

Table 1

Distribution of patients by renal injury group

ESRD		23.2%
AKI	Ischaemic	81.8%
	Toxic component	12.1%
	Others	6.1%

The median ICU length of stay was 17 days (2-240 days); mean time of SLED was 8.1±8.2 days and mean number of SLED sessions per patient was 7.6 (1-43 SLED sessions). During this time period, we performed an average of 27.4±16.9 sessions per month.

In the AKI group, 25.5% (n=11) of the patients recovered renal function (47.8% of those that survived) while 18.6% (n=8) developed ESRD.

The overall mortality rate was 46.5% (Fig. 2); 60% of ESRD patients died. Although the actual mortality rate was inferior to the SAPS II predicted death rate (53.7%), this was not statistically significant (p=0.140). When comparing the distribution by tertiles of the predicted death rate by SAPS II score with the mortality of those patients, they were also not significantly different (p=0.414).

In terms of technical support, during this first year, an average of one extra call for each two SLED treatments occurred. In the last 3 months the number of extraordinary calls declined – one extra call for each five SLED treatments.

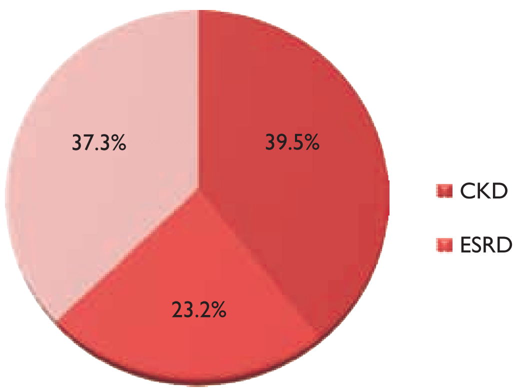

Figure 1

Previous kidney function

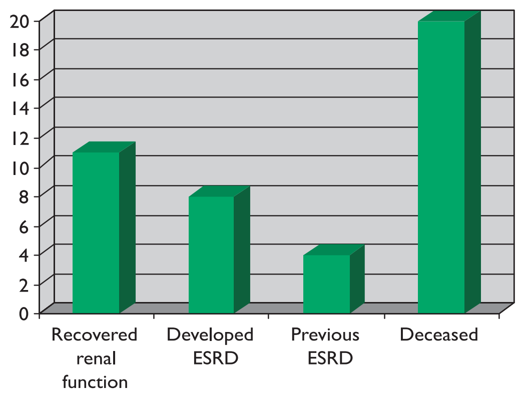

Figure 2

Renal outcome

DISCUSSION

We performed 329 SLED treatments in 43 patients over the study period, a number significantly superior to previous reports in literature[5].

Our experience was similar to what has been reported: SLED constitutes a safe, effective and less expensive alternative to the classic dialysis strategies in the critically ill patient[7]. SLED presents several advantages over CRRT. It requires fewer interventions by the ICU nursing personnel, with a less intensive burden of work compared to CRRT. The fact that the treatment is not continuous provides a better compliance with out-of-unit procedures, which are performed without interrupting the treatment and with no effect on dialysis dose. The use of low blood flows, with lower ultrafiltration rates, allows a better haemodynamic control than conventional haemodialysis, which is an essential feature for critically ill, unstable patients. Another important issue is the high cost of CRRT as specialised machinery, lines and filters and high volumes of replacement fluids for dialysate or filtrate are needed. It has been reported that daily costs for CRRT are between 6 and 8 times higher than those for hybrid therapy[8,9].

According to our experience, we believe that SLED is a valuable alternative for renal replacement therapy in the critically ill patient and will probably become a first choice technique over the next decade. A successful implementation relies on a synergic cooperation between intensive care and nephrology medical and nursing staffs, with clear perception of the role played by each party.

Conflict of interest statement. None declared.

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