

Slow Low Efficiency (Daily) Dialysis – SLE(D)D

Patients with Acute Kidney Injury requiring renal replacement therapy can be managed either by intermittent or continuous dialysis therapies, depending on their cardiovascular stability and the intended rate of fluid removal (ultrafiltration). Generally, the rate of solute and fluid removal determines cardiovascular stability, so haemodynamics are improved with longer duration, allowing slower diffusion and ultrafiltration rates. Whilst CVVH is the preferred modality in the critical care setting, to date there is no compelling evidence to suggest that intermittent therapies are inferior in terms of mortality or restoration of residual renal function [1-3].

SLED is a hybrid modality that provides RRT for an extended period of time (ranging from 6 to 18 hours) but is intermittent in frequency (minimum 3 x week, typically 5 x week) [4]. SLED offers advantages for patients requiring frequent interventions or repositioning and for patients where continuous anticoagulation is to be avoided. The intermittent nature of SLED also allows several patients to receive ongoing renal replacement therapy using the same machine if resources are limited.

A comparison of three typical modalities is highlighted in the table below:

Modality	IHD	SLED	CVVH
Frequency	3 x week	4-6 x week	Daily
Duration	4 hours	8 hours	24 hours
Blood Pump Speed	300-400 mls/min	200-300 mls/min	100-200 mls/min
Dialysate Flow rate	500-800 mls/min	300-400 mls/min	Determined by wgt.
Stability	-	-/+	+
Anticoagulation	Usually LMWH	LMWH / UFH	UFH/Regional

The SLED Procedure

1. Equipment required:

SLED can be performed on standard intermittent haemodialysis machines, but these require the capability to run at low blood and dialysate flow rates. At present, the RD&E are using the Gambro A200S with RO addition on ICU, with some limitations on dialysate flow rates as described below. Lining and priming requires standard extracorporeal circuit tubing. High-

flux, high efficiency dialysers (e.g. FX80 or FX100) are preferred to achieve target clearance, but theoretically and anecdotally, filter clotting may be reduced when using dialysers with lower surface areas, such as FX8 (at the expense of efficiency).

2. Vascular Access

Patients can dialyse through a line, fistula or graft, but it should be noted that longer-duration and higher frequency treatments will result in higher attrition and the incidence of access complication increases with these modalities. There is also an increased risk of needle dislodgement in extended treatments so access should be adequately secured and monitored [4]. Post-dialysis needle site bleeding times may be increased in patients on the higher dose of anticoagulation required for extended duration treatments.

3. Duration and Frequency of SLED

SLED should be performed at least three times per week to provide an adequate dialysis dose, but some patients require daily treatment. A frequency of 5 times weekly is typical. The prescribed duration may range from 6 to 18 hours but is typically 8 hours. The treatment duration is varied according to the needs of the patient (usually the obligatory ultrafiltration rate) and hemodynamic stability. The treatment time is limited to approx. 11 hours with use of the AK200S Gambro machine because of the volume of dialysate available for each treatment (see below).

4. Dialysate Composition

As a general rule, patients dialysing for longer durations require higher concentrations of potassium and calcium in the dialysate. Therefore, patients receiving SLED for >6hrs should be started on an A453 (K 3.0; Ca 1.25) with adjustments made according to intra-dialytic ABG sampling or post-dialysis biochemistry. Other constituents such as sodium and glucose do not change with duration of treatment.

5. Blood Flow/Blood Pump Speed

A typical starting blood flow (QB) is 200-300mls/min, depending on quality of the access. Higher QB may reduce clotting of the circuit/dialyser and allow for lower doses of anticoagulation. Contrary to previous opinion, increasing QB does not affect haemodynamic stability. Solute clearance may be improved with higher QB but is limited by the saturation of dialysate at low dialysis flow rates.

6. Dialysate Flow Rates (QD)

The dialysate flow rates typically range between 100 to 300 mL/min for SLED. However, the AK200S Gambro machines on RD&E ICU are limited to a minimum of 300ml/min. A 6000ml dialysate can is diluted in a 34:1 mix, so will make a total dialysis volume of 204 Litres per session. Assuming a constant flow rate of 300mls/min, then this will allow for a maximum

treatment time of $204/18 = 11.3$ hours. Large differences in technical success/filter clotting or patient outcomes for different dialysate flow rates have not been shown for SLED.

7. Ultrafiltration rates

As an extended duration therapy, SLED allows for a significant reduction in UF rates when compared to intermittent HD. As a rule, UF rates $<5\text{ml/kg/hr}$ (eg 350ml/hr for 70kg patient) are optimal to allow time for vascular refilling and minimise the risk of haemodynamic instability.

8. Anticoagulation

Strategies for anticoagulation vary widely between units, and no single approach appears optimal. Critically ill patients may be prone to both thrombosis and bleeding, and the metabolism of anticoagulant may be affected by acute liver and/or renal failure. Even patients on 'therapeutic' regular anticoagulation may require additional anticoagulant to prevent clotting of the extracorporeal circuit. Regional anticoagulation has been used successfully in challenging cases but requires experienced staff and regular monitoring.

Some options are given below:

- Unfractionated Heparin:
Loading dose typically $1000\text{-}2000$ units with a maintenance dose of 1000 units/hr given by continuous infusion. The APPT may not be representative of bleeding risk in patients with critical illness.
- LMWH:
It should be noted that the potential for accumulation increases significantly for higher frequency (daily) treatments when compared to alternate-day treatments. Monitoring of Factor Xa levels is strongly advised.

Andrew Davenport at the Royal Free suggests the following strategy for patients on extended duration HD treatments:

"For sessions >6 hours either single bolus 4500 tinzaparin or split dose with 3500 at start and 2500 after 3 hours

Empirical increasing/decreasing dosage based on observation blood streaking/clot formation in air chamber vs aiming for < 7 minute time for bleeding to stop from needle puncture sites.

If using Enoxaparin or dialysis dialysis $> 4\text{hr}$ (including nocturnal dialysis) - start Enoxaparin 0.8 mg/kg and then adjust as above"

References

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4. Edrees F, Li T, Vijayan A. Prolonged Intermittent Renal Replacement Therapy. *Adv Chronic Kidney Dis* 2016; 23:195.

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