Dialysis Dose and Adequacy

Introduction

HD provides only a fraction of some of the numerous functions performed by the native kidneys. Patients receiving inadequate dialysis suffer from malnutrition, inflammation, and a poor quality of life. In addition, these conditions may lead to accelerated atherosclerosis. Since 1981, inadequate dialysis has been shown to adversely affect survival, while increasing the frequency and duration of dialysis improved both survival and quality of life and medication amounts. No single clinical or laboratory parameter can assess the adequacy of dialysis, and overt signs may develop very late, hence it is necessary to develop a comprehensive monitoring system of measuring the adequacy of dialysis which is also easy to use and reproducible. Some of these guidelines are set down in the following document.

Recommendations

Recommendations/guidelines suggested are based on international data and local experience.

We recommend that patients on MHD must receive three times dialysis in a week for at least 4 h each time with blood flows of 300 ml/min and dialysate flows of 500 ml/min. MHD less than twice a week (<8 h in two sessions) is not recommended.

• We suggest that CKD Stage V patients with residual renal function >10 mL/min with indication for initiating dialysis may consider incremental dialysis

• We suggest that those on twice-a-week dialysis, may be given longer dialysis for 6 h, i.e., at night.

• We recommend that residual renal function must be monitored every 3 months. It should be determined by an average of 24 h urea and creatinine clearance. Monitor rigorously for malnutrition, urine output, and fluid overload – increase dialysis to three times/week if patient not doing well clinically on twice-weekly dialysis.

• We recommend that Kt/V or urea reduction ratio (URR) be used as a measure of dialysis prescription

URR is a simpler method to determine dialysis adequacy. URR should be targeted to >65%. Postdialysis sample should be taken 2 min after dialysis or during slowing pump speed to 100 ml/min and sample should be taken 15 s later.

Kt/V of 1.4–1.6 should be achieved in each dialysis.

We suggest that the minimally adequate dose of dialysis can be reduced among patients with residual kidney function of >2 mL/min/1.73 m², although the minimum spKt/V should be no lower than 60% of the minimum target for those without residual renal function.

An assessment of the dialysis dose in stable HD patients should be performed once per month. More frequent measurements may be required in patients not doing well on dialysis.

We recommend a search for causes of a low Kt/V or URR and should include:

• An assessment of fistula integrity

• Treatment duration

• Possible technical errors in the method of obtaining blood urea nitrogen (BUN) samples

• Dialysis machine and patient-specific variables such as:
  • Inadequate machine calibration
  • Low blood flow rates
  • Hypotensive episodes that require changes in treatment
  • Overestimation of dialyzer clearance.

• Measures should be incorporated to improve effective HD treatment times, improve blood flows, correct errors in blood sampling, or improve dialyzer clearance.

Dialysis adequacy is related also to other related variables. Lower death risk in dialysis patients is associated with:

• Dialysis time >4 h

• Predialysis BUN between 70 and 90 mg/dL with adequate protein catabolic rate (PCR)

• Low requirement for erythropoietin (EPO) and antihypertensive drugs

• Plasma albumin >4 g/dL.

• Plasma cholesterol between 200 and 300 mg/dL.

• Predialysis creatinine >12.5 mg/dL.

We recommend that dialysis adequacy also needs to be assessed by the clinical well-being of the patient assessed by a regular monthly clinical checkup of dialysis patients in the clinic along with monthly hematology and biochemistry reports and other tests as required.

Nocturnal daily dialysis or daily dialysis has been shown to improve dialysis outcomes even further. These need to be validated in more studies.

Currently, many newer dialysis machines have online Kt/V monitors which provide measures of Kt/V delivered. They offer the advantage of monitoring the dose of dialysis delivered in each dialysis session, do not require a lag time, and no blood collection is required. We suggest that where available, these may be used for more frequent monitoring.

As the machine software uses the Watson formula to calculate V, it is often overestimated and consequently Kt/V measured by online sodium or conductivity monitoring underestimates urea-based measurements by around 0.03. It is recommended to measure spKt/V or URR at least once a month even when online Kt/V is available and is being monitored on the machine.
**Explanation and Discussion**

Assessment of adequacy of HD is important. Monitoring the patient’s symptoms alone, as is commonly done in India, is insufficient as dialysis and EPO to correct anemia may eliminate most symptoms for many months even when patients are underdialyzed. Following BUN and creatinine is insufficient because a low BUN and creatinine may reflect malnutrition and poor muscle mass rather than sufficient dialytic removal, also a common clinical state in our dialysis population. PCR and timed average urea concentration have been shown to be important determinants of morbidity and mortality as shown by the National Cooperative Dialysis Study.

Urea clearance has been used mechanistically in a formula $Kt/V$ and shown to reflect the amount of dialysis prescribed and delivered. $Kt/V$ is defined as dialyzer clearance of urea ($K$ obtained from manufacturer of dialyzer and is available as ml/min), multiplied by duration of dialysis and divided by volume of distribution of urea in the body ($V$ in ml), which is approximately equal to total body water. Individualizing dialysis prescription is a useful method to achieve a cost-effective dialysis treatment. Dialysis dose can be measured by kinetic urea modeling ($Kt/V$) or by simple URR.

There is no universally accepted target value for the $Kt/V$. It is recommended that target sp$Kt/V$ of approximately 1.4 to 1.6 be achieved. These levels are consistent with the 2006 Kidney Disease Outcomes Quality Initiative (K/DOQI) guidelines for HD patients with minimal residual renal function (<2 mL/min/1.73 m²).

Residual renal function facilitates the regulation of fluid and electrolyte balance and may enhance survival. The 2006 K/DOQI clinical practice guidelines recommend that the minimally adequate dose of dialysis can be reduced among patients with residual kidney function of >2 mL/min/1.73 m², although the minimum sp$Kt/V$ should be no lower than 60% of the minimum target for those without residual renal function.

The HEMO study established that the risk of death (primary outcome) and secondary outcomes of combined hospitalization and death were not different between high-dose versus standard-dose and high-flux versus low-flux dialysis. In India, majority of the patients on MHD receive twice-a-week dialysis. Dialysis dose received by patients is mostly not measured, and we do not have studies to provide any specific guidelines based on Indian data. However, such patients should have more frequent measurements of residual renal function and if it is <2 ml/min/1.73 m², then thrice-a-week dialysis should be recommended.