II.5 Dialysis schedules

Guideline II.5.1

A. The standard HD dose should be delivered as 3×4 h. Even if the standards of adequacy such as dose expressed as eKt/V are reached, a minimum time of 3×4 h/week is desirable.
(*Evidence level: B*)

Guideline II.5.2

A. Treatment time and/or frequency should be increased in patients with haemodynamic instability or cardiovascular problems. The same may apply for the aged HD patients, who suffer more frequently from the above-mentioned conditions.
(*Evidence level: B*)

Commentary on Guidelines II.5.1 and II.5.2

Effects of different HD schedules regarding solute removal

Dialysis schedules of different frequency have been compared theoretically with an index, the standard Kt/V (std Kt/V) [198], that utilizes the ratio of generated urea to peak urea concentration, and equates all HD doses to continuous therapy. The modelled dose of therapy equivalent to the recommended weekly CAPD Kt/V of 2.0 was a spKt/V of 1.2 per 3.5-h session with thrice-weekly HD, or a spKt/V of 0.4 to 0.3 with daily HD, depending on the length of the session (2–8 h) [198].

The more frequently intermittent HD is performed, the more it approaches continuous therapy. When HD was simulated at different frequency and length with a variable-volume double-pool model [151], it was shown that, relative to a standard three times weekly HD regimen:

- daily/short-time HD of similar total (weekly) duration results in modest (3–6%) increases in effective small solute and MM removal,

- daily low-flow/long-time HD substantially increases the effective removal of all solutes,
- three times weekly low-flow/long-time HD results in comparable effective small solute removal and progressive increases in MM and β2-m removal.

Treatment time *per se* affects solute removal in spite of similar Kt/V for urea. This is particularly true for intermediate-size molecules [199].

Impact on morbidity and mortality

Length of the treatment session. An adequate removal of small solutes may be delivered in very short times ($\sim$2–2.5 h) with high flux, high efficiency treatments [200,201].

Small and time-limited experiences in single renal units [202,203] and reports on large databases [48,52,204], did not show significant effects of the length of the sessions on patient morbidity and survival, provided that patients had received an adequate HD dose (URR $>$65–70% or Kt/V $>$1.3). However, prescribed HD time in the majority of patients of the latter two studies covered a narrow range, with very few session-time cases of $>$5 h, which makes definite conclusions impossible.

Conversely, other reports suggested an association between HD length and risk of death. It is well known that a very long survival was reported by the Tassin Group. Patients dialyzed twice or thrice weekly for a total of 22–24 h/week [118,119,205], had a better survival, less intradialytic complications and better blood pressure control than patients in Europe, the US, and Japan, treated during conventional HD times. Mean spKt/V was remarkably high in the long sessions. However, these results have been ascribed mainly to an excellent control of hypertension, with minimal antihypertensive therapy, favoured by a better intradialytic weight removal through smooth UF during the long sessions, and a subsequent reduced cardiovascular morbidity and mortality [206,207].

Recently, a survey on a large Japanese database showed a progressively decreasing risk of death in HD patients as the session duration increased until 5 h [53]. Dialysis duration up to 5.5 h was independently associated with survival even after adjustment of the RR of death by the dose of HD, either in terms of spKt/V [122] or of eKt/V [54]. This finding suggests that shorter HD times may be associated with increased risk of death even when an adequate dose of therapy is delivered.

Daily dialysis. Long, slow, nocturnal HD is performed 6–7 nights per week for 8–10 h during sleep at home. The results of a single unit, 3 years experience in 170 patients/months [208], updated to 5 years [209], reproduced the results of the Tassin experience in terms of patient well being, control of blood pressure with reduced use of antihypertensive drugs, reduced incidence of intradialytic hypotension and cardiovascular complications. Slow nocturnal HD provided, at the same time, an increased weekly clearance of MM [210], and phosphate, with control of hyperphosphatemia without any phosphate binders [211].

Short/standard daily HD. Prolonged experience in a single unit with daily HD sessions of 2–2.5 h and 'standard efficiency' [212,213], similarly to other more limited experiences [214,215], reported better control of hypertension and intradialytic fluid removal, improved nutritional status (increase in serum albumin, and dry weight), with substantial benefits in terms of well being. These were attributed to increased small- and middle-MW solute clearances and to a lower peak concentration of uraemic toxins. The more intensive use of the vascular access did not cause an increased incidence of complications and did not reduce access survival [213]. Similar conclusions were reported in a recent publication of a retrospective data collection from nine centres involving 72 patients shifted from standard HD to a daily HD schedule (1–3 h, 5–7 times per week) and followed for 6 months [216].

No prospective randomized studies, comparing intermittent treatments at variable frequency on a large number of patients are available yet.

The best HD long-term survival rates have been reported by the groups that used the largest doses and the longer times. Effects of dose and time are difficult to disentangle. Thus, it cannot be assumed that treatment time *per se* can replace Kt/V or other quantitative indices of HD adequacy.

Prospective controlled studies on large number of patients are necessary to confirm the other claimed advantages of long daily schedules, attributed to an improved removal and lower blood level of uraemic toxins of various molecular size.

A unique index combining the effects of HD therapy and residual renal clearance should be defined and validated in order to compare intermittent HD treatments at variable frequency with continuous treatments (peak concentration hypothesis [106], standard Kt/V [198], equivalent renal clearance [189]).

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