**National Quality Forum—Evidence (subcriterion 1a)**

**Measure Number** (*if previously endorsed*)**:** Click here to enter NQF number

**Measure Title**: Ultrafiltration rate greater than 13 ml/kg/hr

**IF the measure is a component in a composite performance measure, provide the title of the Composite Measure here:** Click here to enter composite measure #/ title

**Date of Submission**: 2/27/2015

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| **Instructions**  *For composite performance measures:*  *A separate evidence form is required for each component measure unless several components were studied together.*  *If a component measure is submitted as an individual performance measure, attach the evidence form to the individual measure submission.*   * Respond to all questions as instructed with answers immediately following the question. All information needed to demonstrate meeting the evidence subcriterion (1a) must be in this form. An appendix of *supplemental* materials may be submitted, but there is no guarantee it will be reviewed. * If you are unable to check a box, please highlight or shade the box for your response. * Maximum of 10 pages (*incudes questions/instructions*; minimum font size 11 pt; do not change margins). ***Contact NQF staff if more pages are needed.*** * Contact NQF staff regarding questions. Check for resources at [Submitting Standards webpage](http://www.qualityforum.org/Measuring_Performance/Submitting_Standards.aspx). |

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| **Note: The information provided in this form is intended to aid the Steering Committee and other stakeholders in understanding to what degree the evidence for this measure meets NQF’s evaluation criteria.**   1a. Evidence to Support the Measure Focus The measure focus is evidence-based, demonstrated as follows:   * Health outcome: [**3**](#Note3) a rationale supports the relationship of the health outcome to processes or structures of care. Applies to patient-reported outcomes (PRO), including health-related quality of life/functional status, symptom/symptom burden, experience with care, health-related behavior. * Intermediate clinical outcome: a systematic assessment and grading of the quantity, quality, and consistency of the body of evidence [**4**](#Note4)that the measured intermediate clinical outcome leads to a desired health outcome. * Process: [**5**](#Note5) a systematic assessment and grading of the quantity, quality, and consistency of the body of evidence [**4**](#Note4) that the measured process leads to a desired health outcome. * Structure: a systematic assessment and grading of the quantity, quality, and consistency of the body of evidence [**4**](#Note4) that the measured structure leads to a desired health outcome. * Efficiency: [**6**](#Note6) evidence not required for the resource use component.   **Notes**  **3.** Generally, rare event outcomes do not provide adequate information for improvement or discrimination; however, serious reportable events that are compared to zero are appropriate outcomes for public reporting and quality improvement.  **4.** The preferred systems for grading the evidence are the U.S. Preventive Services Task Force (USPSTF) [grading definitions](http://www.uspreventiveservicestaskforce.org/uspstf/grades.htm) and [methods](http://www.uspreventiveservicestaskforce.org/methods.htm), or Grading of Recommendations, Assessment, Development and Evaluation [(GRADE) guidelines](http://www.gradeworkinggroup.org/publications/index.htm).  **5.** Clinical care processes typically include multiple steps: assess → identify problem/potential problem → choose/plan intervention (with patient input) → provide intervention → evaluate impact on health status. If the measure focus is one step in such a multistep process, the step with the strongest evidence for the link to the desired outcome should be selected as the focus of measurement. Note: A measure focused only on collecting PROM data is not a PRO-PM.  **6.** Measures of efficiency combine the concepts of resource use and quality (see NQF’s [Measurement Framework: Evaluating Efficiency Across Episodes of Care](http://www.qualityforum.org/Publications/2010/01/Measurement_Framework__Evaluating_Efficiency_Across_Patient-Focused_Episodes_of_Care.aspx); [AQA Principles of Efficiency Measures](http://www.aqaalliance.org/files/PrinciplesofEfficiencyMeasurementApril2006.doc)). |

**1a.1.This is a measure of**: (*should be consistent with type of measure entered in De.1*)

Outcome

Health outcome: Click here to name the health outcome

Patient-reported outcome (PRO): Click here to name the PRO

*PROs include HRQoL/functional status, symptom/symptom burden, experience with care, health-related behaviors*

Intermediate clinical outcome (*e.g., lab value*): ultrafiltration rate

Process: Click here to name the process

Structure: Click here to name the structure

Other: Click here to name what is being measured

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**HEALTH OUTCOME/PRO PERFORMANCE MEASURE**  *If not a health outcome or PRO, skip to* [*1a.3*](#Section1a3)

**1a.2.** **Briefly state or diagram the path between the health outcome (or PRO) and the healthcare structures, processes, interventions, or services that influence it.**

N/A

**1a.2.1.** **State the rationale supporting the relationship between the health outcome (or PRO) to at least one healthcare structure, process, intervention, or service (*i.e., influence on outcome/PRO*).**

*Note: For health outcome/PRO performance measures, no further information is required; however, you may provide evidence for any of the structures, processes, interventions, or service identified above.*

N/A

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**intermediate outcome, PROCESS, or STRUCTURE PERFORMANCE measure**

**1a.3.****Briefly state or diagram the path between structure, process, intermediate outcome, and health outcomes**. Include all the steps between the measure focus and the health outcome.

The ultrafiltration rate measures the rapidity with which fluid is removed at dialysis per unit (kg) body weight in unit (hour) time. It is under control of the dialysis facility providers and is monitored throughout the hemodialysis session. Rapid rates of fluid removal at dialysis can precipitate events like intradialytic hypotension, or subclinical yet significantly decreased organ perfusion, and in the case of the myocardium, leading to adverse phenomena such as myocardial stunning, which over time can result in myocardial damage and heart failure, thereby resulting in higher mortality. Intradialytic hypotension resulting from rapid fluid removal can result in all the complications of hypotension including dizziness, syncope, falls, post-dialysis fatigue and lower quality of life, as well as death or hospitalization. Flythe et al examined UFR thresholds <10, 10-13 and >13 (Flythe 2011). Between UFR of 10-13, the differences were not statistically different although there was a demonstrably rising risk of cardiovascular mortality using a cubic spline function between UFR thresholds of 10 and 13ml/kg/hour, and continuously rising risk for UFR higher than 13ml/kg/hour.

**1a.3.1.** **What is the source of the systematic review of the body of evidence that supports the performance measure?**

Clinical Practice Guideline recommendation – ***complete sections*** [***1a.4***](#Section1a4)***, and*** [***1a.7***](#Section1a7)

US Preventive Services Task Force Recommendation – ***complete sections*** [***1a.5***](#Section1a5) ***and*** [***1a.7***](#Section1a7)

Other systematic review and grading of the body of evidence (*e.g., Cochrane Collaboration, AHRQ Evidence Practice Center*) – ***complete sections*** [***1a.6***](#Section1a6) ***and*** [***1a.7***](#Section1a7)

Other – ***complete section*** [***1a.8***](#Section1a8)

*Please complete the sections indicated above for the source of evidence. You may skip the sections that do not apply.*

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**1a.4. CLINICAL PRACTICE GUIDELINE RECOMMENDATION**

**1a.4.1.** **Guideline citation** (*including date*) and **URL for guideline** (*if available online*):

2009 UK Renal Association Guidelines for Hemodialysis

<http://www.renal.org/Clinical/GuidelinesSection/Haemodialysis.aspx>

**1a.4.2.** **Identify guideline recommendation number and/or page number** and **quote verbatim, the specific guideline recommendation**.

8.3: We suggest that the maximum hourly ultrafiltration rate during haemodialysis should not exceed 10ml/kg/hour.

**1a.4.3.** **Grade assigned to the quoted recommendation with definition of the grade:**

The above recommendation was graded using the GRADE system as level “2C”.

**1a.4.4. Provide all other grades and associated definitions for recommendations in the grading system.** (*Note: If separate grades for the strength of the evidence, report them in section 1a.7.*)

The authors cited a modified GRADE system:

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| Grade | Patients | Clinicians | Policy |
| Level 1  “We recommend” | Most people in your situation would want the recommended course of action and only a small proportion would not. | Most patients should receive the recommended course of action | The recommendation can be evaluated as a candidate for developing a policy or performance measure |
| Level 2 “We suggest” | The majority of people in your situation would want the recommended course of action, but many would not. | Different choices will be appropriate for different patients. Each patient needs help to arrive at a management decision consistent with her or his values and preferences. | The recommendation is likely to require substantial debate and involvement of stakeholders before policy can be determined. |

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| Grade | Quality of Evidence | Meaning |
| A | High | We are confident that the true effect lies close to the estimate of that effect. |
| B | Moderate | The true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different. |
| C | Low | The true effect may be substantially different from the estimate of the effect. |
| D | Very Low | The estimate of the effect is very uncertain, and often will be far from the truth. |

**1a.4.5. Citation and URL for methodology for grading recommendations** (*if different from 1a.4.1*)**:**

GRADE Working Group. Systems for grading the quality of evidence and the strength of recommendations II: a pilot study of a new system for grading the quality of evidence and the strength of recommendations. BMC Health Serv Res 2005 2005; 5: 25.

Uhlig K, Macleod A, Craig J et al. Grading evidence and recommendations for clinical practice guidelines in nephrology. A position statement from Kidney Disease Improving Global outcomes (KDIGO). Kidney Int 2006;70:2058-2065

**1a.4.6. If guideline is evidence-based (rather than expert opinion), are the details of the quantity, quality, and consistency of the body of evidence available (e.g., evidence tables)?**

Yes **→ *complete section*** [***1a.7***](#Section1a7)

No **→ *report on another systematic review of the evidence in sections*** [***1a.6***](#Section1a6) ***and*** [***1a.7***](#Section1a7)***; if another review does not exist, provide what is known from the guideline review of evidence in*** [***1a.7***](#Section1a7)

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**1a.5.** **UNITED STATES PREVENTIVE SERVICES TASK FORCE RECOMMENDATION**

**1a.5.1.** **Recommendation citation** (*including date*) and **URL for recommendation** (*if available online*):

N/A

**1a.5.2.** **Identify recommendation number and/or page number** and **quote verbatim, the specific recommendation**.

N/A

**1a.5.3.** **Grade assigned to the quoted recommendation with definition of the grade**:

N/A

**1a.5.4. Provide all other grades and associated definitions for recommendations in the grading system.** (*Note: the* *grading system for the evidence should be reported in section 1a.7.*)

N/A

**1a.5.5. Citation and URL for methodology for grading recommendations** (*if different from 1a.5.1*)**:**

***Complete section*** [***1a.7***](#Section1a7)

N/A

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**1a.6. OTHER SYSTEMATIC REVIEW OF THE BODY OF EVIDENCE**

**1a.6.1.** **Citation** (*including date*) and **URL** (*if available online*):

N/A

**1a.6.2.** **Citation and** **URL for methodology for evidence review and grading** (*if different from 1a.6.1*)**:**

***Complete section*** [***1a.7***](#Section1a7)

N/A

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**1a.7. FINDINGS FROM SYSTEMATIC REVIEW OF BODY OF THE EVIDENCE supporting the measure**

*If more than one systematic review of the evidence is identified above, you may choose to summarize the one (or more) for which the best information is available to provide a summary of the quantity, quality, and consistency of the body of evidence. Be sure to identify which review is the basis of the responses in this section and if more than one, provide a separate response for each review.*

**1a.7.1.** **What was the specific structure, treatment, intervention, service, or intermediate outcome addressed in the evidence review?**

A systematic review of the body of evidence was not performed.

**1a.7.2.** **Grade assigned for the quality of the quoted evidence with definition of the grade**:

N/A

**1a.7.3. Provide all other grades and associated definitions for strength of the evidence in the grading system.**

N/A

**1a.7.4.** **What is the time period covered by the body of evidence? (*provide the date range, e.g., 1990-2010*). Date range**: Click here to enter date range

N/A

**QUANTITY AND QUALITY OF BODY OF EVIDENCE**

**1a.7.5.****How many and what type of study designs are included in the body of evidence**? (*e.g., 3 randomized controlled trials and 1 observational study*)

N/A

**1a.7.6.** **What is the overall quality of evidence across studies in the body of evidence**? (*discuss the certainty or confidence in the estimates of effect particularly in relation to study factors such as design flaws, imprecision due to small numbers, indirectness of studies to the measure focus or target population*)

N/A

**ESTIMATES OF BENEFIT AND CONSISTENCY ACROSS STUDIES IN BODY OF EVIDENCE**

**1a.7.7.** **What are the estimates of benefit—magnitude and direction of effect on outcome(s) across studies in the body of evidence**? (*e.g., ranges of percentages or odds ratios for improvement/ decline across studies, results of meta-analysis, and statistical significance*)

N/A

**1a.7.8.** **What harms were studied and how do they affect the net benefit (benefits over harms)?**

N/A

**UPDATE TO THE SYSTEMATIC REVIEW(S) OF THE BODY OF EVIDENCE**

**1a.7.9.** **If new studies have been conducted since the systematic review of the body of evidence, provide for each new study: 1) citation, 2) description, 3) results, 4) impact on conclusions of systematic review**.

N/A

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**1a.8 OTHER SOURCE OF EVIDENCE**

*If source of evidence is NOT from a clinical practice guideline, USPSTF, or systematic review, please describe the evidence on which you are basing the performance measure.*

**1a.8.1** **What process was used to identify the evidence?**

Multiple lines of evidence in the literature suggest that in order to prevent repetitive intradialytic hypotension and subclinical myocardial stunning as well as potentially damage to other vascular organs such as the brain and the gut, slower rates of fluid removal during dialysis are advisable in order to prevent progressive vital organ dysfunction, ensure patient safety and prevent higher mortality. The ‘lines of evidence’ include: (i) Association of higher UFR to higher all cause and cardiovascular mortality, (ii) association of higher UFR to greater instability of dialysis sessions, (iii) the link between intradialytic hypotension and mortality, (iv) recent evidence implicating dialysis as resulting in micro-ischemic insults to organs such as the heart (e.g., demonstrable wall motion abnormalities during dialysis using PET scans) and (v) the independent association of higher interdialytic weight gain on the one hand and shorter duration of hemodialysis sessions with higher mortality, suggesting that rapid fluid removal is undesirable. This evidence is based on medium to large observational studies. There is no randomized trial evidence to date studying the effect of different UFR thresholds in clinical practice.

Several observational studies were reviewed after an extensive Medline literature search from year 2004 to 2013 and presented both during and after the Adequacy Technical Expert Panel (TEP) in April 2013. This measure was proposed in order to increase the safety of the dialysis procedure based on separate but related lines of evidence as alluded to in section 1a.8 above. First, recent medium to large observational studies suggest that higher UFR is associated with higher mortality [Movilli 2007, Flythe 2011, Saran 2006, Flythe 2013] as well as higher odds of ‘unstable’ dialysis session (Saran 2006). Second, during the dialysis procedure, instability in the form of symptomatic or asysmptomatic intradialytic hypotension occurs frequently affecting nearly half of all hemodialysis patients and is associated with higher mortality (Shoji 2004). Hemodialysis sessions also predispose to organ hypoperfusion and critical phenomena such as ventricular wall motion abnormalities indicative of ‘myocardial stunning’ demonstrated by PET scanning during dialysis [Burton 2009, McIntyre 2010]. Importantly, frequent hemodialysis schedules with lower UFR and lower volume of fluid removal have been shown to be associated with reduced levels of dialysis-induced cardiac injury (myocardial stunning) (Jefferies 2011). Among individuals who appear to ‘tolerate’ relatively large volume ultrafiltration over the relatively short periods of conventional thrice weekly dialysis, repetitive subclinical ischemic insult to the myocardium may occur during the hemodialysis procedure may cumulatively result in systolic or diastolic heart failure. Flythe et al examined UFR thresholds <10, 10-13 and >13 (Flythe 2011). Between UFR of 10-13, the differences were not statistically different although there was a demonstrably rising risk of cardiovascular mortality using a cubic spline function between UFR thresholds of 10 and 13ml/kg/hour, and continuously rising risk for UFR higher than 13ml/kg/hour. More recently (Flythe 2013), higher interdialytic weight gain and shorter length of hemodialysis sessions were each independently associated with higher mortality.

A majority of TEP members voted to include a measure of UFR based on the evidence reviewed. The specific thresholds for a UFR measure were however debated during the discussions by the CMS TEP based on available literature and in particular, the observational studies cited above (Saran 2006, Movilli 2007 and Flythe 2011). A relatively conservative threshold of 13ml/kg/min was chosen based on discussions over the thresholds examined in the study by Flythe.

**1a.8.2.** **Provide the citation and summary for each piece of evidence.**

1. Burton J, Jefferies HJ, et al. Hemodialysis-Induced Cardiac Injury: Determinants and Associated Outcomes. Clin J Am Soc Nephrol. 2009; 4: 914-920.

Abstract: Background and objectives: Hemodialysis (HD)-induced myocardial stunning driven by ischemia is a recognized complication of HD, which can be ameliorated by HD techniques that improve hemodynamics. In nondialysis patients, repeated ischemia leads to chronic reduction in left ventricular (LV) function. HD may initiate and drive the same process. In this study, we examined the prevalence and associations of HD-induced repetitive myocardial injury and long-term effects on LV function and patient outcomes.

Design, setting, participants, & measurements: Seventy prevalent HD patients were assessed for evidence of subclinical myocardial injury at baseline using serial echocardiography and followed up after 12 mo. Intradialytic blood pressure, hematologic and biochemical samples, and patient demographics were also collected at both time points.

Results: Sixty-four percent of patients had significant myocardial stunning during HD. Age, ultrafiltration volumes, intradialytic hypotension, and cardiac troponin-T (cTnT) levels were independent determinants associated with its presence. Myocardial stunning was associated with increased relative mortality at 12 mo (P = 0.019). Cox regression analysis showed increased hazard of death in patients with myocardial stunning and elevated cTnT than in patients with elevated cTnT alone (P < 0.02). Patients with myocardial stunning who survived 12 mo had significantly lower LV ejection fractions at rest and on HD (P < 0.001).

Conclusions: HD-induced myocardial stunning is common, and may contribute to the development of heart failure and increased mortality in HD patients. Enhanced understanding of dialysis-induced cardiac injury may provide novel therapeutic targets to reduce currently excessive rates of cardiovascular morbidity and mortality.

2. Flythe JE, Kimmel SE, Brunelli SM. Rapid fluid removal during dialysis is associated with cardiovascular morbidity and mortality. Kidney International (2011) Jan; 79(2):250-7. PMID: 20927040

Abstract: Patients receiving hemodialysis have high rates of cardiovascular morbidity and mortality that may be related to the hemodynamic effects of rapid ultrafiltration. Here we tested whether higher dialytic ultrafiltration rates are associated with greater all-cause and cardiovascular mortality, and hospitalization for cardiovascular disease. We used data from the Hemodialysis Study, an almost-7-year randomized clinical trial of 1846 patients receiving thrice-weekly chronic dialysis. The ultrafiltration rates were divided into three categories: up to 10 ml/h/kg, 10-13 ml/h/kg, and over 13 ml/h/kg. Compared to ultrafiltration rates in the lowest group, rates in the highest were significantly associated with increased all-cause and cardiovascular-related mortality with adjusted hazard ratios of 1.59 and 1.71, respectively. Overall, ultrafiltration rates between 10-13 ml/h/kg were not associated with all-cause or cardiovascular mortality; however, they were significantly associated among participants with congestive heart failure. Cubic spline interpolation suggested that the risk of all-cause and cardiovascular mortality began to increase at ultrafiltration rates over 10 ml/h/kg regardless of the status of congestive heart failure. Hence, higher ultrafiltration rates in hemodialysis patients are associated with a greater risk of all-cause and cardiovascular death.

3. Flythe JE, Curhan GC, Brunelli SM. Disentangling the Ultrafiltration Rate–Mortality Association: The Respective Roles of Session Length and Weight Gain. Clin J Am Soc Nephrol. 2013 Jul;8(7):1151-61

BACKGROUND AND OBJECTIVES:

Rapid ultrafiltration rate is associated with increased mortality among hemodialysis patients. Ultrafiltration rates are determined by interdialytic weight gain and session length. Although both interdialytic weight gain and session length have been linked to mortality, the relationship of each to mortality, independent of the other, is not adequately defined. This study was designed to evaluate whether shorter session length independent of weight gain and larger weight gain independent of session length are associated with increased mortality.

DESIGN, SETTING, PARTICIPANTS, & MEASUREMENTS:

Data were taken from a national cohort of 14,643 prevalent, thrice-weekly, in-center hemodialysis patients dialyzing from 2005 to 2009 (median survival time, 25 months) at a single dialysis organization. Patients with adequate urea clearance and delivered dialysis session ≥240 and <240 minutes were pair-matched on interdialytic weight gain (n=1794), and patients with weight gain ≤3 and >3 kg were pair-matched on session length (n=2114); mortality associations were estimated separately.

RESULTS:

Compared with delivered session length ≥240, session length <240 minutes was associated with increased all-cause mortality (adjusted hazard ratio [95% confidence interval], 1.32 [1.03 to 1.69]). Compared with weight gain ≤3, weight gain >3 kg was associated with increased mortality (1.29 [1.01 to 1.65]). The associations were consistent across strata of age, sex, weight, and weight gain and session length. Secondary analyses demonstrated dose-response relationships between both and mortality.

CONCLUSIONS:

Among patients with adequate urea clearance, shorter dialysis session length and greater interdialytic weight gain are associated with increased mortality; thus, both are viable targets for directed intervention.

4. Jefferies HJ, Virk B, Schiller B, Moran J, McIntyre CW. Frequent hemodialysis schedules are associated with reduced levels of dialysis-induced cardiac injury (myocardial stunning). Clin J Am Soc Nephrol. 2011 Jun;6(6):1326-32

BACKGROUND AND OBJECTIVES:

Recurrent hemodialysis (HD)-induced ischemic cardiac injury (myocardial stunning) is common and associated with high ultrafiltration (UF) requirements, intradialytic hypotension, long-term loss of systolic function, increased likelihood of cardiovascular events, and death. More frequent HD regimens are associated with lower UF requirements and improved hemodynamic tolerability, improved cardiovascular outcomes, and reduced mortality compared with conventional thrice-weekly HD. This study investigated the hypothesis that modification of UF volume and rate with more frequent HD therapies would abrogate dialysis-induced myocardial stunning.

DESIGN, SETTINGS, PARTICIPANTS, & MEASUREMENTS:

A cross-sectional study of 46 patients established on hemodialysis >3 months compared four groups receiving the current range of quotidian therapies: conventional thrice-weekly HD (CHD3); more-frequent HD five to six times/week in a center (CSD) and at home (HSD); and home nocturnal HD (HN). Serial echocardiography quantitatively assessed regional systolic function to identify intradialytic left ventricular regional wall motion abnormalities (RWMAs). Cardiac troponin T (cTnT), N-terminal prohormone brain natriuretic peptide (NT-proBNP), and inflammatory markers were quantified.

RESULTS:

More frequent HD regimens were associated with lower UF volumes and rates compared with CHD3. Intradialytic fall in systolic BP was reduced in CSD and HSD groups and abolished in HN group. Mean RWMAs per patient reduced with increasing dialysis intensity (CHD3 > CSD > HSD > HN). Home-based groups demonstrated lower high-sensitivity C-reative protein levels, with trends to lower cTnT and NT-proBNP levels in the more frequent groups.

CONCLUSIONS:

Frequent HD regimes are associated with less dialysis-induced myocardial stunning compared with conventional HD. This may contribute to improved outcomes associated with frequent HD therapies.

5. Movilli, Ezio, et al. “Association between high ultrafiltration rates and mortality in uraemic patients on regular haemodialysis. A 5-year prospective observational multicenter study.” Nephrology Dialysis Transplantation 22.12(2007): 3547-3552

BACKGROUND:

High ultrafiltration rate on haemodialysis (HD) stresses the cardiovascular system and could have a negative effect on survival.

METHODS:

The effect of ultrafiltration rate (UFR; ml/h/kg BW) on mortality was prospectively evaluated in a cohort of 287 prevalent uraemic patients in regular HD from 1 January 2000 to 31 December 2005.

PATIENTS:

165 men and 122 women, age 66 +/- 13 years, on regular HD for at least 6 months, median: 48 months (range 6-372 months). Mean UFR was 12.7 +/- 3.5 ml/h/kg BW, Kt/V: 1.27 +/- 0.13, body weight (BW): 62 +/- 13 kg, PCRn: 1.11 +/- 0.20 g/kg/day, duration of dialysis: median 240 min (range 180-300 min), mean arterial blood pressure (MAP) 99 +/- 9 mm/Hg. One hundred and forty nine patients (52%) died, mainly for cardiovascular reasons (69%). Multivariate Cox regression analysis was utilized to evaluate the effect on mortality of UFR, age, sex, dialytic vintage, cardiovascular disease (CVD), diabetes, dialysis modality, duration of HD, BW, interdialytic weight gain (IWG), body mass index (BMI), MAP, pulse pressure (PP), Kt/V, PCRn.

RESULTS:

Age (HR 1.06; CI 1.04-1.08; P < 0.0001), PCRn (HR 0.17, CI 0.07-0.43; P < 0.0001), diabetes (HR 1.81, CI 1.24-2.47; P = 0.007), CVD (HR 1.86; CI 1.32-2.62; P = 0.007) and UFR (HR 1.22; CI 1.16-1.28; P < 0.0001) were identified as factors independently correlated to survival. We estimated the discrimination potential of UFR, evaluated at baseline, in predicting death at 5 years, calculating the relative receiver operating characteristic (ROC) curves and the cut-off that minimizes the absolute difference between sensitivity and specificity.

CONCLUSIONS:

High UFRs are independently associated with increased mortality risk in HD patients. Better survival was observed with UFR < 12.37 ml/h/kg BW. For patients with higher UFRs, longer or more frequent dialysis sessions should be considered in order to prevent the deleterious consequences of excessive UFR.

6. McIntyre CW. “Haemodialysis-induced myocardial stunning in chronic kidney disease—a new aspect of cardiovascular disease.” Blood Purif. 2010;29:105–10.

Abstract: Chronic haemodialysis (HD) patients are already primed by a large number of structural and functional peripheral vascular and cardiac abnormalities to experience demand myocardial ischaemia. Transient myocardial ischaemia may lead to left ventricular (LV) dysfunction that can persist after the return of normal perfusion. This prolonged dysfunction is known as myocardial stunning. Repetitive episodes of ischaemia can be cumulative and have been shown to lead to prolonged LV dysfunction (in patients with ischaemic heart disease). Conventional HD itself is a sufficient cardiovascular functional stressor to precipitate such recurrent ischaemic insults, leading to myocardial functional and structural changes, eventually resulting in fixed systolic dysfunction and heart failure (conferring a dismal prognosis for patients undergoing dialysis). Furthermore these same haemodynamic insults may also adversely affect other vascular beds in other vulnerable organ systems, driving an even wider range of pathophysiological processes. A variety of therapeutic manoeuvres aimed at improving the haemodynamic tolerability of treatment have been shown to reduce acute dialysis-induced myocardial ischaemia. This article aims to give an appreciation of the possibility that modification of the dialysis treatment to improve tolerability of therapy may have the potential to provide us with additional therapeutic targets, to reduce currently excessive rates of cardiovascular morbidity and mortality.

7. Saran R, Bragg-Gresham JL, Levin NW, Twardowski ZJ, Wizemann V, Saito A, Kimata N, Gillespie BW, Combe C, Bommer J, Akiba T, Mapes DL, Young EW, Port FK.: “Longer treatment time and slower ultrafiltration in hemodialysis: associations with reduced mortality in the DOPPS.” Kidney International (2006) 69: 1222–28.

Abstract: Longer treatment time (TT) and slower ultrafiltration rate (UFR) are considered advantageous for hemodialysis (HD) patients. The study included 22,000 HD patients from seven countries in the Dialysis Outcomes and Practice Patterns Study (DOPPS). Logistic regression was used to study predictors of TT > 240 min and UFR > 10 ml/h/kg bodyweight. Cox regression was used for survival analyses. Statistical adjustments were made for patient demographics, comorbidities, dose of dialysis (Kt/V), and body size. Europe and Japan had significantly longer (P < 0.0001) average TT than the US (232 and 244 min vs 211 in DOPPS I; 235 and 240 min vs 221 in DOPPS II). Kt/V increased concomitantly with TT in all three regions with the largest absolute difference observed in Japan. TT > 240 min was independently associated with significantly lower relative risk (RR) of mortality (RR = 0.81; P = 0.0005). Every 30 min longer on HD was associated with a 7% lower RR of mortality (RR = 0.93; P < 0.0001). The RR reduction with longer TT was greatest in Japan. A synergistic interaction occurred between Kt/V and TT (P = 0.007) toward mortality reduction. UFR > 10 ml/h/kg was associated with higher odds of intradialytic hypotension (odds ratio = 1.30; P = 0.045) and a higher risk of mortality (RR = 1.09; P = 0.02). Longer TT and higher Kt/V were independently as well as synergistically associated with lower mortality. Rapid UFR during HD was also associated with higher mortality risk. These results warrant a randomized clinical trial of longer dialysis sessions in thrice-weekly HD.

8. Shoji T, Tsubakihara Y, Fujii M, Imai E. Hemodialysis-associated hypotension as an independent risk factor for two-year mortality in hemodialysis patients. Kidney International. 2004;66(3):1212-20

BACKGROUND:

The relationship between blood pressure (BP) and mortality in hemodialysis patients has remained controversial. Some studies suggested that a lower pre- or postdialysis BP was associated with excess mortality, while others showed poorer outcome in patients with uncontrolled hypertension. We conducted a multicenter prospective cohort study to evaluate the impact of hemodialysis-associated hypotension on mortality.

METHODS:

We recruited 1244 patients (685 males; mean age, 60 +/- 13 years) who underwent hemodialysis in 28 units during the two-year study period beginning in December 1999. Pre-, intra-, and postdialysis BP, and BP upon standing soon after hemodialysis, were measured in all patients at entry. Logistic regression analysis was used to assess the effect on mortality of pre-, intra-, and postdialysis BP, a fall in BP during hemodialysis, and a fall in BP upon standing soon after hemodialysis.

RESULTS:

During the study period, 149 patients died. Logistic models identified the lowest intradialysis systolic blood pressure (SBP) and degree of fall in SBP upon standing soon after hemodialysis as significant factors affecting mortality, but not pre- or postdialysis SBP and diastolic BP. The adjusted odds ratio for death was 0.79 (95% CI 0.64-0.98) when the lowest intradialysis SBP was analyzed in increments of 20 mm Hg, and was 0.82 (95% CI 0.67-0.98) when the fall in SBP upon standing soon after hemodialysis was analyzed in increments of 10 mm Hg.

CONCLUSION:

These results suggest that intradialysis hypotension and orthostatic hypotension after hemodialysis are significant and independent factors affecting mortality in hemodialysis patients.