



Blood Pressure and Outcomes in Dialysis: “Does it make sense?”

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Disclosure of Financial Relationships

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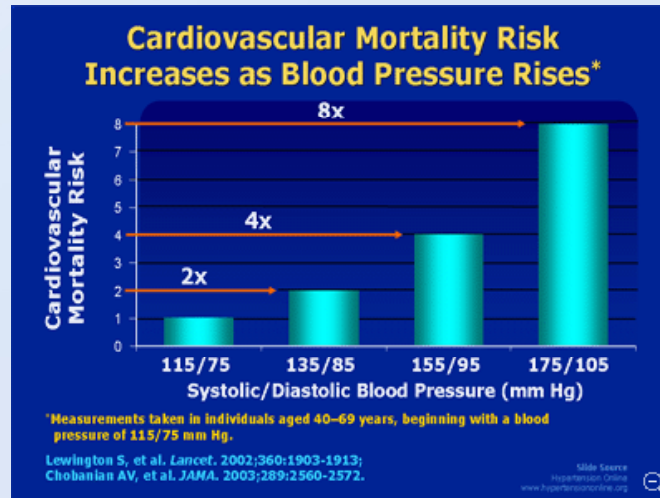
Objectives

- Review observational data showing increased mortality associated at both low-normal and high blood pressure in dialysis patients
- Consider factors influencing the data
 - Timing and method of blood pressure measurement
 - Severity and prevalence of cardiovascular disease burden
 - Therapeutic interventions
- Derive insights and formulate hypotheses that may impact management of blood pressure in this population

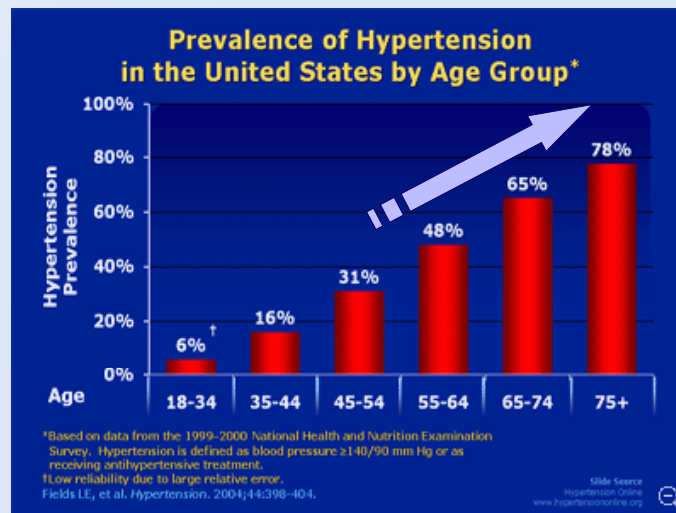
The 7th Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JAMA, May 2003).

| BP classification | SBP mmHg | DBP mmHg |
|----------------------|-----------|------------|
| Normal | <120 | and <80 |
| Prehypertension | 120 ~ 139 | or 80 ~ 89 |
| Stage 1 Hypertension | 140 ~ 159 | or 90 ~ 99 |
| Stage 2 Hypertension | >=160 | or >=100 |

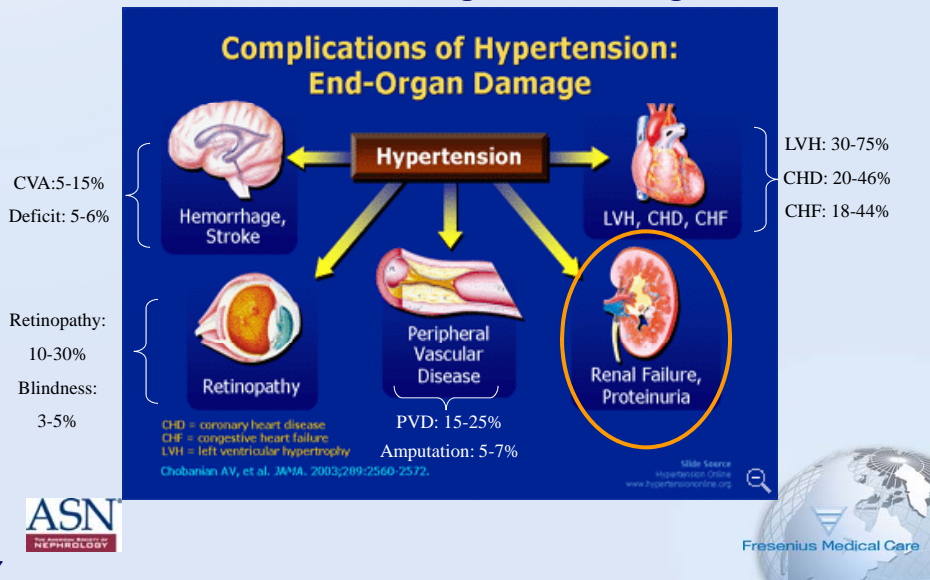
General Population Data



Many ESRD Patients are Elderly

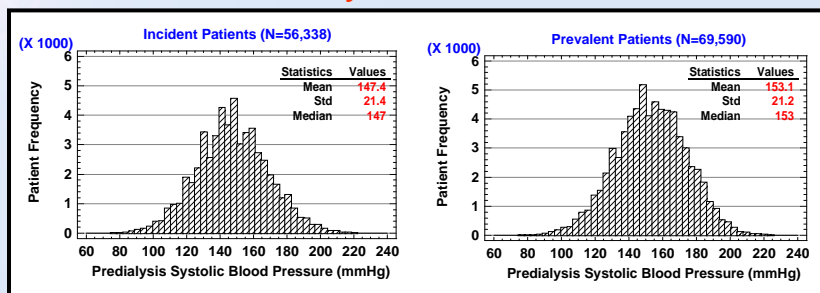


ESRD Patients By Definition Have End-organ Damage



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SBP in Dialysis Patients at FMCNA



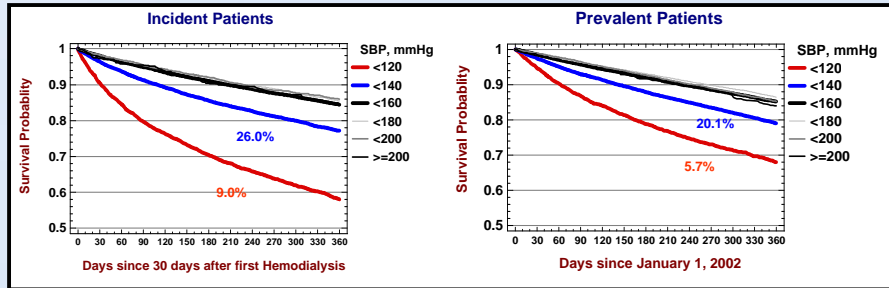
| SBP Groups | SBP (mmHg) | % of Patients | |
|------------|------------|---------------|-----------|
| | | Incident | Prevalent |
| Normal | <120 | 9.0 | 5.7 |
| PreHTN | 120 ~ 139 | 26.0 | 20.1 |
| Stage 1 | 140 ~ 159 | 36.7 | 35.6 |
| Stage 2 | 160 ~ 179 | 21.3 | 28.1 |
| Stage 2 + | 180 ~ 199 | 6.1 | 9.3 |
| Stage 2 ++ | >=200 | 1.0 | 1.2 |

65% (Stage 2 + and Stage 2 ++ for Incident) | 74% (Stage 2 + and Stage 2 ++ for Prevalent)

- Li et al, AJKD, 2005

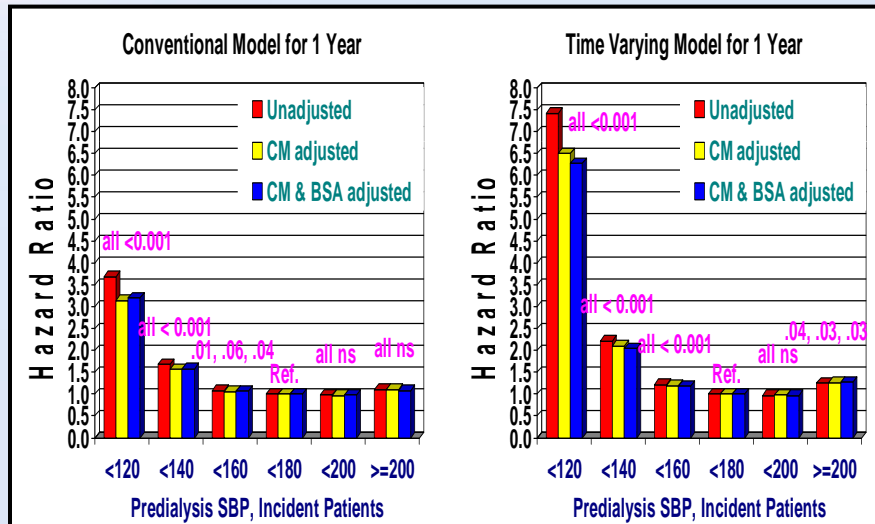
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Survival Curves

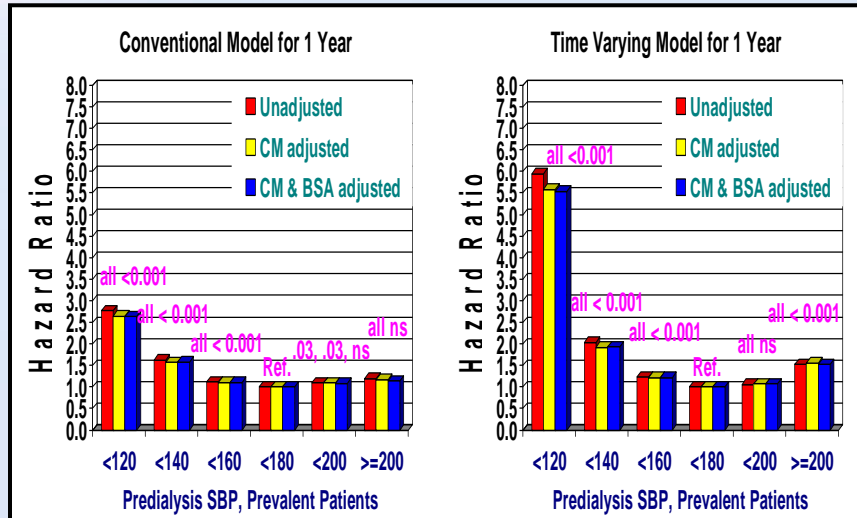


- Patients with <120 mmHg and <140 mmHg (120-139 mmHg) had the worst mortality rate.
- They comprised 35% of incident patients and 26% of prevalent patients

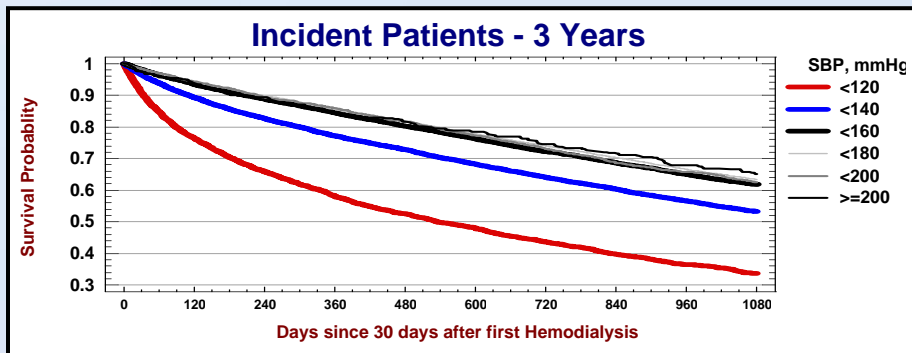
Incident Patients: 1 Year Survival



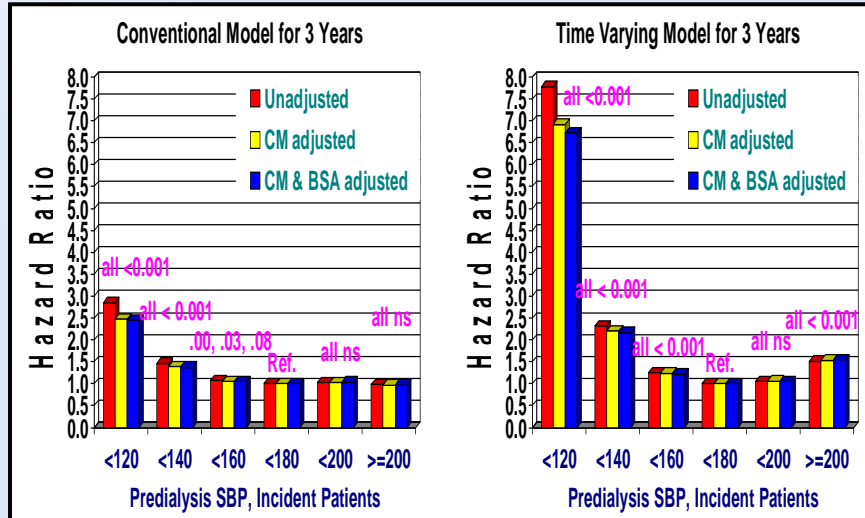
Prevalent Patients: 1 Year Survival



Maintained on Long-term Follow-up

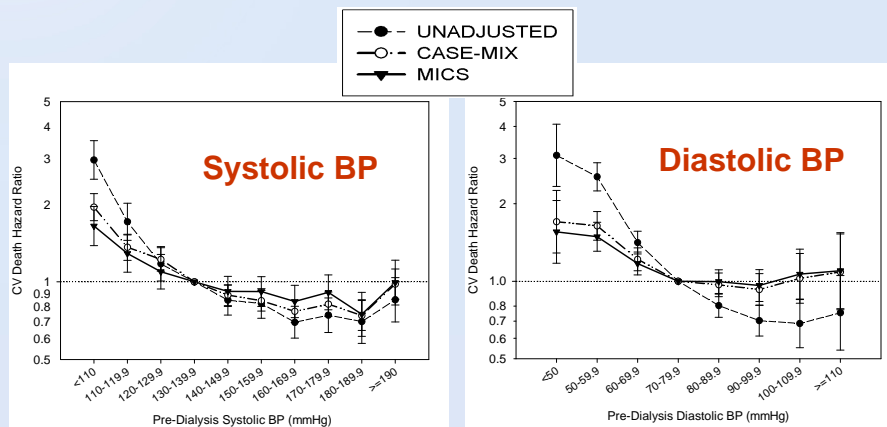


Incident Patients: 3 Year Survival



Comparing Pre-Dialysis Systolic & Diastolic BP in 40,933 DaVita HD Patients:

15 Month mortality



Association between Pre-Dialysis BP and CV Death

Peritoneal Dialysis Patients

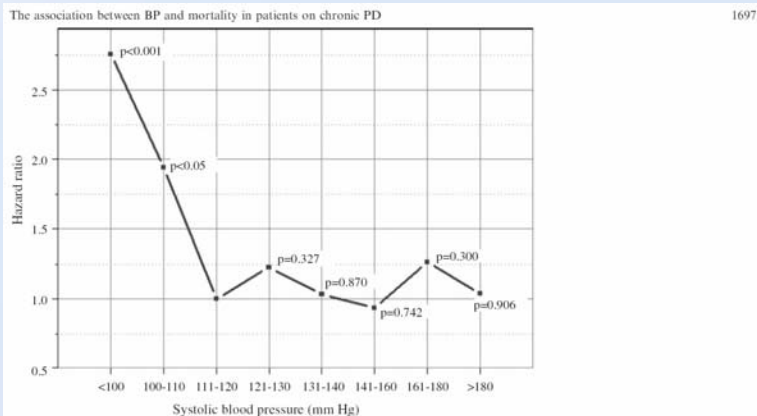


Fig. 2. The association of systolic blood pressure categories with all-cause mortality evaluated in a proportional hazard model using the 111-120 mmHg group as a reference group. Both categories of low SBP, i.e. <100 mmHg (HR 2.71, $P < 0.001$) and 101-110 mmHg (HR 1.85, $P < 0.05$), substantially increased the risk of all-cause mortality. None of the high blood pressure categories was associated with a significant increase in mortality.

- Goldfarb-Rumantzyev et al, NDT, 2005

“U” curve association of blood pressure and mortality in hemodialysis patients

PHILIP G. ZAGER, JOVANKA NIKOLIC, RICHARD H. BROWN, MARIAN A. CAMPBELL, WILLIAM C. HUNT, DARWIN PETERSON, JOHN VAN STONE, ANDREW LEVEY, KLEMENS B. MEYER, MICHAEL J. KLAG, H. KEITH JOHNSON, EUGENE CLARK, JOHN H. SADLER, and PRADIP TEREDesai, for the MEDICAL DIRECTORS OF DIALYSIS CLINIC, INC.

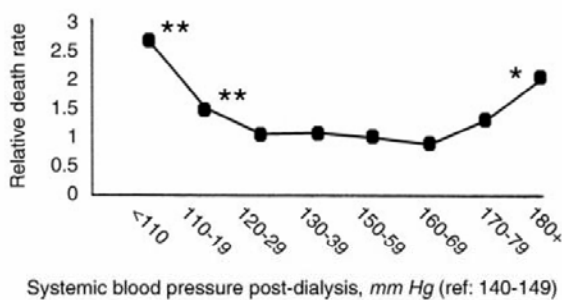


Fig. 1. Systolic blood pressure post-dialysis (SBP; time-varying) and cardio/cerebrovascular mortality in hemodialysis (HD) patients 1992 to 1996. The “U” curve relationship between SBP post-dialysis and mortality is: SBP < 110 mm Hg, RR = 2.62, $**P < 0.01$ versus reference 140 to 49; SBP 110 to 19 mm Hg, RR = 1.48, $**P < 0.01$ versus reference; SBP \geq 180 mm Hg, RR = 1.06, $*P < 0.05$ versus reference.

Predialysis Blood Pressure and Mortality Risk in a National Sample of Maintenance Hemodialysis Patients

Friedrich K. Port, MD, Temple E. Hulbert-Shearon, MS, Robert A. Wolfe, PhD, Wendy E. Bloembergen, MD, Thomas A. Golper, MD, Lawrence Y.C. Agodoa, MD, and Eric W. Young, MD

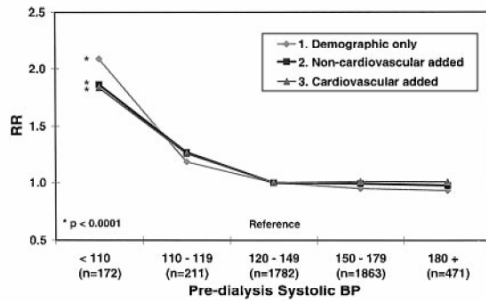


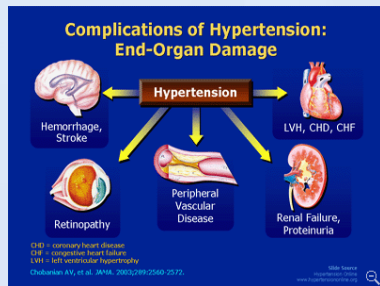
Fig 1. RR according to predialysis systolic BP compared with the reference group of 120 to 149 mm Hg (RR = 1.00). Three separate models are shown according to the level of statistical adjustment (see Table 1). *P < 0.0001.

(AJKD, 1999)

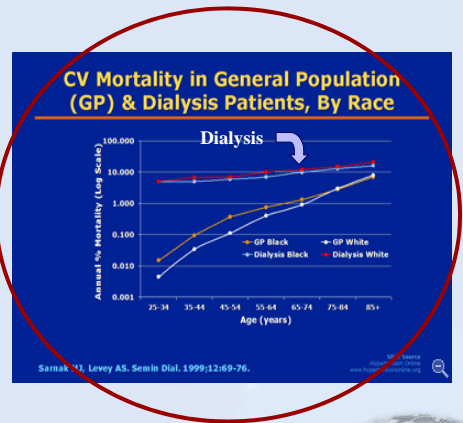


Horse is out of the barn!

In the general population, treatment of HTN will prevent complications:



Complications that lead to increased risk of death!



Role of Competing Risks?



Timing and Method of Blood Pressure Measurement

- Ambulatory Blood Pressure Monitoring provides continuous picture of true blood pressure exposure
 - Not practical for routine use
- Home Blood Pressure Monitoring provides better correlation with ABPM
 - May be promising to test in larger cohorts of patients
- Overestimation by Routine Blood Pressure measurements in the dialysis facility
 - Misclassification Bias: May simply require a “left-shift” of the distribution curve
 - May be more important in terms of preventing intradialytic hypotension

Comparison of BP Measurement

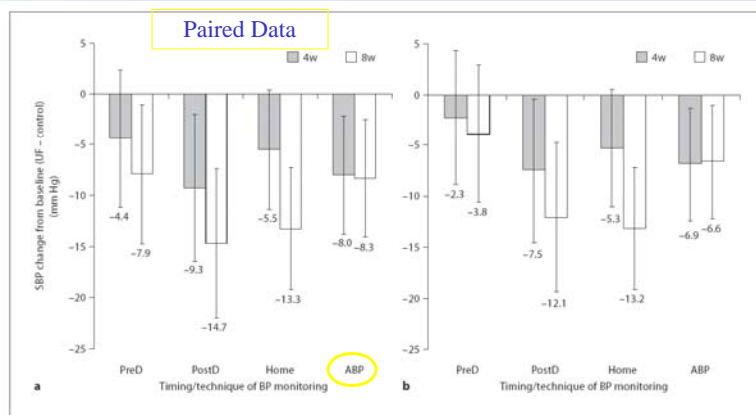


Fig. 1. Mean SBP changes from baseline to 4 weeks (4w) and from baseline to 8 weeks (8w) in the ultrafiltration (UF) group minus changes from baseline to 4 weeks and from baseline to 8 weeks in the control group. The error bars are the 95% confidence intervals of the means. When the bars transect the zero line, then the changes from baseline are not statistically significant. **a** The paired data shown are those detailed in table 2. **b** All available data. Predialysis (PreD) BP is insensitive in detecting change. PostD = Postdialysis; ABP = ambulatory BP.

Overestimation of Routine Facility BP

AM Thompson and TG Pickering: The role of ABPM in chronic and ESRD

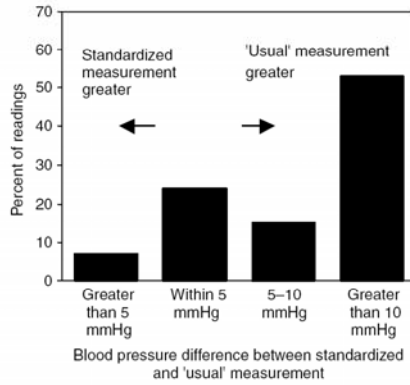
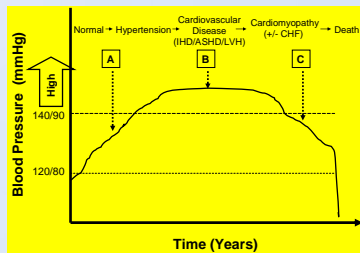


Figure 1 | Systolic BP difference between standardized and 'usual' dialysis center BP measurements in 270 hemodialysis patients. (Adapted from Rahman et al. *Am J Kidney Dis* 2002; 39: 1226-1230.)



Cardiac Function & Blood Pressure in HD Patients



Many patients initiate dialysis at points **B** and **C**.

- Lacson and Lazarus, *Sem Dial*, 2007

LVEF by Echocardiography

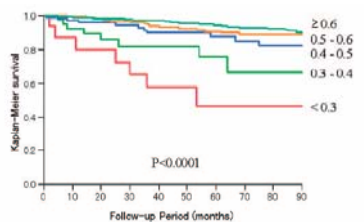


Figure 1. Kaplan-Meier estimates: Event-free survival from cardiovascular death.

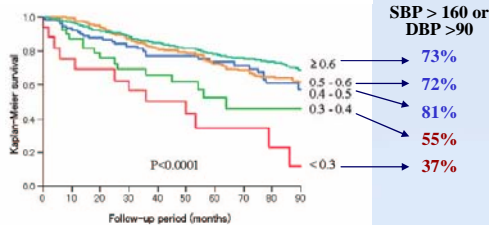


Figure 2. Kaplan-Meier estimates: Event-free survival from all-cause death.

SBP > 160 or DBP > 90

- 73%
- 72%
- 81%
- 55%
- 37%

- Yamada et al, *CJASN*, 2010



NKF KDOQI GUIDELINES

Executive Summaries | Anemia | Hemodialysis | Peritoneal Dialysis | Vascular Access | Nutrition | CKD 2002 | Dyslipidemias | Bone Metabolism | Hypertension and Antihypertensive Agents | Cardiovascular Disease in Dialysis Patients | History of KDOQI |

KDOQI Clinical Practice Guidelines for Cardiovascular Disease in Dialysis Patients

Section II. Guidelines on management of cardiovascular risk factors

Traditional risk factors—such as diabetes, hypertension, dyslipidemia—and those specific to dialysis patients (anemia and mineral metabolism) importance and weight of each of these risk factors in the dialysis population is not known and, in the absence of controlled trials in this population given to potential risks.

Furthermore, lifestyle issues such as smoking, physical activity, depression, and anxiety are the cornerstones of therapy as in the general population dialysis patients. These factors are all discussed in this section. Special attention will be paid to the difference between the usual recommendations

Guideline 12: Blood Pressure

The management of blood pressure is an important component of CVD risk management for all aspects of CVD: CAD, cardiomyopathy, VHD in dialysis patients.

12.1 Measurement of blood pressure:

12.1a In patients who have undergone multiple surgical procedures for vascular accesses in both arms, blood pressure is appropriate cuff size and measure blood pressure only in the supine position. (B)

12.2 Predialysis and postdialysis blood pressure goals should be <140/90 mm Hg and <130/80 mm Hg, respectively. (C)

Dialysis related hypotension is the most common reported treatment related AE

- Occurs in ~ 20 - 30% of hemodialysis sessions¹
- Independent mortality risk
- Contributes to morbidity, adversely affects quality of life

| AEs as Reported in the Literature ^{2,3} (Proportion of treatments with AE)* | | | | | |
|---|------|------|--------------|-------|-------|
| AE [1] | Low | High | AE [2] | Low | High |
| Hypotension | .25 | .55 | Hypotension | .181 | .34 |
| Cramps | .05 | .20 | Nausea | .068 | .088 |
| Nausea and vomiting | .05 | .15 | Vomiting | .023 | .062 |
| Headache | .05 | | Cramps | .067 | .133 |
| Chest pain | .02 | .05 | Chest pain | .009 | .015 |
| Back pain | .02 | .05 | Headache | .018 | .042 |
| Itching | .05 | | Back pain | .002 | .010 |
| Fever and chills | | .01 | Fever | .001 | .006 |
| | | | Chills | .001 | .002 |
| | | | Itching | .024 | .132 |
| | | | Restlessness | .007 | .044 |
| | | | Diarrhea | .001 | .002 |
| AE range (AEs/Rx)* | 0.49 | 1.01 | | 0.402 | 0.876 |

* Assumes maximum of 1 AE in any category per treatment

Primum Non Nocere

Achieving blood pressure targets during dialysis improves control but increases intradialytic hypotension

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¹ICJ Center for Nephrology, Royal Free and University College Medical School, London, UK, ²Audit Information and Analysis Unit, Data and Facilities, Renal HD Care Trust, London, UK and ³Department of Renal Medicine, Barts and The Royal London HD Trust, London, UK

Cardiovascular disease remains the most common cause of mortality in patients with end-stage kidney disease treated by regular hemodialysis. To improve blood pressure control and reduce cardiovascular risk, the United Kingdom Renal Association standards committee introduced pre- and post-dialysis target blood pressures of less than 140/90 and 130/80 mm Hg, respectively. We audited blood pressure control and symptomatic intradialytic hypotension requiring fluid resuscitation in the Greater London area renal centers that serve 2630 patients. The study captured 7890 hemodialysis sessions during a 1-week period where only 36% of the patients achieved the pre-dialysis target and 42% the post-dialysis target, with a wide variation between centers. Different antihypertensive medication prescriptions did not affect achievement of these targets. Fifteen percent of the patients suffered symptomatic hypotension requiring fluid resuscitation associated with significantly greater interdialytic weight gains. Our study found that intradialytic hypotension was significantly greater in centers that achieved better post-dialysis blood pressure targeting.

Kidney International advance online publication, 26 December 2007; doi:10.1038/sj.ki.5002745

KEYWORDS: hemodialysis; hypertension; hypotension; audit; targets; standards



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Conclusion & Recommendations

- Not one BP goal fits all! We need to consider cardiac status to assist in the clinical determination of blood pressure goals in dialysis patients.
- Fluid and sodium management is essential to managing dialysis patients. Proper determination of dry weight and attainment of dry weight will determine the need for additional use of blood pressure medications.
- Use appropriate ultrafiltration rates consistent to the cardiovascular status of your patients – don't be afraid to extend dialysis time or add extra ultrafiltration treatments if necessary.



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Thanks for Your Attention

