Managing dialysis patient. An Internal Medicine Perspective.

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Important Registries and Guidelines

• USRDS (United States Renal Data System)

• Kidney Dialysis Outcome Quality Initiative (K-DOQI) guidelines

• Kidney Disease Improving Global Outcomes (KDIGO) guidelines
End Stage Renal Disease

- End-stage kidney disease (ESRD) is when the kidneys are no longer able to work at a level needed for day-to-day life:
  - Sleep Disturbances
  - Weight loss
  - Poor appetite
  - Nauseous
  - Persistent itch and neuropathies
  - Cramps
  - Fluid and electrolyte disturbances
  - Metabolic Bone Disorders
  - Anemia
Figure 1.10  Trends in the number of ESRD prevalent cases (in thousands) by modality, in the U.S. population, 1996-2013

Data Source: Reference Table D.1. Abbreviation: ESRD, end-stage renal disease.
Principles in dialysis

- Diffusion
- Osmosis
- Convective Transport
Diffusion

- No transport
- Transport restricted
- Transport unrestricted
Convection

Convective clearance:

$$K_x = Q_{UF} \cdot S_x$$

- $K_x$: Convective clearance for solute “x”
- $Q_{UF}$: Ultrafiltration flow across membrane
- $S_x$: Membrane sieving coefficient for solute “x”

Dimension: volume / time
Units: ml/min, l/h, l/d
Inside the Dialyzer

Blood from your body enters the machine and flows past one side of a membrane.

The membrane is a barrier that keeps blood and dialysate from mixing, but lets waste through.

Dialysate is a special fluid that pulls waste from blood. It flows past the other side of the membrane.

Waste, extra fluid, and chemicals move through the membrane into the dialysate.

Clean, filtered blood goes back to your body.

Dialysate with waste

Fresh dialysate
Hemodialysis Filter (Dialyzer)
The Dialysis Set Circuit

- Blood Pump
- Dialyser
- Dialysate
- Display
The Normal Kidney

Highly Efficient

Filters 180 litres / day

36 times the blood volume
History of Dialysis

• 1943- First practical model for hemodialysis, Dr. Kolff.

• 1950- First commercially available dialysis machine.

• Early enthusiasm for this new technique was dampened by vascular access problem. Need 350ml/min + flow.
Next Advance

• 1956-Twin coil artificial Kidney.
• Hemodialysis more easily available to more patients.
• Vascular Access still a major problem
• Cut down or by cannulation with large bore needles.
• 1960-Scribner shunt made chronic dialysis a reality
• Sometimes will work for several weeks without a complication.
• Bleeding, infection, sclerosis of vessel, frequent thrombosis.
• Nephrologists did thrombectomies and taught patients how to do them.
The Great Solution

- In 1966, Brescia, Cimino, Appel, and Hurwich introduced the arteriovenous fistula.
- Brescia, Cimino, and Hurwich were from “Renal Service”.

*CHRONIC HEMODIALYSIS USING VENIPUNCTURE AND A SURGICALLY CREATED ARTERIOVENOUS FISTULA*

Michael J. Brescia, M.D., James F. Cimino, M.D., Kenneth Appel, M.D., and Barth J. Hurwich, M.D.

Types of Vascular Access

• Dialysis Catheters
  – Temporary
  – Permanent

• Arteriovenous Fistulas

• Arteriovenous Grafts
AVF & AVG
Figure 10.1 Dialysis unit counts, by unit affiliation, 2010–2013

Data source: Special analyses, USRDS ESRD Database. Abbreviations: DCI, Dialysis Clinic, Inc.; FMC, Fresenius; Hosp-based, hospital-based dialysis centers; Indep, independent dialysis providers; SDO, small dialysis organizations.
Dialysis options

Dialysis

Hemodialysis
- In-Center HD (3 x week)
- Home HD (short daily, nocturnal)

Peritoneal Dialysis
- CAPD
- CCPD

Home
Figure 6.1a Adjusted all-cause mortality (deaths per 1,000 patient-years) by treatment modality: overall, dialysis, and transplant for period-prevalent patients, 1996-2013

Data Source: Reference Tables H.2_adj, H4_adj, H.8_adj, H.9_adj, and H.10_adj; and special analyses, USRDS ESRD Database. Adjusted for age, sex, race, ethnicity, primary diagnosis and vintage. Ref: period prevalent ESRD patients, 2011. Abbreviations: HD, hemodialysis; PD, peritoneal dialysis.
Dialysis Survival

![Graph showing five-year survival rates for diabetics and nondiabetics.](image)
Understanding the dialysis Patient

• Cause of Death
• Cardiovascular disease in ESRD
• Drug Compliance
• Quality of life
  – Symptoms
  – Hospital Visits
  – Depression
• Cancer screening
• Anemia management
• Hypertension goal
Question

Who should be responsible for “primary care” of chronic dialysis patients?

Dialysis-related care
- Dialysis Prescription
- Access
- Anemia
- MBD

Primary Care
- Care coordination
- Preventive care
- Medication Mgmt
- Other medical issues
## Preventive Care

<table>
<thead>
<tr>
<th>Care area</th>
<th>No PCP visits (n=76,653)</th>
<th>1+ PCP visit (n=118,730)</th>
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<tbody>
<tr>
<td>Vaccination in 2012–13 flu season</td>
<td>63.9</td>
<td>76.2</td>
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</table>

<table>
<thead>
<tr>
<th></th>
<th>No PCP visits (n=26,974)</th>
<th>1+ PCP visit (n=53,615)</th>
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</thead>
<tbody>
<tr>
<td>Diabetes-related care in 2013*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1+ HbA1C test</td>
<td>79.0</td>
<td>87.1</td>
</tr>
<tr>
<td>1+ Lipid test</td>
<td>55.4</td>
<td>67.1</td>
</tr>
<tr>
<td>1+ Diabetic eye exam</td>
<td>38.3</td>
<td>47.9</td>
</tr>
<tr>
<td>All 3 tests</td>
<td>22.8</td>
<td>32.5</td>
</tr>
</tbody>
</table>
PCP Involvement in the Care of HD Patients in the US

Percentage of dialysis patients visiting a PCP, 2001-2013

Note: Among dialysis patients who were Medicare primary and alive for the entire calendar year.

Cause of Death

Cardiovascular disease accounts for approximately 50 percent of deaths.

Prevalence of cardiovascular diseases in adult ESRD patients, by treatment modality, 2016

Data Source: Special analyses, USRDS ESRD Database. Point prevalent hemodialysis, peritoneal dialysis, and transplant patients aged 22 and older, who are continuously enrolled in Medicare Parts A and B, and with Medicare as primary payer from January 1, 2016 to December 31, 2016, and ESRD service date is at least 90 days prior to January 1, 2016. Abbreviations: AF, atrial fibrillation; AMI, acute myocardial infarction; CAD, coronary artery disease; CVA/TIA, cerebrovascular accident/transient ischemic attack; CVD, cardiovascular disease; HF, heart failure; PAD, peripheral arterial disease; SCA/VA, sudden cardiac arrest and ventricular arrhythmias; VHD, valvular heart disease; VTE/PE, venous thromboembolism and pulmonary embolism.
Cause of Cardiovascular Disease

• Cardiac diseases in maintenance hemodialysis patients: results of the HEMO Study. (1846 patients) Kidney Int. 2004;65(6):2380.
  – 80% of patients had cardiac diseases,
  – ischemic heart disease (IHD) (39%),
  – congestive heart failure (40%), arrhythmia (31%), and
  – The HEMO Study identified IHD to be a major cause of cardiac hospitalizations and cardiac deaths.
  – Sudden cardiac death (SCD) in 22-23% of deaths in patients on HD.
Hypercholesterolemia in ESRD

2005


2009


2013

Kidney Disease Improving Global Outcomes (KDIGO) guidelines: Statin therapy not be routinely initiated in dialysis patients, despite being at high overall cardiovascular risk.
Atorvastatin vs Placebo

![Graph showing median LDL cholesterol levels over time for Placebo and Atorvastatin groups.](image)
AURORA TRIAL

A

Mean LDL Cholesterol (mg/dl)

Year

P = 0.001

Placebo

Rosuvastatin

No. at Risk

Placebo 1372 1248 1005 719 543 298 70
Rosuvastatin 1375 1243 994 719 553 315 61

B

Mean Triglyceride (mg/dl)

Year

P = 0.001

Rosuvastatin

Placebo

No. at Risk

Placebo 1372 1249 1006 719 543 298 70
Rosuvastatin 1375 1244 996 719 553 315 61

C

Mean HDL Cholesterol (mg/dl)

Year

P = 0.045

Placebo

Rosuvastatin

No. at Risk

Placebo 1372 1248 1005 719 543 298 70
Rosuvastatin 1375 1243 994 719 553 315 61

D

Median High-Sensitivity C-Reactive Protein (mg/liter)

Baseline 3 Months 1 Year

Placebo

Rosuvastatin

No. at Risk

Placebo 1370 1248 1002
Rosuvastatin 1374 1244 994
AURORA

Cumulative Incidence of the Primary End Point (%)

Placebo
Rosuvastatin

Hazard ratio, 0.96
P=0.59

Years since Randomization

No. at Risk
Placebo 1384 1163 952 809 534 153
Rosuvastatin 1390 1152 962 826 551 148
Hypertension in ESRD patient

- Pre-Dialysis
- Post-Dialysis
- Non Dialysis Day
- Avoid Hypotension on Dialysis
- Follow patient symptoms
- Pre-dialysis value of <140/90 mmHg and a post-dialysis value of <130/80
- Mean ambulatory BP <135/85 mmHg during the day and <120/80 mmHg at night, is also a reasonable goal.
Blood Pressure in Dialysis (BID) 
Results of a Pilot Study

METHODS

- A pilot RCT to assess feasibility and safety of conducting a full-scale trial of intensive control of hypertension in HD patients.
- Randomized 126 patients to a predialysis standardized SBP of 115-140 or 155-165 mm Hg for one year.

SAE Summary

<table>
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<tr>
<th>Event</th>
<th>Hazard Ratio of Recurrent Events (95% CI)</th>
<th>P-value</th>
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<tbody>
<tr>
<td>MACE</td>
<td>0.89 (0.30 – 2.66)</td>
<td>0.84</td>
</tr>
<tr>
<td>Hospitalization</td>
<td>1.66 (1.18 – 2.34)</td>
<td>0.004</td>
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<tr>
<td>Vascular access thrombosis</td>
<td>2.80 (1.18 – 6.66)</td>
<td>0.020</td>
</tr>
<tr>
<td>Systolic blood pressure &lt;90 mm Hg</td>
<td>1.30 (1.10 – 1.52)</td>
<td>0.002</td>
</tr>
<tr>
<td>Cramps</td>
<td>1.16 (1.04 – 1.30)</td>
<td>0.01</td>
</tr>
<tr>
<td>Nausea/vomiting</td>
<td>1.41 (1.02 – 1.94)</td>
<td>0.04</td>
</tr>
</tbody>
</table>

RESULTS

- Sustained separation in SBP.
- No significant reduction in MACE.
- Hospitalization, vascular access thrombosis, and intradialytic hypotension were increased in intensive arm.
- No difference in change in left ventricular mass across arms.

CONCLUSIONS

It is feasible to conduct a full-scale RCT. Given the study’s small size and short duration the safety signal may not be a definitive result.

doi: 10.1681/ASN.
Echocardiography in Dialysis Patients

- Ejection Fraction
- LV Hypertrophy
- Diastolic Dysfunction
- Valvular Heart Disease
- Wall motion abnormalities
- AV access effect on cardiac function
- Pulmonary Hypertension
Ejection fraction and contraction were normal in 15 patients (Group A), six of whom had signs of congestive failure; they were abnormal in five patients (Group B), all of whom were in clinical heart failure. Mean arterial pressure and body weight decreased by a similar amount after dialysis in both groups, and heart rate did not change. In Group A ejection fraction was unchanged by dialysis (0.63±0.06 before vs. 0.62±0.09 after) (mean ±S.D.), but in Group B it was improved significantly (0.32±0.04 before vs. 0.44±0.08 after) (P<0.01).
Sudden Cardiac Death (SCD) in ESRD

- Age
- Diabetes,
- Peripheral vascular disease
- Ischemic heart disease
- Low serum creatinine (reflecting decreased muscle mass and poor nutrition)
- An elevated alkaline phosphatase
- Traditional cardiovascular risk factors such as smoking and cholesterol did not
- LV hypertrophy
- Rapid electrolyte shifts during hemodialysis sessions
Risk of mortality among hemodialysis patients according to serum albumin during maintenance dialysis

Odds ratio for death, adjusted for age, sex, race, and underlying disease, according to the plasma albumin concentration in patients on maintenance hemodialysis. The likelihood of dying was inversely related to the plasma albumin concentration, being greatest at a plasma albumin concentration below 3.0 g/dL (30 g/L). All values are significantly different (p<0.001 to 0.03) from the odds ratio of 1.0 at a normal plasma albumin concentration of 4.0 to 4.4 g/dL (40 to 44 g/L).

Estimated unadjusted survival of dialysis patients with and without an implantable cardioverter-defibrillator (ICD)

Figure showing probability of survival over time among dialysis patients with a history of sudden cardiac death. At every time point, a higher unadjusted survival is observed in patients with an ICD (blue line) compared with those without an ICD (black line).

ICD: implantable cardioverter-defibrillator.

Survival of patients who received an implantable cardioverter-defibrillator (ICD) for secondary prevention compared with matched controls.

"Life-threatening ventricular arrhythmias, especially in patients awaiting renal transplantation, should be treated conventionally, including the use of ICD and pacemaker as required, in patients who are receiving chronic optimal medical therapy and who have reasonable expectation of survival with a good functional status for more than one year."
Central Vein Stenosis associated with Pacemaker
Central Vein Stenosis associated with Pacemaker
Central Vein Stenosis associated with Pacemaker
ASDIN: Patency Rates for Angioplasty in the Treatment of Pacemaker-Induced Central Venous Stenosis in Hemodialysis Patients: Results of a Multi-Center Study
Atrial Fibrillation in ESRD


CONCLUSIONS: Our results suggest that warfarin use is not beneficial in reducing stroke risk, but it is associated with a higher bleeding risk in patients with AF undergoing dialysis.

- For most AF on dialysis, recommend no anticoagulant therapy (Grade 2C). For patients with known atrial thrombus, valvular/rheumatic valve disease, and previous transient ischemic attack or stroke, we suggest anticoagulation with warfarin (Grade 2C).
Catheter related Atrial Thrombus (CRAT)

Right atrial thrombi complicating haemodialysis catheters. A meta-analysis of reported cases and a proposal of a management algorithm. Stavroulopoulos, Aristeidis; Aresti, Vasiliki; Zounis, Christos

Nephrology Dialysis Transplantation. 27(7):2936-2944, July 2012. DOI: 10.1093/ndt/gfr739
DIAGNOSIS OF CRAT

Yes

Alternative access

No

Exchange over a wire with the tip of the new catheter in SVC

Remove or exchange catheter after therapeutic AC is achieved (if AC is not contraindicated), especially if the thrombus is large, mobile or adherent to the catheter tip

Contraindication to AC or thrombus ≥6 cm³ or cardiac abnormalities or endocarditis with indications for surgery

Yes

AC with target INR 2-3

Follow-up weekly

Pulmonary embolism during AC

No

Other complications during AC

No

Thrombus shrinking

Yes

Consider thrombolysis

Unsuccessful

Suitable for surgery

No

Surgical Thrombectomy

No

Consider percutaneous intravascular removal of the thrombus

Continue AC for 6 months or till complete dissolution of the thrombus

In any case of bacteremia prescribe antibiotics
Pill burden in Dialysis Patients.

Chiu Y et al. CJASN 2009;4:1089-1096
Definition

• QOL can be defined as an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards, and concerns.

• HRQOL can be defined as the extent to which an individual's usual or expected physical, social, or emotional well-being is affected by a medical condition and/or its treatment.
ESRD: QOL

4 Truths About Living With Kidney Failure

1. It’s exhausting
2. Looks can be deceiving
3. There is no cure
4. The pain is real
Assessing and improving the health-related quality of life of patients with ESRD
Fredric O. et al
Nature Reviews Nephrology 8, 718-724 (December 2012)

- Physical symptoms (presence, absence and severity), including dry skin, muscle cramps, bone or joint pain, swelling in legs, muscle soreness or weakness, shortness of breath, appetite disturbance and itching
- Depression
- Anxiety
- Sleep disturbances
- Energy and vitality
- Restless legs
- Physical functioning
- Pain
- Sexual functioning
- Marital and family discord
- Social functioning
- Spirituality
- Burden of illness and care
- Satisfaction with care
- Time to recovery after a dialysis session
Anemia Management in ESRD

• The effects of normal as compared with low hematocrit values in patients with cardiac disease who are receiving hemodialysis and epoetin. Besarab et al N Engl J Med. 1998;339(9):584


Target: 10-11gm/dl
Cancer Screening

- Practice guidelines and/or standards for cancer screening that have been developed in the general population are not necessarily applicable to patients with ESRD.
- Given the limited information about cancer screening that is currently available, routine screening cannot be advocated for all such patients. Routine cancer screening is perhaps most inappropriate in patients with ESRD who are diabetic, white, or ≥65 years of age.
- Cancer-screening protocols are best implemented on an individual patient basis, a setting in which personal risk factors (family history, comorbid diseases, etc) may be considered.
- Patients being considered for renal transplantation should undergo routine cancer screening as part of the transplant evaluation process.
Glycated Hemoglobin and Risk of Death in Diabetic Patients Treated With Hemodialysis: A Meta-analysis

Higher mortality HgbA1C < 5.4% or > 8.4%

For relatively young (≤50 years) and have no other significant comorbid conditions, recommend using an HbA1c goal of 7 to 7.5, rather than higher values (Grade 2C).

For older patients (ie, >50 years) who have multiple comorbid conditions, we suggest using an HbA1c goal of 7.5 to 8, rather than lower values (Grade 2C).
Glycated Hemoglobin and Risk of Death in Diabetic Patients Treated With Hemodialysis: A Meta-analysis
Summary

• Patients with ESRD on HD have unique characteristics
• Studies based on general population may not be applicable to patients with ESRD
• Primary Care Involvement can play an important role in improving care of patients with ESRD
• Offers an interesting challenge with ample opportunity for further research
Cure sometimes, treat often, comfort always.

Hippocrates
Thank You