Management of Intradialytic Blood Pressure Fluctuations

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Gap Analysis

• Current State
Clinically significant alteration in blood pressures is one of the biggest challenges encountered in the dialysis unit

• Ideal State
Clinicians understand the physiological changes in blood pressures during hemodialysis and prevent and manage these changes effectively to ensure patient’s safety

Objectives

1. Discuss the physiological changes in blood pressure during hemodialysis
2. Discuss risk factors associated with significant blood pressure alterations with dialysis
3. Determine appropriate therapeutic options in the management of blood pressure fluctuations

Physiological Changes during Hemodialysis

• Changes associated with
1. Ultrafiltration
2. Vascular refill
3. Plasma osmolality

Hypertension

• Cuff size
• Body position
• Arm position
• Difference between 2 arms
• Observer
• Number of measurements

• Automated methods
• Home or self monitoring
**Intradialytic Hypotension**

K/DOQI

- ↓SBP ≥20mmHg or ↓MAP 10mmHg with symptoms = abdominal discomfort, yawning, sighing, N/V, cramps, restlessness, anxiety, fainting

**Factors Related to IDH**

- Patient Related
  1. DWD, objective assessment
  2. ↑IDWG
  3. Blunted volume loss
  4. Medications
  5. Eating
  6. Loss of cardiovascular compensatory mechanism (Venous constriction, increase in HR, contractile force of heart)
  7. LVH, CAD
  8. Autonomic dysfunction
  9. Hypotension
  10. Anemia
  11. Hypoalbuminemia
- Dialysis related
  1. Low sodium
  2. High temperature
  3. ↑UF = short time

**Complications of Hypotension during HD**

- Minor
  - Nausea
  - Vomiting
  - Dizziness
- More serious
  - Cardiac ischemia
  - Cerebral ischemia
  - (more pronounced in elderly)

**NKF K/DOQI Blood Pressure Goals in Hypertensive ESRD Patients**

- Target BP ≤ 140/90 mmHg (pre)
- ≤ 130/80 mmHg (post)

**Intradialytic Hypertension**

**Clinical Definitions**

- ↑MAP of ≥ 15 mmHg during or immediately post dialysis
- Hypertension during 2nd or 3rd hr of HD after significant UF removed
- ↑BP that is resistant to UF

**Possible causes of Intradialytic Hypertension**

- Pre existing
- Genetics
- ↑renin-angiotensin activity
- ↑sympathetic nervous system activation
- ↑sodium (dialysate, diet)
- Extracellular volume excess
- Abnormal calcium/phosphorus homeostasis
- Recombinant human erythropoietin
- Hyperviscosity
Intradialytic Weight Gain

- Thirst vs. plasma osmolality are different among individuals
- Higher sodium prescribed to reduce intradialytic symptoms i.e. cramps, hypotension
- Studies have shown ↑dialysate Na = ↑IDWG and ↑MAP

Residual Kidney Function

Increasing the dialysis dose has failed to have an impact on the mortality of dialysis patients. In contrast, residual kidney function has consistently been a potent predictor of improved survival for both HD and PD patients.

- Loss of RKF = urine volume ≤ 200mL/d
- PD
- Avoid volume depletion

Sodium Modeling

- YES
  - ↑Na at onset facilitates movement of water from interstitial space
  - Reduce IDM

- NO
  - HTN
  - ↑Na = ↑thirst = ↑IDWG

THE HYPOVOLEMIA-HYPERTENSION CASCADE!

- Hypovolemia
- Renal Ischemia
- Renin
- Angiotensin I
- ACE
- Angiotensin II
- Vasoconstriction

Residual Kidney Function

- Know your patient = trends in BP, IDWG
- Incidence of IDM
- Sodium levels
- Eating habits? Fast foods? Processed food
- Na modeling used only with MD’s order
Interdialytic weight gain

- Determinants of weight gain = fluid and food (sodium)
- “DRY” Weight = ideal state = TRUE weight
- Normotensive
- No edema

Medications

- Lower BP = lower CV risks
- HTN is more severe in African Americans
- Diurctics – Thiazide, Loop
- Beta blockers
- Alpha blockers
- Sympathetic blockers
- ACE I
- ARBS
- Calcium channel blockers

Pears

- Dialyzability of drugs
- Not all same class medications act the same way
- Need to know – long acting Vs. short acting

KDOQI Clinical Practice Guidelines for Cardiovascular Disease in Dialysis Patients

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Isolated Ultrafiltration (Sequential)

Schematic representation of water movement during isolated ultrafiltration. Plasma at an osmolality of 320 mosmol/kg flows into the dialyzer (filter) (step 1) which is not perfused with dialysate. The favorable hydrostatic pressure gradient results in the isosmotic removal of fluid in the dialyzer. The fluid returning to the patient is osmotic and not changed in osmolality (step 2). The ensuing rise in plasma oncotic pressure results in fluid movement from the interstitial fluid and the cells into the vascular space (step 3). This last effect will tend to maximize the degree of plasma volume depletion and protect against the development of hypotension.

Schematic representation of water movement during standard hemodialysis. Plasma at an osmolality of 320 mosmol/kg flows into the dialyzer (step 1) which is perfused with a dialysate having an osmolality of 280 mosmol/kg. Diffusive loss of urea (and other small solutes) lowers the osmolality of the fluid returning to the patient (step 2). The ensuing fall in extracellular osmolality creates an osmotic gradient favoring water movement into the cells. This effect plus water loss by ultrafiltration across the dialyzer leads to extracellular volume depletion and may cause hypotension. The rapid fall in plasma osmolality also may play a contributory role, perhaps by interfering with sympathetic responsiveness to volume depletion.
The management of blood pressure is an important component of CVD risk management for all aspects of CVD.

- BP measurement: patients’ HX of numerous accesses in both arms = thigh or leg pressure.
- Hypertension in HD patients = attention to fluid status and adjustment of medications.

**BP Goals:**
- Pre: $\leq 140/90$ mmHg
- Post: $\leq 130/80$ mmHg

**Methods of checking BP:**
- Seated quietly, feet on floor, arm supported at heart level.
- Appropriate cuff size (80%) of the arm.

**Therapeutic Options**
- EXCESSIVE Fluid accumulation = adjustment of EDW
  1. Education and REGULAR counseling
  2. ↓Na (2-3 g/day)
  3. ↑UF
  4. Longer dialysis
  5. ↑frequency of dialysis
  6. Assessment – including variations in appetite
  7. Correct anemia
  8. O2 supplementation
  9. Reassess medications (monthly home medication check)
  10. Isolated UF
  11. UF profiling
  12. Non invasive monitoring of blood volume changes

**Summary**
- NKF KDOQI Clinical Practice Guidelines for Cardiovascular Disease in Dialysis Patients
- Section II. Guidelines on Management of cardiovascular risks
- Guideline 12: **Blood Pressure**

- BP Goals = Pre $\leq 140/90$ mmHg; Post $\leq 130/80$ mmHg
- Methods of checking BP = seated quietly, feet on floor, arm supported at heart level
- Appropriate cuff size (80%) of the arm.
Table 13. Causes of Resistant Hypertension in Dialysis Patients

Patient noncompliance with prescribed treatment
Dietary (excessive sodium intake or alcohol consumption, inability to reduce excessive body weight)
Drug regimen
Indication regimen
Drug-drug interaction
Administration of heparin, aminosalicylates, NSAIDs
Secondary hypertension (Renovascular, primary aldosteronism or other mineralocorticoid excess syndromes, pheochromocytoma, hyperparathyroidism, sleep apnea, or pseudoephedrine, methyldopa, etc.)

Questions?