Complications of hemodialysis

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- **The advance in technology and the delay in kidney transplant lead to the prolongation of period of hemodialysis in children with CKD and the emergence of many complications.**

Common complications

Patient Complications

- Hypotension (20-30%)
- Muscle Cramps
- Disequilibrium Syndrome
- Nausea and Vomiting
- Headache
- Chest Pain
- Itching
- Fever and Chills
- Pyrogen reaction
- Hypertension

Technical Complications

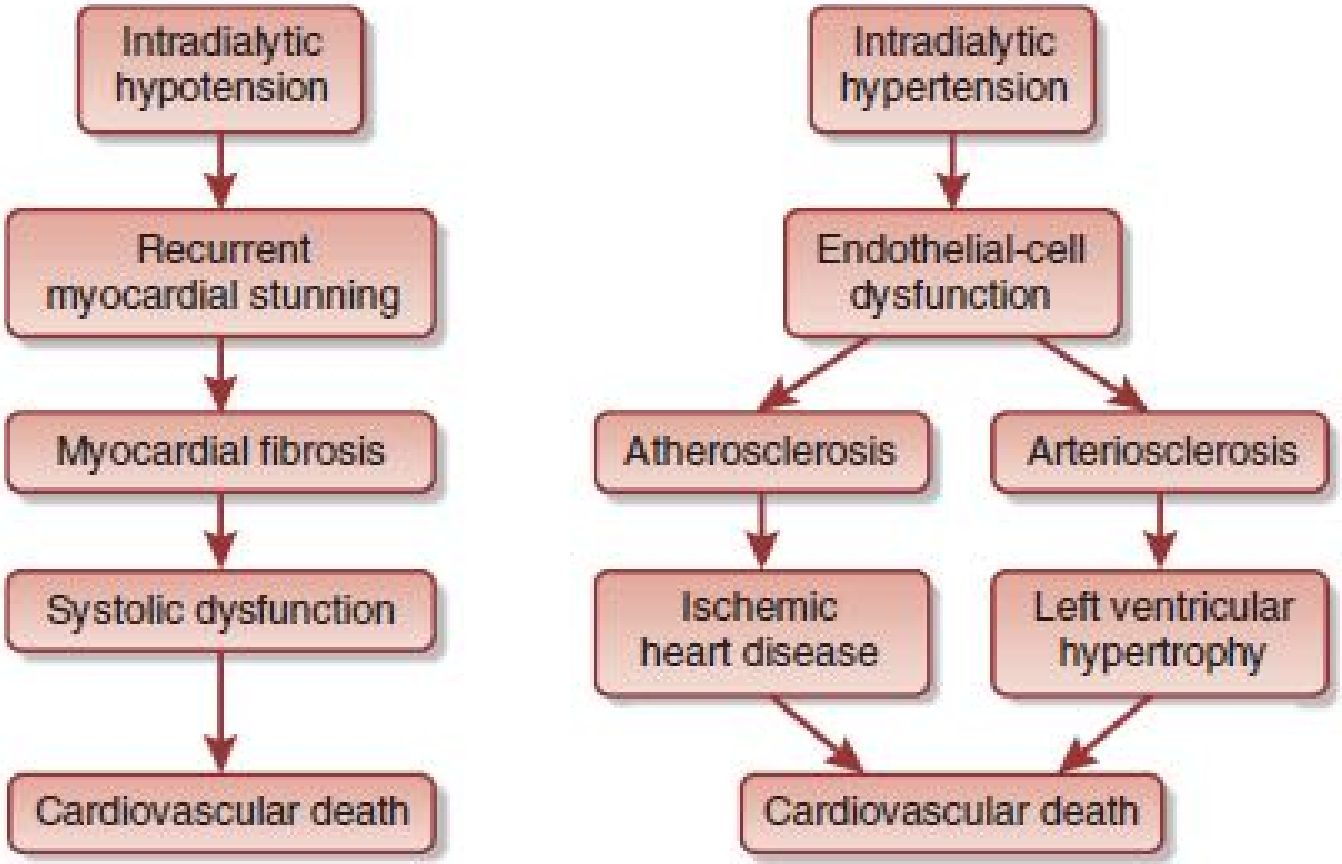
- Clotting
- Blood leak
- Power failure
- Hemolysis
- Air Embolism
  - Air in bloodlines
- Exsanguination
- Dialyzer reactions

Cardiovascular complications

- **Intradialytic hypotension (IDH)**
- **Paradoxical (intradialytic) hypertension**
- **Cardiac arrhythmias**

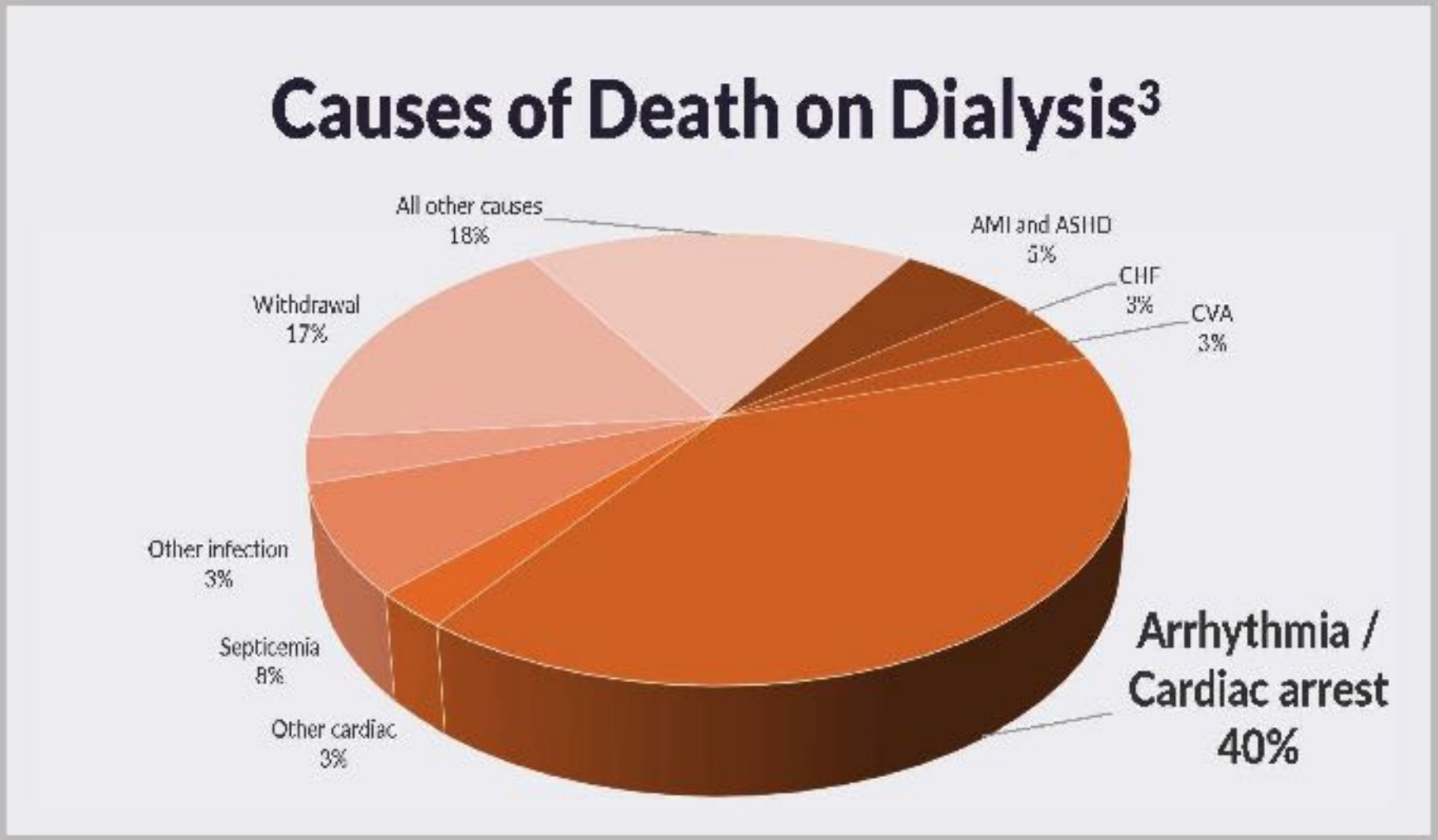
Cardiovascular complications

Adverse outcomes

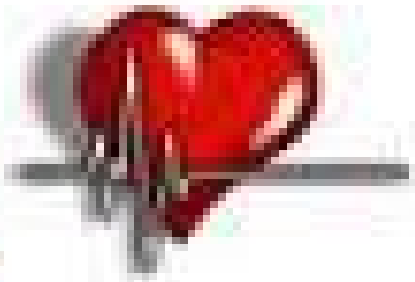


Cardiovascular complications

Adverse outcomes



Intradialytic hypotension (IDH)



20-30%

National Kidney Foundation
KDOQI

Intradialytic hypotension (IDH)

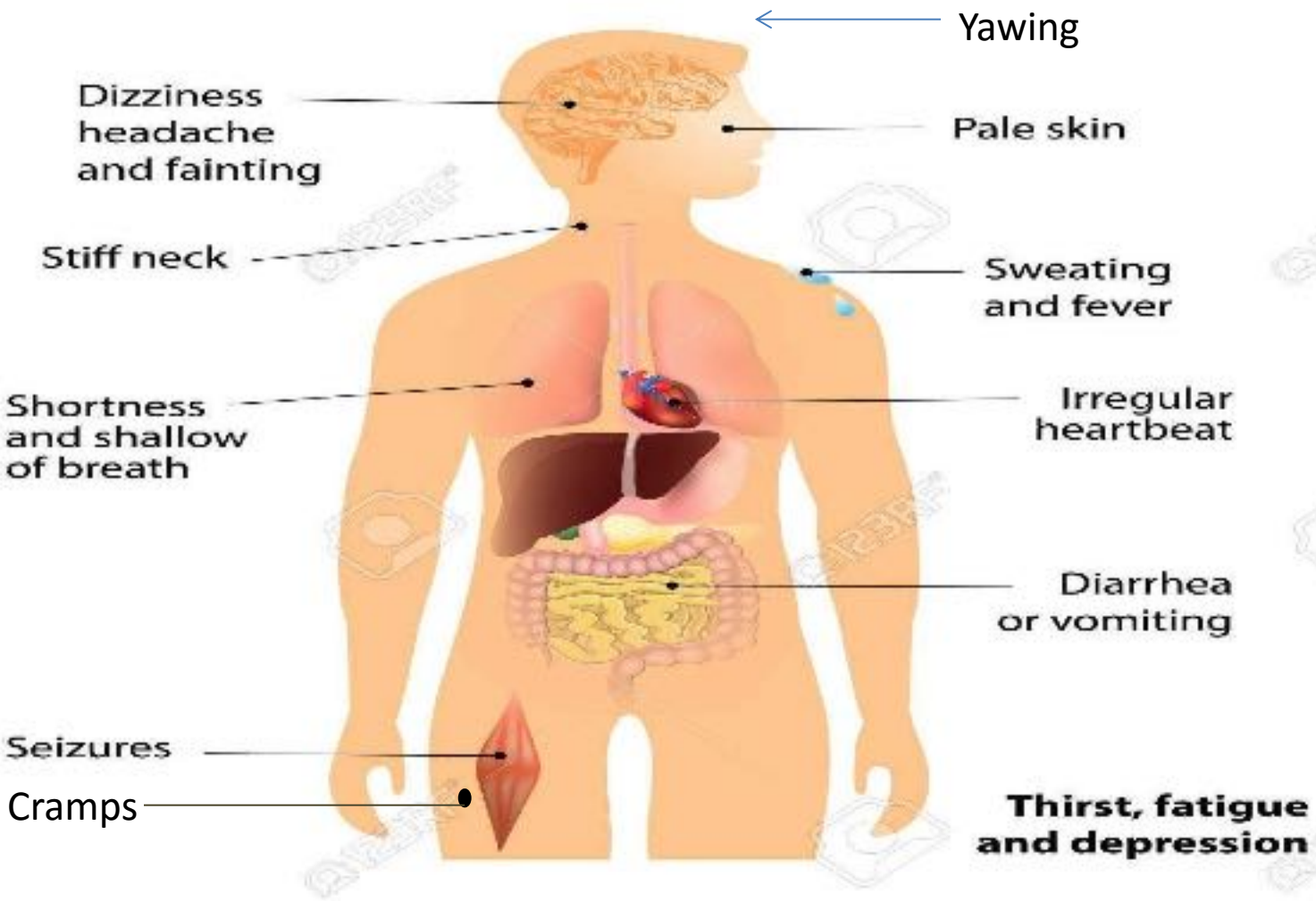
Definition

KDOQI Clinical Practice Guidelines for Cardiovascular Disease in Dialysis Patients

- ***A decrease in systolic blood pressure by ≥20 mm Hg or a decrease in MAP by 10 mm Hg***
- ***associated with symptoms*** that include: abdominal discomfort; yawning; sighing; nausea; vomiting; muscle cramps; restlessness; dizziness or fainting; and anxiety

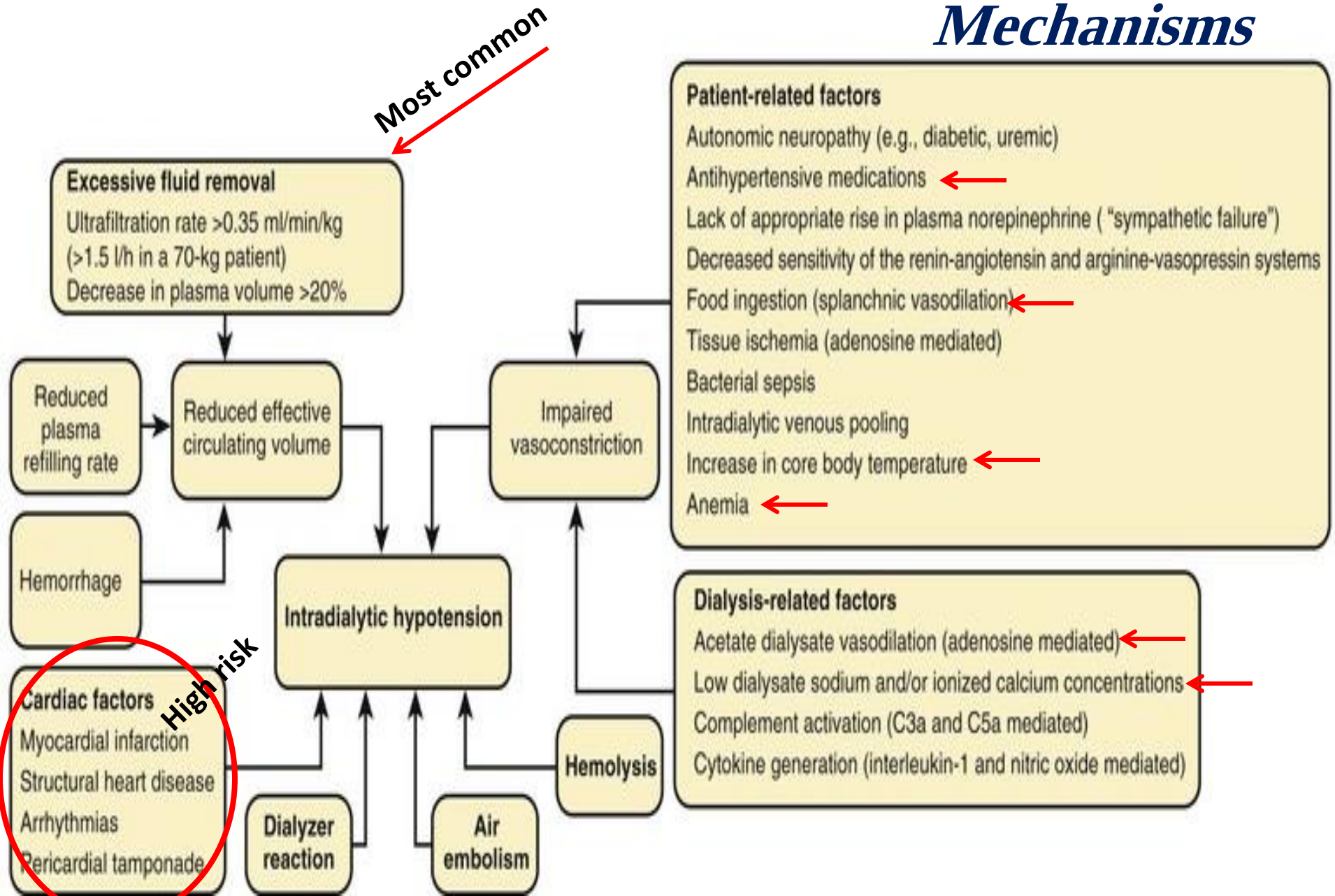
Intradialytic hypotension (IDH)

Signs & symptoms



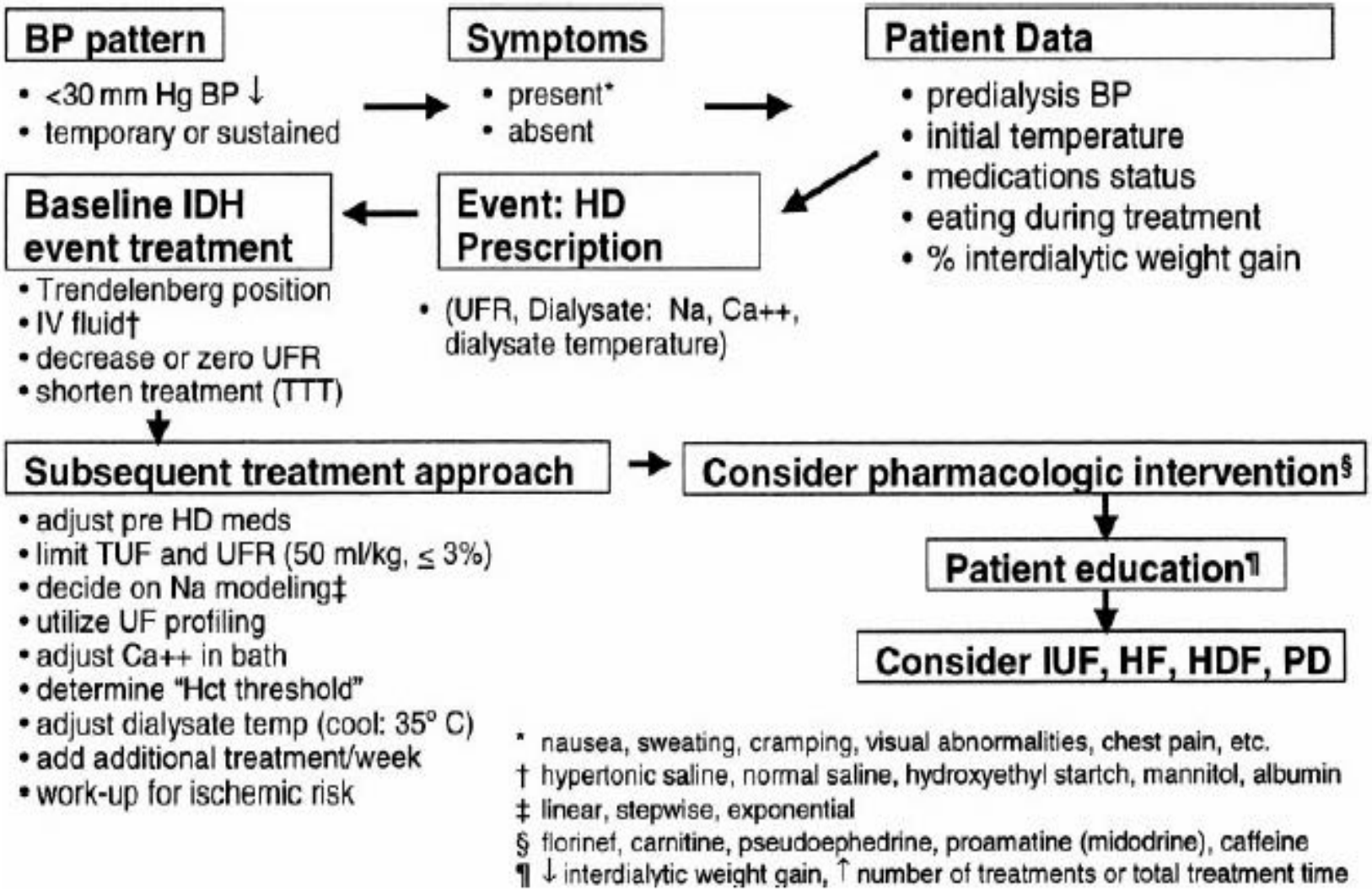
Intradialytic hypotension (IDH)

Mechanisms



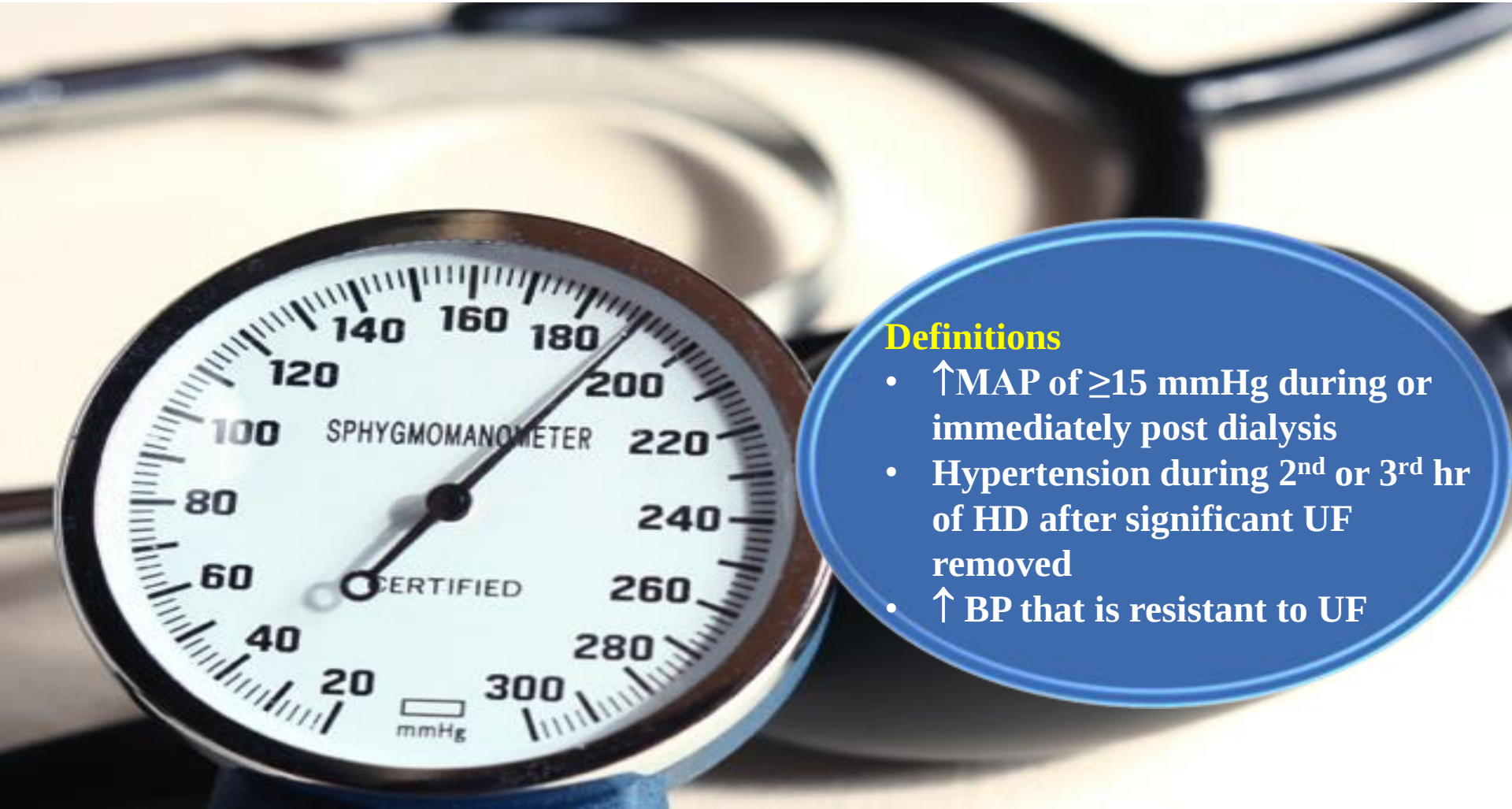
Intradialytic hypotension (IDH)

Management



Paradoxical (intradialytic) hypertension

8-30% (no pediatric no.)



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

Clinical Trial

Dry-Weight Reduction in Hypertensive Hemodialysis Patients (DRIP)

A Randomized, Controlled Trial

Rajiv Agarwal, Pooneh Alborzi, Sangeetha Satyan, Robert P. Light

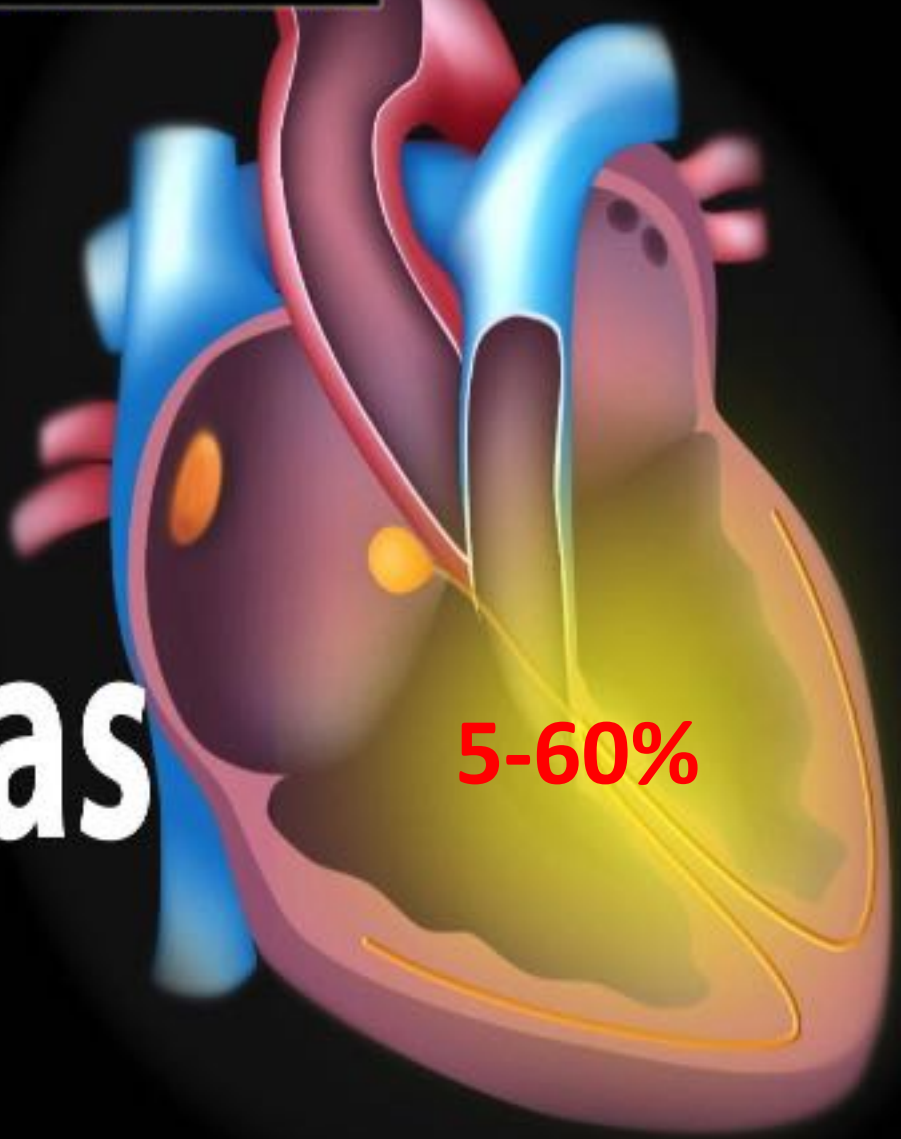
Abstract—Volume excess is thought to be important in the pathogenesis of hypertension among hemodialysis patients. To

"Optimal control of blood pressure in HD patients is via volume control NOT the use of antihypertensive agents"

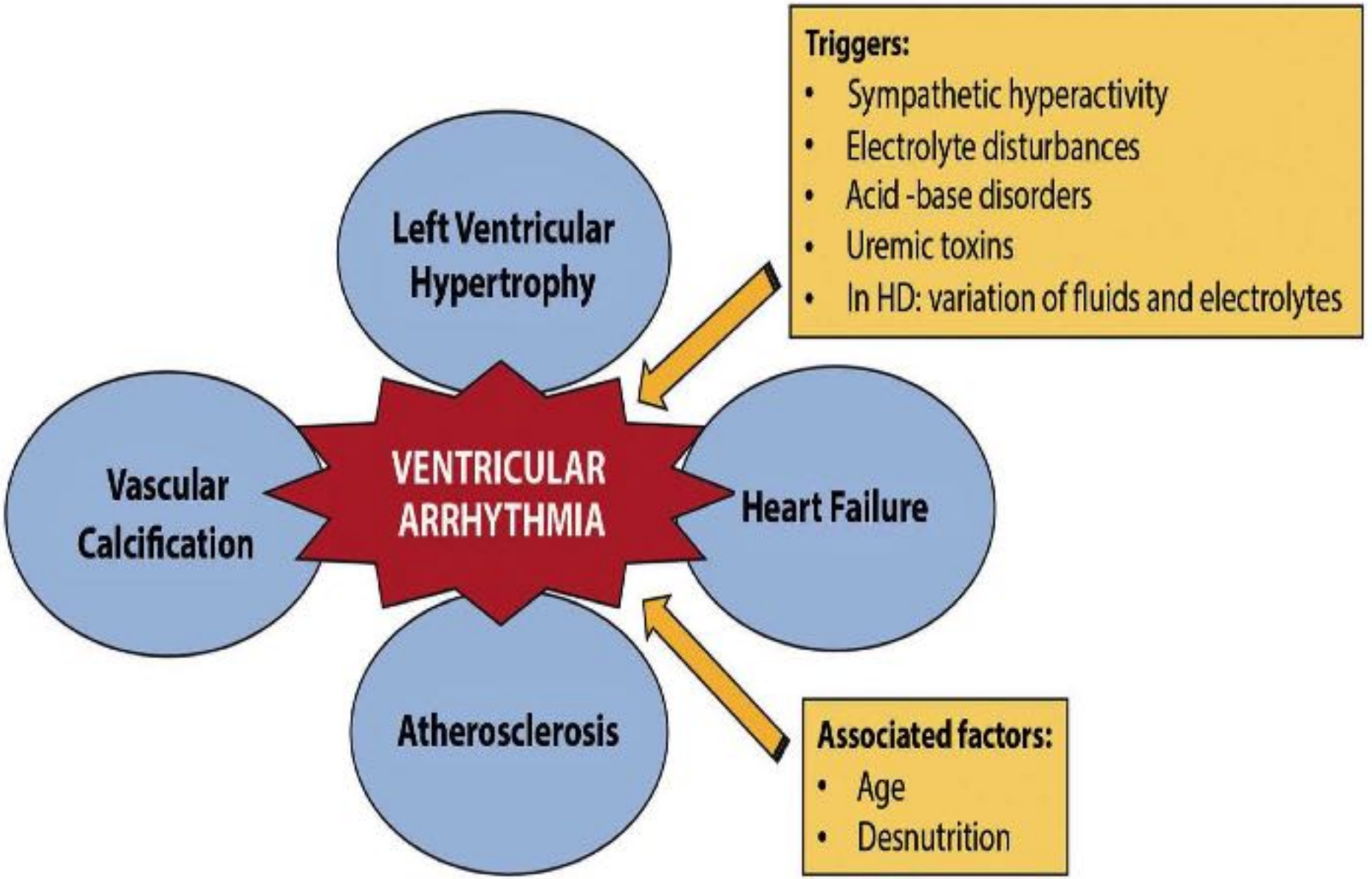
BP changes −6.6 mm Hg (95% CI: −12.2 to −1.0 mm Hg, P=0.021), and diastolic BP changes −3.3 mm Hg (95% CI: −6.4 to −0.2 mm Hg; P=0.037) from baseline. The Mantel-Haenzel combined odds ratio for systolic BP reduction of ≥10 mm Hg was 2.24 (95% CI: 1.32 to 3.81; P=0.003). There was no deterioration seen in any domain of the kidney disease quality of life health survey despite an increase in intradialytic signs and symptoms of hypotension. The reduction of dry weight is a simple, efficacious, and well-tolerated maneuver to improve BP control in hypertensive hemodialysis patients. Long-term control of BP will depend on continued assessment and maintenance of dry weight. (*Hypertension*. 2009;53:500-507.)

Key Words: hemodialysis · hypertension · ultrafiltration · ambulatory blood pressure · volume control

Cardiac Arrhythmias



5-60%


Triggers:
• Sympathetic hyperactivity
• Electrolyte disturbances
• Acid -base disorders
• Uremic toxins
• In HD: variation of fluids and electrolytes
Left Ventricular Hypertrophy
Vascular Calcification
VENTRICULAR ARRHYTHMIA
Heart Failure
Atherosclerosis
Associated factors:
• Age
• Desnutrition

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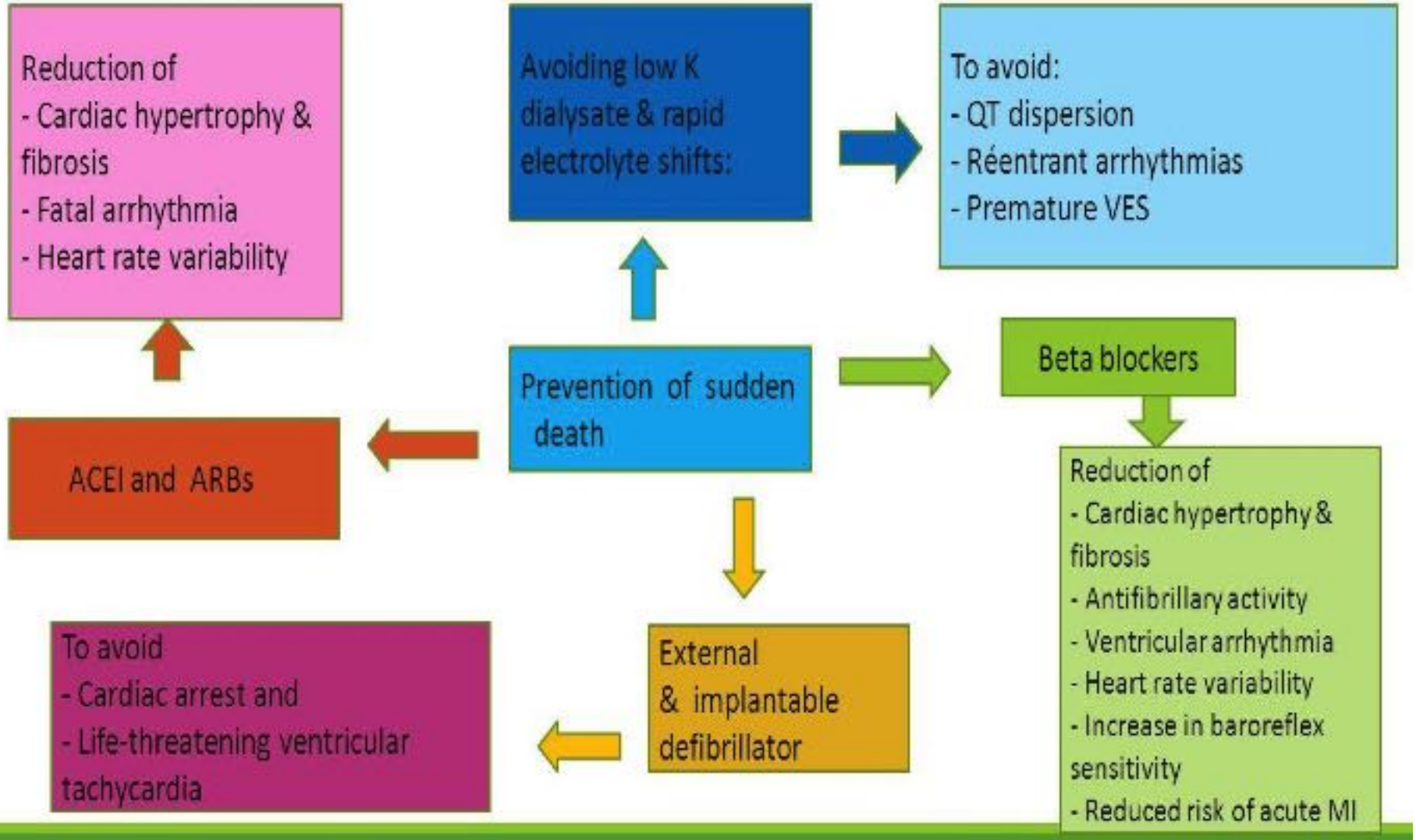
Spotlight on CKD deaths—increasing mortality worldwide

Patients who suffered a cardiac arrest at the time of dialysis were twice as likely to be dialysed against a 0 or 1.0 mEq/l potassium dialysate compared to controls, despite no difference in pre-dialysis serum potassium levels but levels below 4.0 mEq/l or higher than 5.6 mEq/l were associated with increased mortality.

disease has declined over the past two decades. By contrast, new data indicate that the rate of CKD-associated deaths is increasing worldwide. This important finding highlights CKD as a major contributor to global morbidity and mortality.

Despite increasing recognition of the high prevalence and associated mortality of pre-dialysis and dialysis-dependent chronic kidney disease (CKD) in industrialized nations such as the USA[1,2] and the UK,[3] a large knowledge gap remains with regards to the epidemiology of CKD in less-developed countries. A new report from the Global Burden of Disease (GBD) Study has reduced this gap and identified CKD as an increasing cause of mortality worldwide.[4]

Prevention of sudden death in dialysis patients.



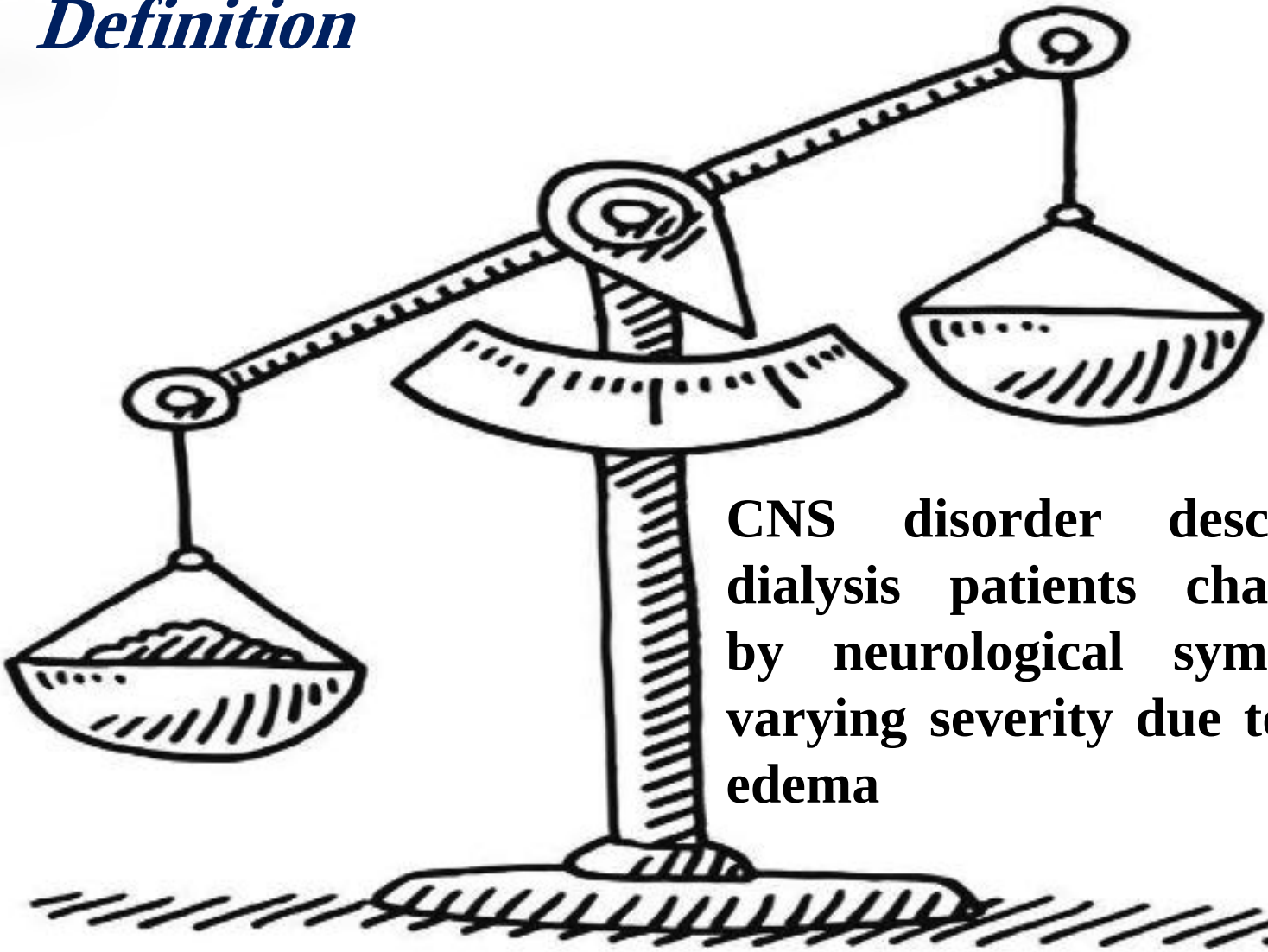
Blood Purif 2010;30:135–145

Neuromuscular complications

- **Dialysis disequilibrium syndrome**
- **Hemodialysis-associated seizure (HAS)**
- **Muscle cramps**
- **Hemodialysis-related headache**

Dialysis disequilibrium syndrome

Definition



CNS disorder described in dialysis patients characterized by neurological symptoms of varying severity due to cerebral edema

Dialysis disequilibrium syndrome

Risk factors

- ✓ 1st session hemodialysis
- ✓ Extreme age : child or aging
- ✓ High BUN level: > 125 mg/dl
- ✓ CNS disorder (stroke, tumor, dementia,hypo Na),

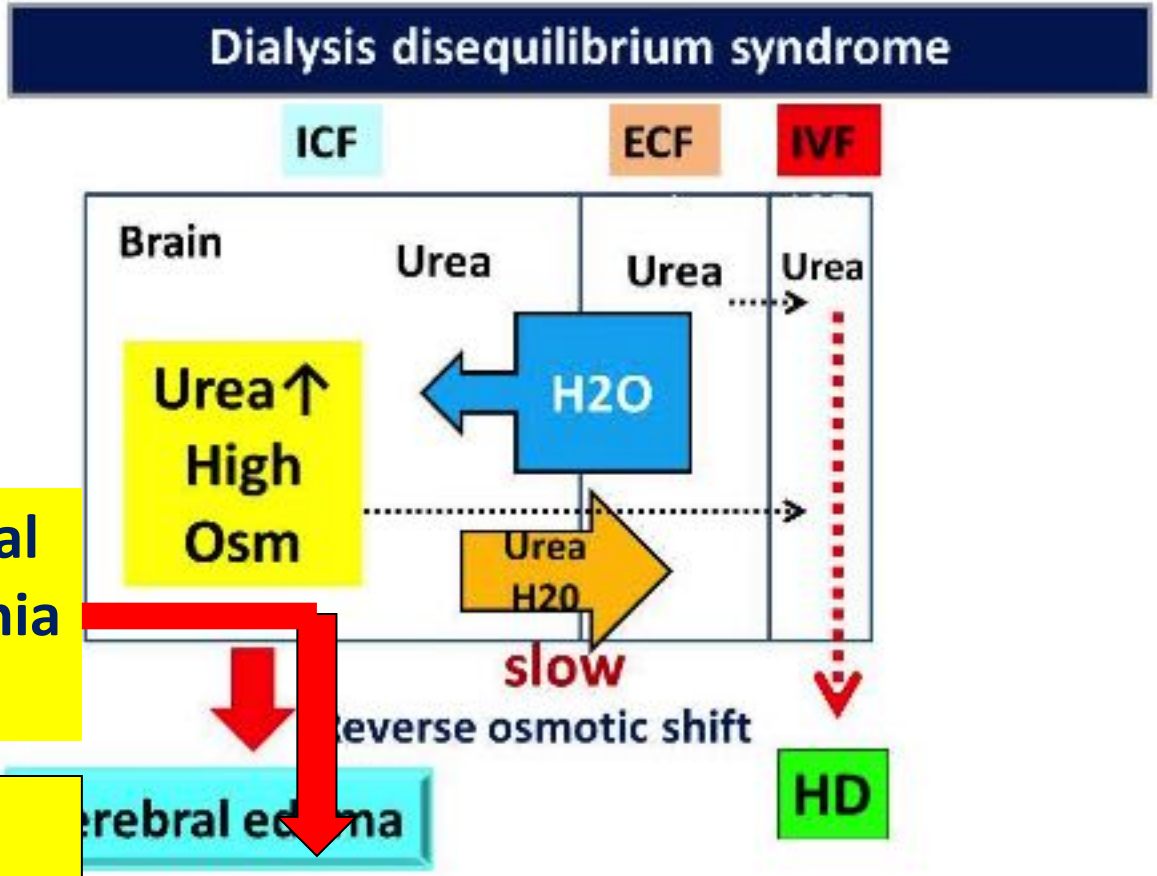
head injury (subdural hematoma) ....

Pediatr Nephrol (2012) 27:2205–2211

Seminars in Dialysis—Vol 20, No 3 2008 pp. 493–498

Dialysis disequilibrium syndrome

Pathogenesis



Paradoxical CSF acidemia

Organic osmolytes (idiogenic osmoles)

Dialysis disequilibrium syndrome

Clinical diagnosis

Clinical : fatigue, mild headache, nausea, vomiting, disturbed consciousness, convulsions... coma.

Common mild..Self limited, fatal.. if severe

Diagnosis

Clinical diagnosis (during HD, after HD)

+ risk factor Exclusion other condition

Dialysis disequilibrium syndrome

Prevention

Children starting chronic dialysis or patients with acute kidney injury

Slow and gentle HD to allow for the gradual reduction in plasma uremic toxin levels over a series of dialysis treatments.

- **Dialyzers: smaller (less efficient)**
- **Dialysis time: 2 h**
- **Blood flow rate: 2–3 mL/kg/ min**
- **Dialysate flow rate: maintaining the 2:1 dialysate: blood flow rate ratio.**
- **Fluid overload: Sequential HD (consider CRRT)**

Dialysis disequilibrium syndrome

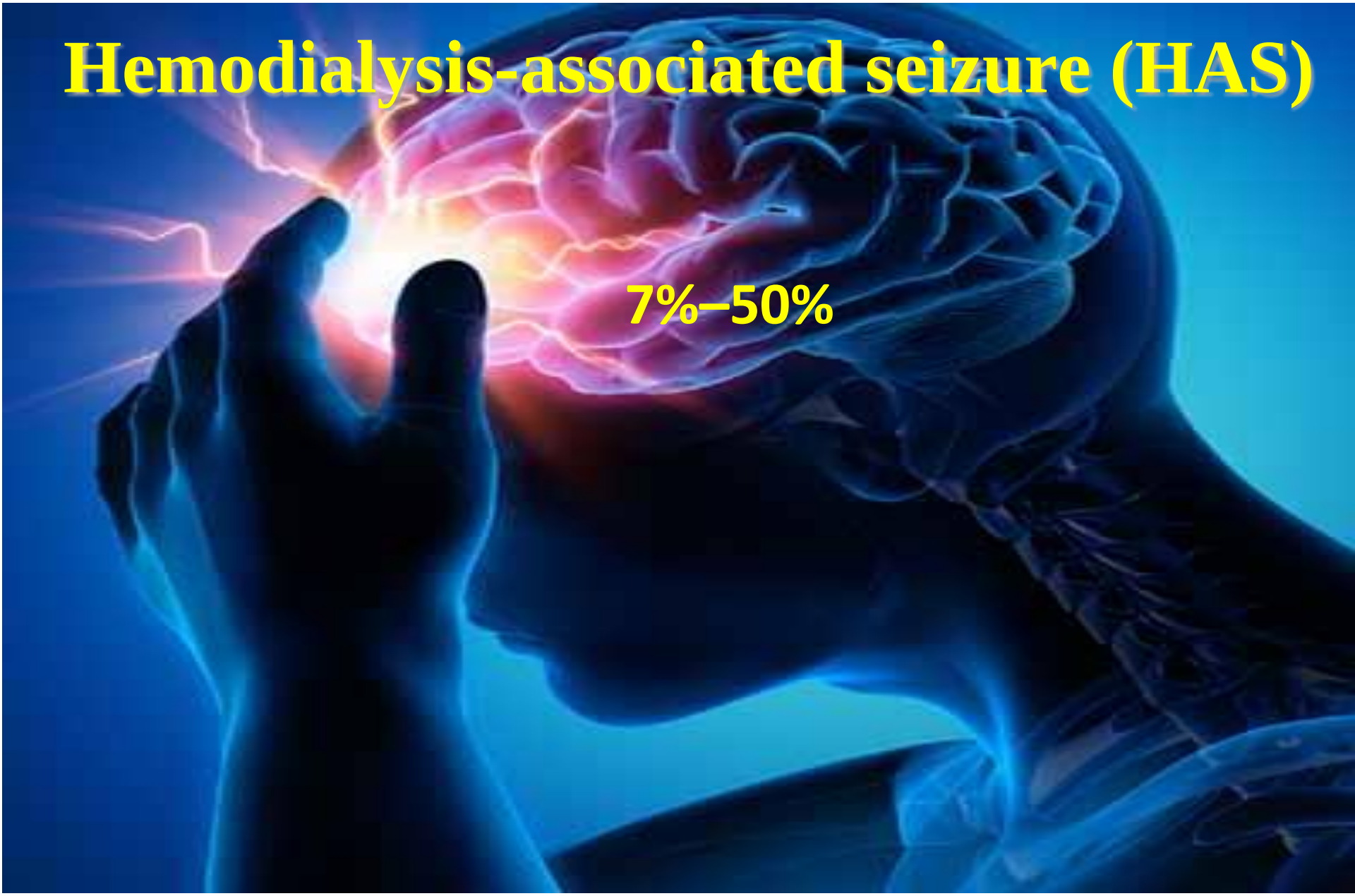
Prevention

Children on maintenance HD suffering from recurrent episodes of DDS

Higher dialysate sodium concentrations: increase in dialysate Na linear or stepwise manner from 135–137 mmol/L to 142–148 mmol/L over the course of the dialysis session.

- **The most evidence-based maneuver**
- **Counterbalance the rapid ↓ in plasma osmolality from urea purification.**
- **May stimulate thirst causing ↑ interdialytic weight gain and hypertension.**

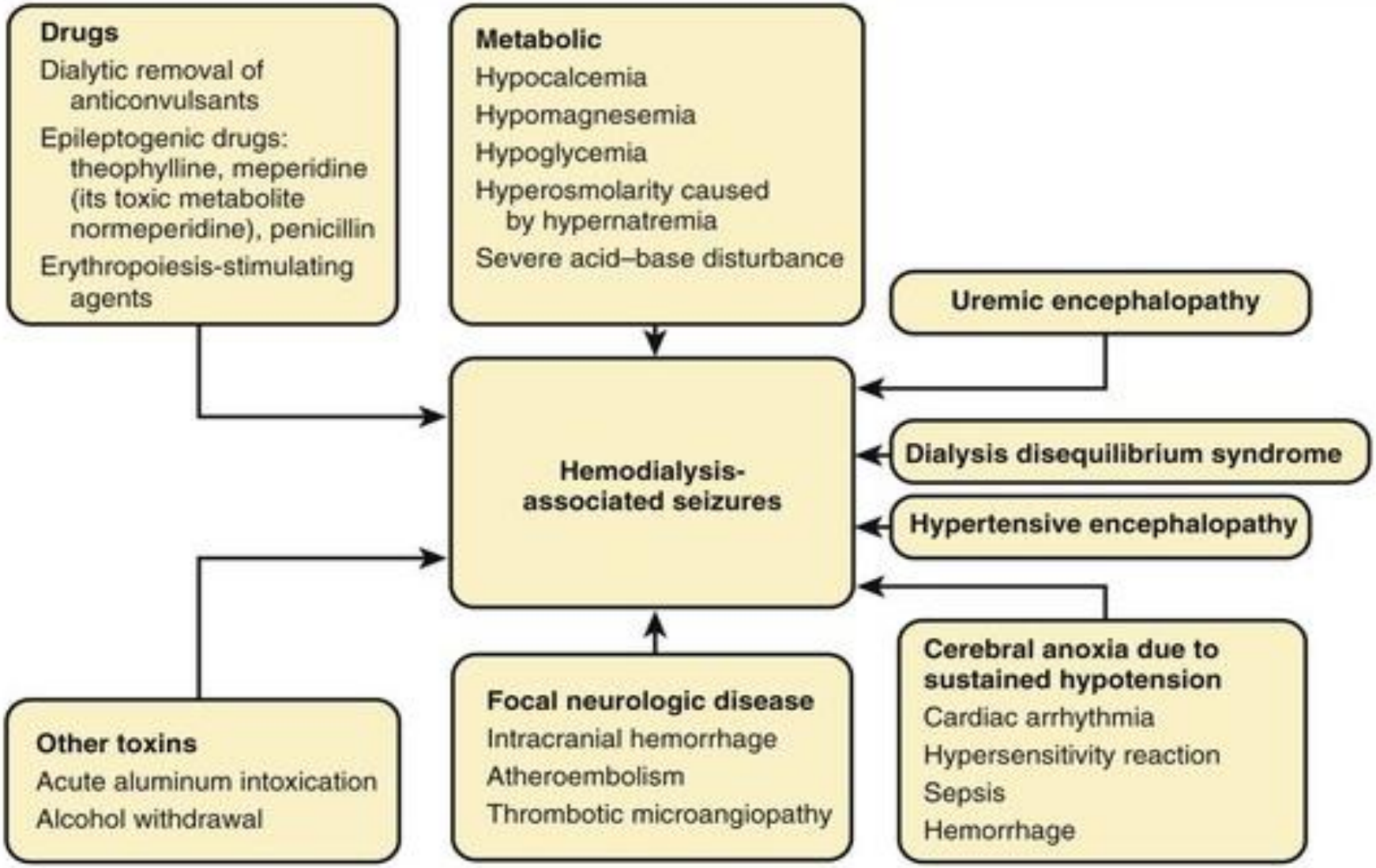
Hemodialysis-associated seizure (HAS)



Usually reported as generalized tonic-clonic seizures

Hemodialysis-associated seizure (HAS)

Causes



Hemodialysis-associated seizure (HAS)

Prevention

Pediatr Nephrol (2000) 14:367–369

BRIEF REPORT

Ferah Sönmez · Sevgi Mir · Sarenur Tütüncüoğlu

Potential prophylactic use of benzodiazepines for hemodialysis-associated seizures

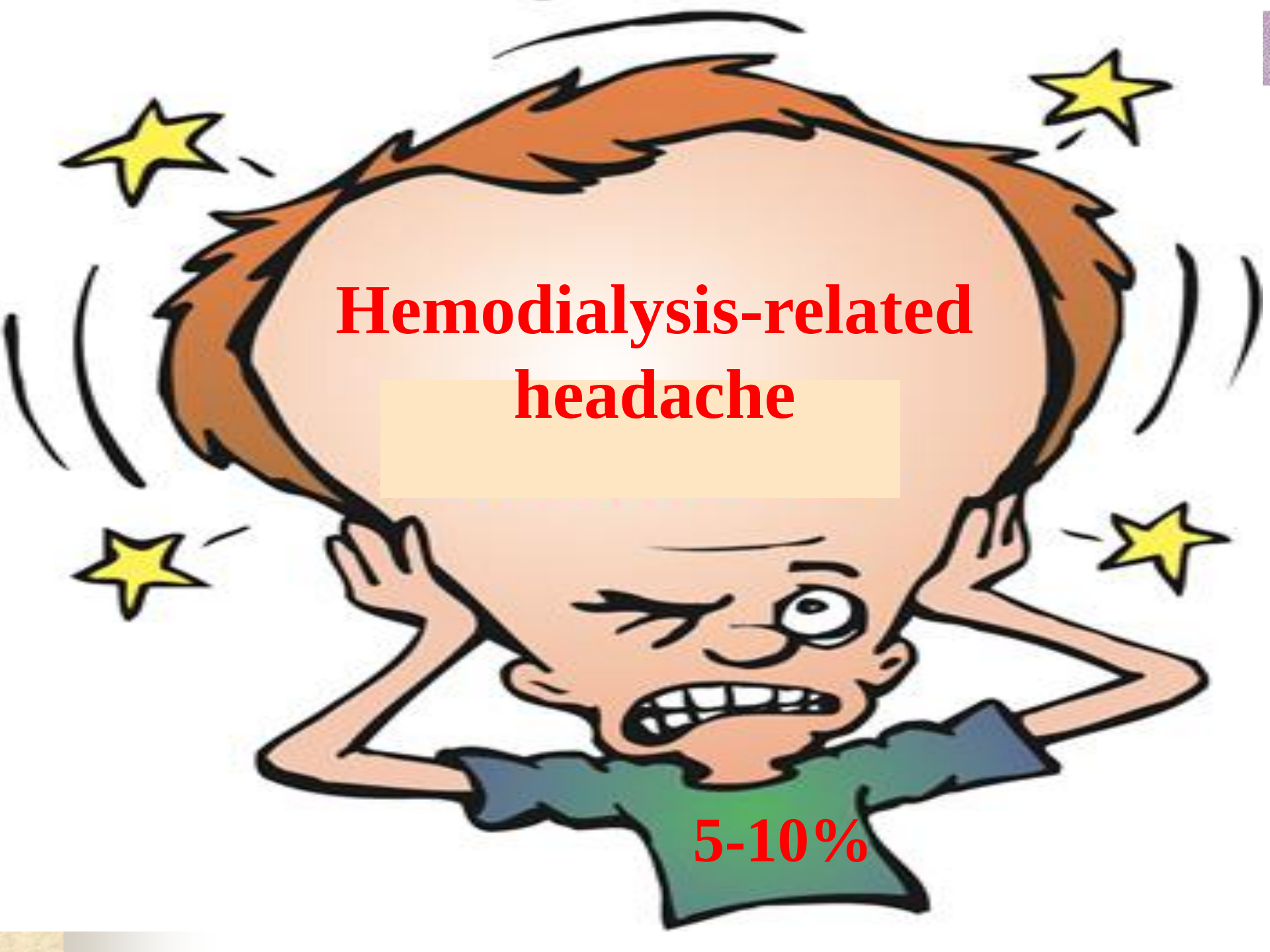
Lower extremities

Mechanisms:

- **Rapid ultrafiltration**
- **Intradialytic hypotension**
- **Tissue hypoxia**

Management of Cramps

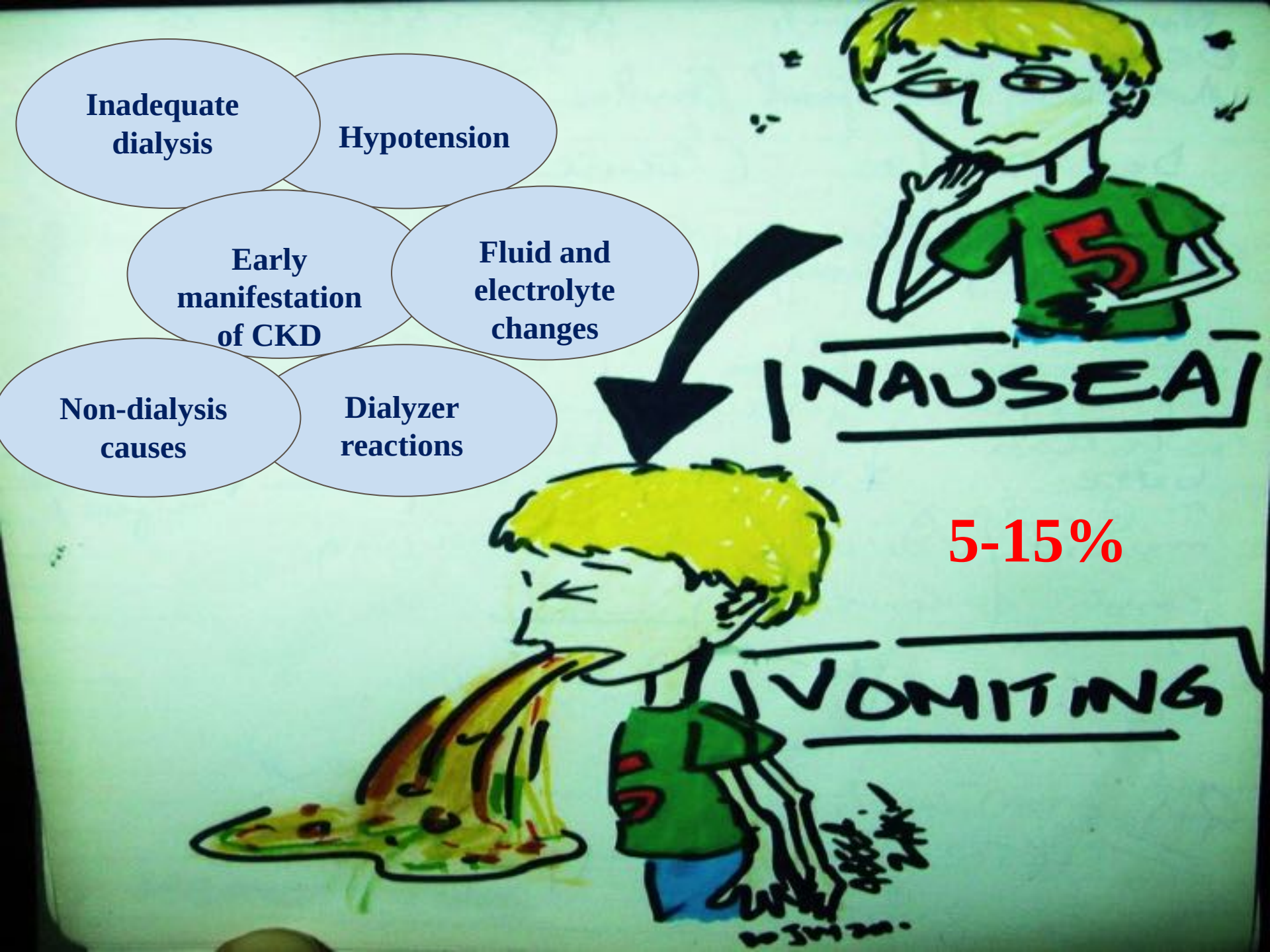
- Minimize interdialytic wt gain & need for excessive UF, prevent dialysis hypotension, higher sodium dialysate, or sodium profiling.
- IV saline (normal or hypertonic); IV **50% dextrose** are very effective (but saline will contribute to HPN & volume overload)
- Local massage offers some relief
- **Carnitine** supplementation & **quinine sulphate** may help some pts. Quinine is best used 2 h before dialysis. **Vitamin E** (400iu)
- Some pts respond to **diazepam**, **carbamazepine**, **amitriptyline**, **phenytoin**, or **alcohol**


Hemodialysis-related headache
5-10%

Hemodialysis-related headache

Diagnosis

Diagnostic criteria of dialysis headache
A. At least 3 attacks of acute headache fulfilling criteria C and D
B. Patient is on hemodialysis
C. Evidence of causation demonstrated by at least two of the following 1. Each headache developing during a hemodialysis session 2. At least one of the following a) Each headache worsening during the dialysis session b) Each headache resolving within 72hr after the end of the dialysis session 3. Headache episodes cease altogether after successful KT and termination of HD
D. Not better accounted by another The International Classification of Headache Disorders, 3rd edition diagnosis


Inadequate dialysis
Hypotension
Early manifestation of CKD
Fluid and electrolyte changes
Non-dialysis causes
Dialyzer reactions
NAUSEA
VOMITING
5-15%

Management of N&V, headache

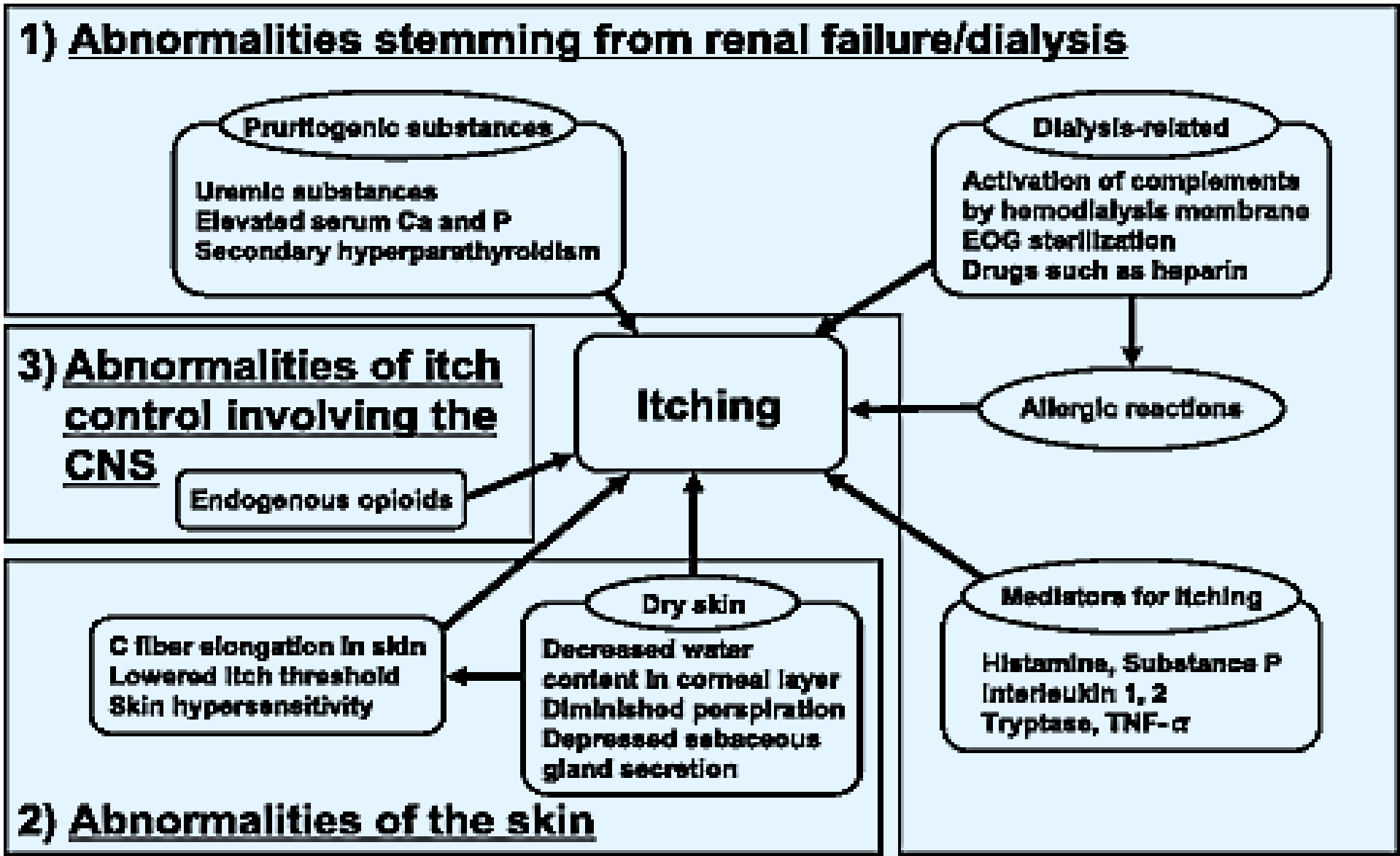
- Treat & prevent hypotension
- **Antiemetics** & **paracetamol** may help if not precipitated by hypotension
- Reduction of BFR (by 25-30%) during 1st hr of HD sometimes useful (but overall dialysis time must be lengthened to maintain dose of dialysis)
- Use bicarbonate rather than acetate dialysis

Diagnostic criteria

1. Pruritus appears shortly before the onset of dialysis, or at any time, without evidence of any other active disease that could explain the pruritus.
2. more than or equal to three episodes of itch during a period of <2 weeks, with the symptom appearing a few times a day, lasting at least few minutes, and troubling the patient.
3. Appearance of an itch in a regular pattern during a period of 6 months, but less frequently than listed above.

ITCHING

Pathogenesis



ITCHING

Treatment

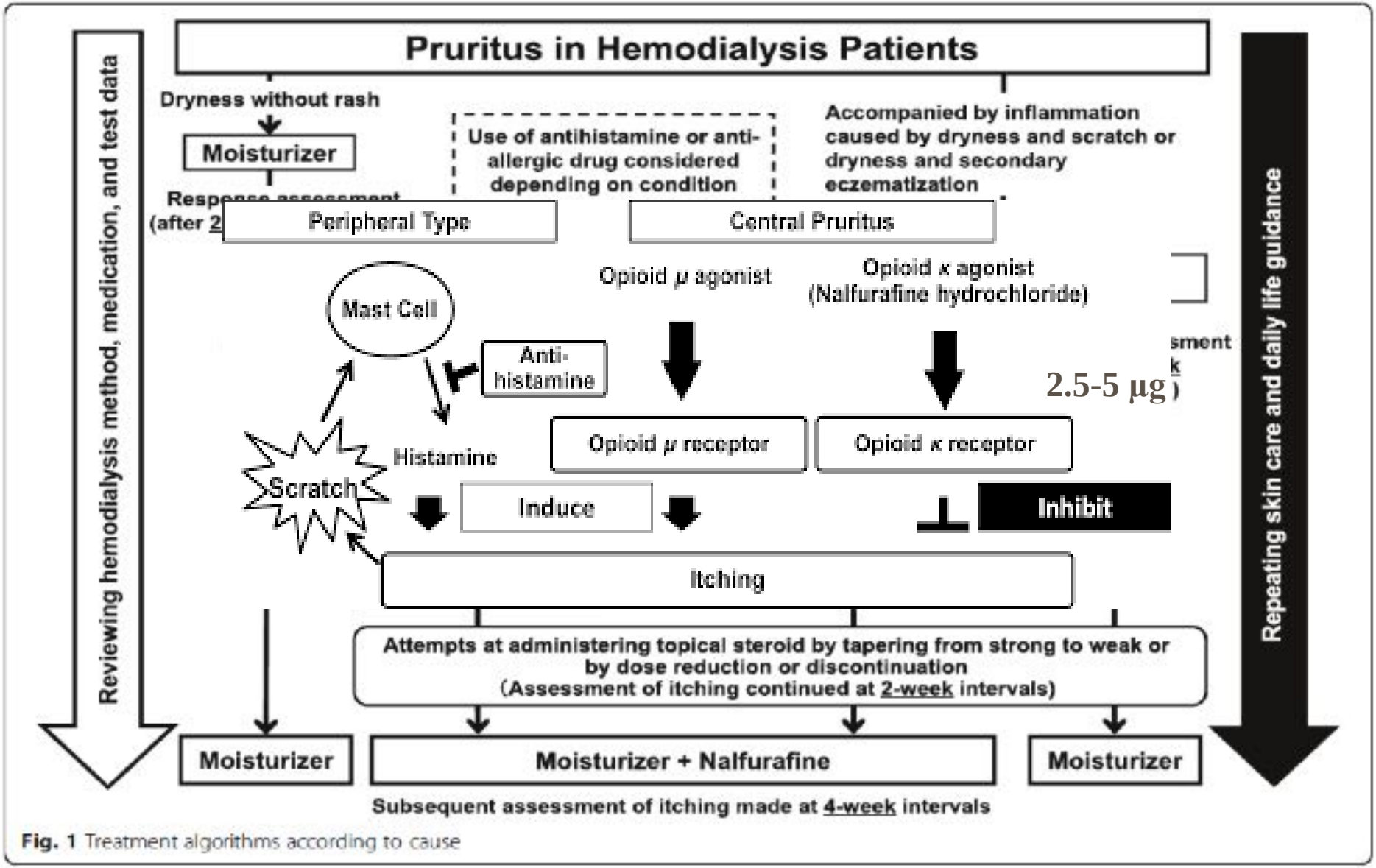


Fig. 1 Treatment algorithms according to cause

ITCHING

Treatment

Physical treatment

- **Phototherapy**
- **Acupuncture**
- **Sauna**

Dialyzer reactions

Dialyzer reactions

	Type A Anaphylactic	Type B Mild
Incidence	Rare (max 5/100000 dialyses)	Common (3-5/100 dialysis)
Onset	Usually 1st min. Up to 30 min	30-60min
Symptoms	Moderate-severe Anaphylaxis Itching, urticaria, cough, abdominal cramps, dyspnoea, burning collapse, death	Mild Chest pain, back pain
Causes	Ethylene oxide (previously common, now rare; patients often have IgE anti-ethylene oxide antibodies) ACE inhibitors and AN69 membranes (activation of bradykini system by membrane amplified by ACEI Bacterial contamination of dialysis in high flux dialysis Reused dialyzers (bacterial contamination, endotoxin, unknown causes) Heparin allergy (rare) Acetate dialysate	Unknown Complement activation?
Treatment	Stop dialysis immediately Clamp lines and discard Cardiopulmonary resuscitation if necessary Intravenous antihistamines, steroids and adrenaline (SC/IM) if severe	Exclude other causes of chest pain Supportive O2 Continue dialysis
Outcome	Can be fatal-seek cause	Symptoms usually resolve after 30-69 min


How Evil Are You?
HEMODIALYSIS
IDH
Cardiac arrhythmia
HAS
Cramps
Vomiting & nausea
Itching
Dialyzer reactions

Complications of hemodialysis

- EARLY RECOGNIZE
- TRY TO PREVENT
- APPROPRIATELY TREAT


How Evil Are You?
TAKE THIS QUIZ

Let's Take a Quiz

MCQ

1- Which of following statement is TRUE:

A. **Parenteral infusion of hypotonic saline is effective in treating dialysis cramps**
B. **Cerebral edema is not a consistent finding is dialysis disequilibrium syndrome**
C. **Optimal control of blood pressure in HD patients is via volume control, not the use of antihypertensive agents**
D. **None of the above**

MCQ

2- If inter dialysis wt gain is >3%, the most prudent approach to ensuring patient safety is:

A. **Scheduling him for additional session**
B. **Increase the UFR**
C. **Decrease dialysate Na**
D. **None of the above**

MCQ

3- Which of the following is minimally dialyzable or nondialyzable medications:

A. **Angiotensin receptor blockers**
B. **Calcium channel blockers**
C. **Clonidine and carvedilol.**
D. **None of the above**


Thank
you!!