



Acute Hemodialysis Prescription



Case: Acute Hemodialysis

- آقای 50 ساله بدنبال مولتیپل تروما و پارگی طحال و خونریزی داخل شکمی با تابلوی شوک هیپوولمیک به اتاق عمل برده شده و اسپلنکتومی میشود و 4 واحد پک سل و 3 لیتر سرم نرمال سالین دریافت کرده است. آزمایشات روز اول کراتینین 1 و هموگلوبین 6 و پتاسیم 4 داشته و سایر آزمایشات نرمال است. روز دوم پس از عمل الیگوری شده و کراتینین 2 و پتاسیم 5 شده است. روز چهارم پس از جراحی همچنان الیگوری بوده و دچار کاهش هوشیاری و ادم ریه میشود. فشار خون بیمار 160/100 است کراتینین 5 و اوره 200 و سدیم 125 و پتاسیم 6.6 و اسیدوز متابولیک دارد. بیمار با تشخیص نارسایی حاد کلیه (نکروز حاد توبولی) نیاز به دیالیز حاد اورژانسی دارد.
- **سوال: دستورات دیالیز حاد چگونه نوشته شود؟**

Indication of dialysis

Clinical:

- Pulmonary edema/ Desaturation
- Pericardial rub
- GI symptoms
- Altered Mental status
- Anasarca
- Bleeding tendency
- Anuria/ Oliguria
- Infection/sepsis

Biochemical:

- Hyperkalemia
- Metabolic Acidosis
- Intoxication:
ASA, Alcohol, Lithium

Renal Replacement Therapy in AKI

- 1. Peritoneal dialysis (PD)**
- 2. Intermittent Hemodialysis (IHD)**
- 3. Slow Low-Efficiency Daily Dialysis (SLED)**
- 4. Continuous Renal Replacement Therapy (CRRT)**
 - **Slow Continuous Ultrafiltration (SCUF)**
 - **Continuous Venovenous Hemofiltration (CVVH)**
 - **Continuous Venovenous Hemodialysis (CVVHD)**
 - **Continuous Venovenous Diafiltration (CVVHDF)**

Acute Hemodialysis prescription

DIALYSIS PRESCRIPTION

Components of the Dialysis Prescription

- Dialyzer (membrane, configuration, surface area)
- Time
- Blood flow rate
- Dialysate flow rate
- Ultra filtration rate
- Dialysate composition
- Dialysate temperature
- Anticoagulation

Order HD prescription (initial treatment)

- ✓ Session length : Perform HD 2 hrs
- ✓ BFR : 200 ml/min
- ✓ Dialyzer: Low flux
- ✓ Dialysate solution composition:
Na ..., K..., HCO₃ ..., Ca..., Mg..., Dextrose....
- ✓ DFR : 500 ml/min
- ✓ Dialysis solution temp. : 36°C
- ✓ Fluid removal order: remove ... Lite
- ✓ Anti-coagulant : heparin loading .., maintenance ...
(หรือ non-heparin ตามความเหมาะสม)
- ✓ 50 % glucose 50-100 ml intra HD

Acute vs Chronic Hemodialysis Prescription

- Initial t/t – when predialysis BUN is high
 - ↓ dialysis session length
 - ↓ blood flow rate
- A urea reduction ratio of <40% should be targeted.
- Blood flow rate of 250 mL/min for adults along with 2-hr t/t time
- If large amount of fluid (e.g., 4.0 L) to be removed
 - dialysis solution flow can initially be shut off
 - isolated ultrafiltration can be performed for 1-2 hours, removing 2-3 kg of fluid
- Only after that dialysis should be performed. Why?

Composition of typical dialysis solution

COMPONENT	meq/l
□ Na+	135-145
□ K+	0-4
□ Ca ++	2.5-3.5
□ Mg++	0.5-0.75
□ Cl-	98-124
□ Acetate	2-4
□ Hco ₃ -	30-40
□ Dextrose	11 g
□ PH	7.1-7.3

THE DIALYSIS PRESCRIPTION-

Dialysate Composition

□ **Potassium**

- Dialysate K - 1-3mEq/L is used in most patients
- Low K+ should be used with caution due to association between use of Low K+ dialysate with SCD

□ **Calcium.**

- Patients with hypocalcemia, positive intradialytic calcium balance may be desired for control of metabolic bone disease
- Standard dialysate calcium -2.5-3.0 mEq/L is used
- Dialysate calcium also affect hemodynamic stability during HD procedure

DIALYSIS PRESCRIPTION

□ **Temperature.**

- Dialysate temperature is maintained between 36.5°C and 38°C at inlet of dialyzer
- Lower dialysate temperature may reduce intradialytic hypotension and also increase cardiac contractility, improve oxygenation, increase venous tone
- New accurate monitors allow isothermic HD

□ **Microbiological characteristics**

- Medical Instrumentation standards

Dialyser

- **Dialyzers are classified as**
- **1. Conventional-**
- Has a membrane that is homogenous and permits effective small solute clearance, but its clearance of middle molecules is low
- Cellulose based and permit complement activation

- **2. High-flux. –**
- Constructed with pores that permit passage of molecules exceeding 10,000 D or more with a clearance
- Significant binding of protein and peptides from the blood

- **3. High-efficiency-**
- When the high-flux membrane is chemically modified, hydraulic permeability as well as the permeability to HMW substances is reduced, creating a high efficiency membrane

DIALYSIS PRESCRIPTION-

DIALYZER TYPE

- **Capacity for solute clearance:** Ideal dialyzer should have high clearance of small- and middle-molecular weight uremic toxins and
- Negligible loss of vital solutes
- Biocompatibility:
- Cost
- Low blood volume compartment

- **UF coefficient (KUF)**-determines quantity of pressure that must be exerted across dialysis membrane to generate a ultrafiltrate
- High-flux membranes are defined as having $>UF$ coefficient 15 mL/h/mm Hg

- **Acceptable reuse** parameters, the fiber bundle volume must be $>80\%$ of the initial , UF rate must $>20\%$ of the manufacturer's stated value, and the dialyzer should not leak .



DIALYSIS PRESCRIPTION:

Dialysate flow /UF rate



Dialysate flow

- Practical upper limit of effective dialysate flow is twice blood flow rate, beyond which gain in solute removal is minimal
- High flow rates should be confined to blood flows >300 mL/min

UF rate prescription.

- Goal is to achieve estimated **dry weight**
- Tolerance determined by vascular refilling
- *UF modeling* may reduce intradialytic complication
- On-line monitoring of blood volume changes may help prescription

Anticoagulation for Hemodialysis

- Interaction of plasma with the dialysis membrane produces activation of the clotting cascade- thrombosis – dysfunction

- **Dialyzer thrombogenicity** is determined by
 - Dialysis membrane composition
 - Rate of blood flow through dialyzer and UF rate
 - Length, diameter, and composition of blood lines

- Most widely used anticoagulant for dialysis is heparin

- Monitor - activated clotting time (ACT) /APTT

- Heparin administration usually ceases at least 1 h before the end of dialysis

	IHD	CRRT	SLED
Fluid shift mechanism	Ultrafiltration	Ultrafiltration	Ultrafiltration
Solute shift mechanism	Diffusion	Diffusion, convection, or both	Diffusion
Blood flow rate	≥ 200 ml/min	< 200 ml/min	200 ml/min
Dialysate flow rate	≥ 500 ml/min	17-34 ml/min	300 ml/min
Duration	3-4 hours	24 hours/day	6-12 hours
Advantages/special uses			
• Rapid fluid removal	✓		
• Rapid solute clearance	✓		
• Severe hyperkalemia	✓		
• Hemodynamic instability		✓	✓
• Better fluid control		✓	✓
• High nutritional support		✓	?
• Removal of middle-molecular weight solutes		✓	

Post-Dialysis care

- Monitor BP; report hypotension or hypertension
- **Watch for bleeding**
- Check weight and compare (weight loss should be close to fluid removal goal set during treatment)
- Document unusual findings
- **Assess access site for bruit, thrill, exudate, signs of infection, bleeding**
- Give missed meds, if indicated

INTRADIALYTIC COMPLICATIONS

- ❑ **1.Hypotension**-Most common (incidence, 15% to 30%)
- ❑ **2.Muscle Cramps**
- ❑ **3.Dialysis Disequilibrium Syndrome**
- ❑ **4.Dialyzer Reactions** *First-use syndrome/ second-use syndrome*
- ❑ **5.Arrhythmia**
- ❑ **6.Cardiac arrest**
- ❑ **7.Intradialytic Hemolysis**
- ❑ **8.Hypoglycemia**
- ❑ **9.Hemorrhage**
- ❑ **10.Toxic water system treatment contaminants-**
hemolysis/anemia/osteomalacia and encephalopathy/Fluoride bone disease and cardiac arrhythmia
- ❑ **11.Infectious complications**

Acute complication HHCCBNF

- Hypotension — 25 to 55 %
- Cramps — 5 to 20 %
- Nausea and vomiting — 5 to 15 %
- Headache — 5%
- Chest pain — 2 to 5 %
- Back pain — 2 to 5 %
- Itching — 5 %
- Fever and chills — Less than 1 %

Disequilibrium Syndrome

- During or immediately after dialysis.
- Acute increase in brain water or acute changes in pH of CSF during dialysis.
- Minor symptoms: nausea, vomiting, dizziness, headache, blurred vision, restlessness, cramps, tremors.
- Major symptoms: confusion, psychosis, seizures, coma.

در صورت وقوع چه مشکلاتی حین دیالیز لازم است دیالیز متوقف شود؟

1 – افت فشار خون غیر قابل توجیه و پایدار علیرغم قطع اولترافیلتراسیون

•

2- درد حاد قفسه سینه و تغییرات نوار قلب یا اریتمی

3-تب و لرز حین دیالیز

4- کاهش سطح هوشیاری

5-آلودگی آب دیالیز

6-واکنش‌های همولیتیک حین دیالیز

SLEDD (slow low efficiency daily dialysis)

TABLE 1 EXTENDED HEMODIALYSIS PRESCRIPTION MODEL

Duration	6-8 hours
Blood flow	100-200 (ml/min)
Dialysate flow	200-300 (ml/min)
Ultrafiltration	Variable (maximum around 250 ml/h) + profile
Sodium	Fixed 145-150 mEq/L or profile
Dialysate temperature	35°C
Anticoagulation	Unfractionated heparin 500-1000 UI/hour

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