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Interesting Case

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Case

- ▶ A 40 years old male
- ▶ Diagnosis : ESRD
- ▶ Operation : Cadaveric donor kidney transplantation



R1 History?



Patient's History

▶ Chief complaint

▶ แพทย์นัดมาผ่าตัดเปลี่ยนไต

▶ Present illness

▶ นัดมาผ่าตัดเปลี่ยนไต ไม่มีไข้ ไม่มีขาบวม ไม่มีเหนื่อย นอนราบได้ ไม่มีแน่นหน้าอก ไม่มีคลื่นไส้อาเจียน ปัสสาวะออกน้อย

History

- ▶ Underlying disease
 - ▶ ESRD on HD 3 times/wk (Mon, Thu, Sat)
 - ▶ Last HD 1 day before surgery UF 500 ml, no intradialysis hypotension
 - ▶ HT
 - ▶ DLP

Current Medication

- ▶ Enalapril(20) 0.5*1 po pc
- ▶ Atorvastatin(40) 1*1 po hs
- ▶ Sodamint(300) 1*2 po pc
- ▶ CaCO₃ (600) 1*2 po pc
- ▶ Vit B co 1*2 po pc
- ▶ Hemax 4,000 iu sc twice a week Mo,Thu

Past History

- ▶ No history of drug and food allergy
- ▶ No history of alcohol drinking
- ▶ No history of smoking
- ▶ Previous surgery
 - ▶ Lt.BC AVF under BB Jul 2012
 - ▶ Parathyroidectomy under GA May 2018
- ▶ Functional class I



R1 Physical Examination?



Physical Examination

- ▶ Dry BW 68 kg HT 177 cm BMI 19.30 kg/m²
- ▶ V/S BT 37 °C, BP 140/90 mmHg, PR 90 bpm, RR 18/min
- ▶ GA : Good consciousness, well cooperative
- ▶ HEENT : not pale conjunctivae, anicteric sclerae, no sunken eye balls, no dry lips, no dry tongue

Physical Examination

- ▶ Airway examination
 - ▶ Mouth opening > 3 cm
 - ▶ Normal teeth
 - ▶ No prominent incisor
 - ▶ Upper lip bite test : class 1
 - ▶ Mallampati grade : grade 2
 - ▶ Thyromental distance > 6 cm
 - ▶ No limit neck of motion

Physical Examination

- ▶ Heart : pulse full and regular, normal S1 S2, no murmur, PMI 5th ICS, no heaving, no thrill
- ▶ JVP : not engorged, no brise
- ▶ Lung : clear and equal breath sound BL, **no adventitious sound**

Physical Examination

- ▶ Abd: normoactive BS, soft, not tender
- ▶ Ext: **no pitting edema**, no ecchymosis
- ▶ Neuro : E4V5M6, pupil 2 mm RTLBE, motor gr V all extremities

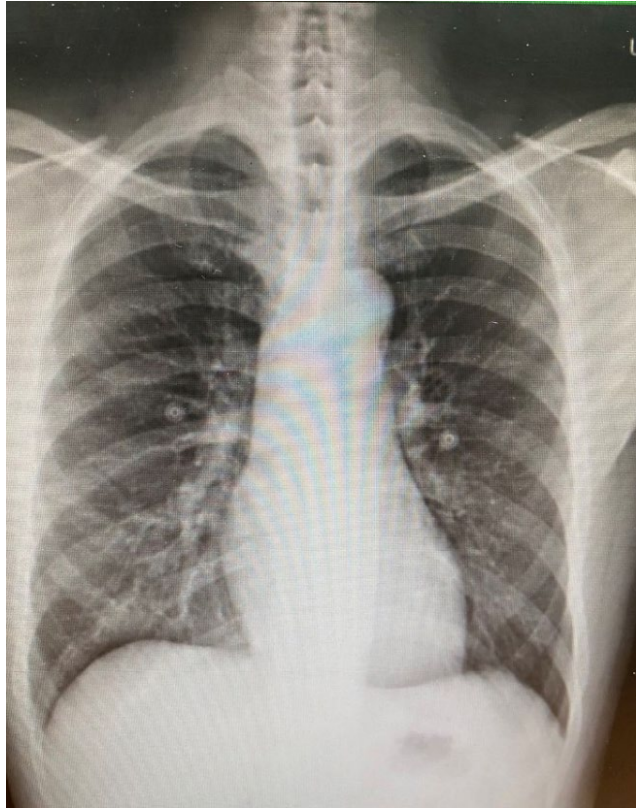


R1 Investigation



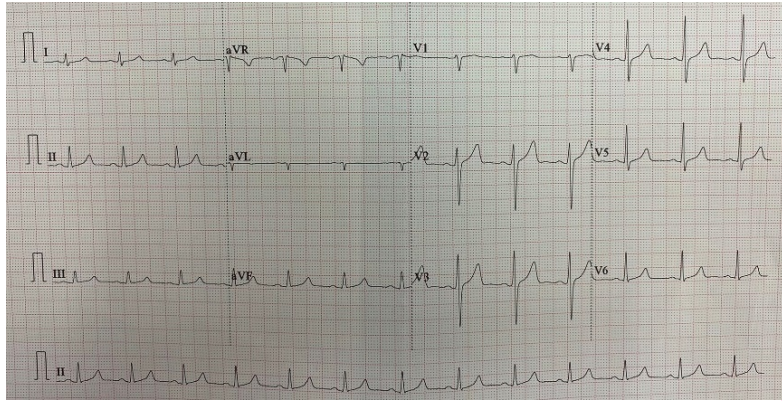
Investigation

- ▶ CBC : Hb 12.7 Hct 36.5% plt 167,000
- ▶ Electrolyte : Na 139.7 mEq/l K 5.31 mEq/l Cl 96.5 mEq/l HCO₃ 24.6 mEq/l Ca 9.03 mEq/L Mg 2.21 mEq/l PO₄ 3.67 mEq/l
- ▶ BUN 64 mg/dl Cr 4.06 mg/dl GFR 13.5 ml/min/1.73 m²
- ▶ Coag : PT 12.3 INR 1.06 PTT 24 ratio 0.97 TT 17.1 ratio 1.1
- ▶ LFT : TP 6.7, alb 3.62, TB 0.43, DB 0.25, AST 24.2, ALT 10.2, ALP 90



Investigation

- ▶ CXR : no infiltration,
no cardiomegaly



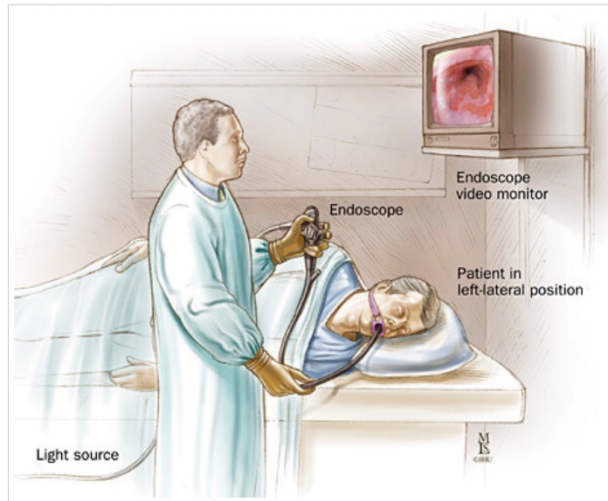
Investigation

- ▶ EKG : NSR HR 77 bpm ,
No ST-T change

Investigation

- ▶ Last Echo 21/10/64 : LVEF 69 %, good overall LV systolic function, no valvular abnormality
- ▶ Last U/S whole abdomen 1/12/63 : acquired multiple renal cyst, increased echogenicity, probably caliceal stone
- ▶ Last VCUG 5/6/64 : bladder capacity 70 ml, VUR grade 2
- ▶ Psychological examination : normal

Screening for Tumor



- ▶ EGD 20/5/64: diffuse erosive gastritis
- ▶ Colonoscopy 20/5/64 : normal

Screening for Infection

Serology	Donor	Recipient
VDRL	Negative	Negative
HBsAg	Negative	Negative
HBsAb	Positive	Positive
Anti-HCV	Negative	Negative
Anti-CMV IgG/IgM	Positive/Negative	Positive/Negative
Anti-HSV IgG/IgM		Positive/Negative
Anti-HBV IgG/IgM		Positive/Negative
Blood group	B, Rh ⁺	B, Rh ⁺



R1 Problem lists & ASA classification



Problem Lists

- ▶ ESRD on HD via Lt.AVF
- ▶ HT
- ▶ Anemia

ASA Classification

- ▶ ASA class III E



R2 Preoperative Evaluation



Preoperative Evaluation



01

Patient Factor

02

Surgical Factor

03

Anesthetic Factor



Pathophysiological of ESRD



1

CVS

2

Pulmonary System

3

Fluid and Electrolyte

4

Hematological System

5

Gastrological System

6

Acid-Base Abnormality

7

CNS dysfunction

8

Peripheral neuropathy

9

Endocrine System

10

Dialysis-related problem





Cardiovascular System

- ▶ IHD leading cause of morbidity and mortality
 - ▶ 35-40% of all deaths receiving hemodialysis
 - ▶ GFR decrease → risk of cardiac mortality increase
- ▶ CAD 25% incidence in CKD

Cardiovascular System

Systemic HT

- Altered RAAS secretion
- Sodium and water retention

CHF

- Primary : uremic cardiomyopathy
- Secondary : fluid overload

Coronary artery disease

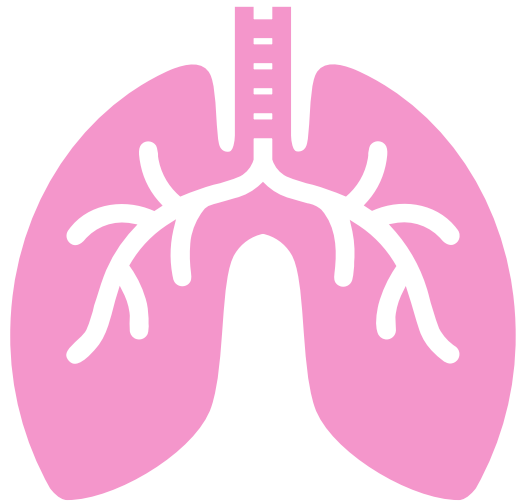
- Accelerated atherosclerosis
- IHD, CVA

Uremic pericarditis

- pericardial effusion
- cardiac tamponade

Cardiac dysrhythmia

- Hyperkalemia
- Hypocalcemia
- AF : 27% on HD



Pulmonary System

- ▶ Pulmonary abnormality
 - ❑ Pulmonary edema
 - ❑ Pleural effusion
 - ❑ Hyperventilation
 - ❑ Basal lung atelectasis
- ▶ Oxygen carrying capacity
 - ❑ Right ward shift of O_2 -Hb
 - ❑ Increased CO
 - ❑ Decrease blood viscosity



Fluid and electrolyte Imbalance

- ▶ Hypervolemia
- ▶ **Hyperkalemia**
 - ▶ Effect on myocardium : most critical electrolyte abnormality
- ▶ Hypocalcemia
- ▶ Hypermagnesemia
- ▶ Hyperphosphatemia
- ▶ Metabolic acidosis

Severity related to timing of dialysis session



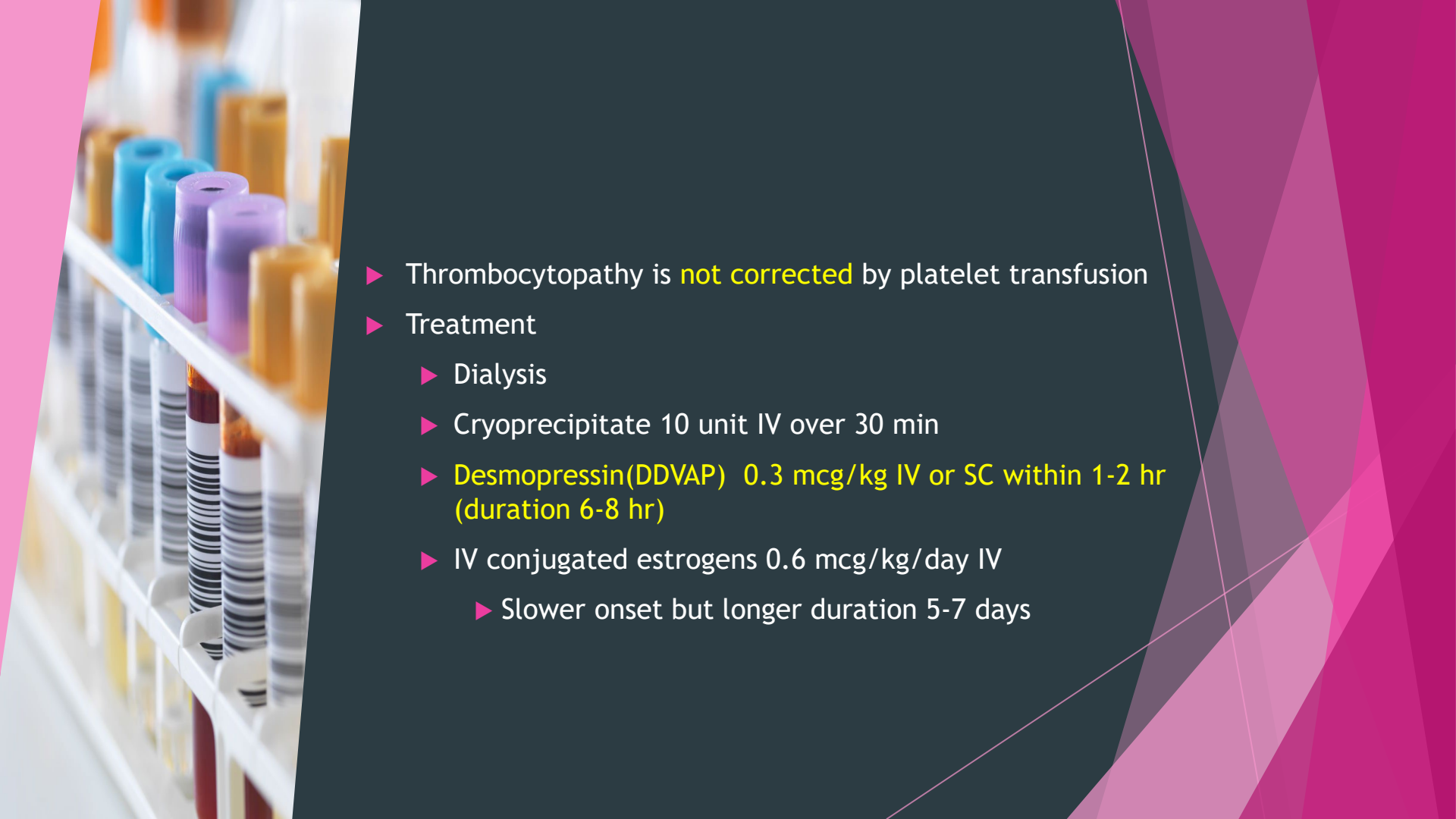
Hematology System

▶ Anemia

- ▶ Decreased EPO production : common
- ▶ Decreased life span
- ▶ Diminished erythrocyte production
- ▶ Blood loss
- ▶ Dietary deficiency
- ▶ Mx: EPO drug+iron → Hb 11-12 g/dl → achieved

▶ Platelet dysfunction

- ▶ Qualitative dysfunction
- ▶ Decrease von willebrand factor and Factor VIII
- ▶ Bleeding diathesis

- 
- ▶ Thrombocytopenia is **not corrected** by platelet transfusion
 - ▶ Treatment
 - ▶ Dialysis
 - ▶ Cryoprecipitate 10 unit IV over 30 min
 - ▶ **Desmopressin(DDVAP) 0.3 mcg/kg IV or SC within 1-2 hr (duration 6-8 hr)**
 - ▶ IV conjugated estrogens 0.6 mcg/kg/day IV
 - ▶ Slower onset but longer duration 5-7 days

Gastrointestinal System

Risk of regurgitation and full stomach



Delay gastric emptying time
(uremic gastropathy)



Nausea and
vomiting



Peptic ulcer
disease



GI bleeding

Management : H1 blocker and metoclopramide

Central Nervous System

Clinical manifestations

- Behavioral changes
- Loss of memory
- Neuromuscular irritability
- Lethargy
- Myoclonus
- Seizure
- Coma

Management

- Dialysis and renal transplant may improve neuropathy

Peripheral Neuropathy

Muscle weakness

- Peripheral nerve palsy

Autonomic neuropathy

- Orthostatic hypotension
- Cardiac arrhythmias
- Gastric dysmotility
- silent MI

Management

- Dialysis and renal transplant

Endocrine disturbances



Glucose intolerance

Altered exogenous insulin requirement



Secondary hyperthyroidism

Renal osteodystrophy
Osteomalacia

Dialysis Related Problem

Dialysis dementia

Dialysis disequilibrium syndrome

Hypovolemia

Systemic anticoagulation



Hypertension

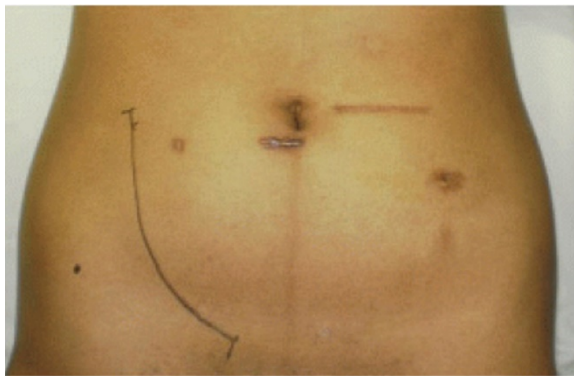
- ▶ Baseline BP 130-140/70-80 mmHg
- ▶ No systemic complication
- ▶ Current medication
 - ▶ Enalapril(20) 0.5*1 o pc



R3 Anesthetic Consideration



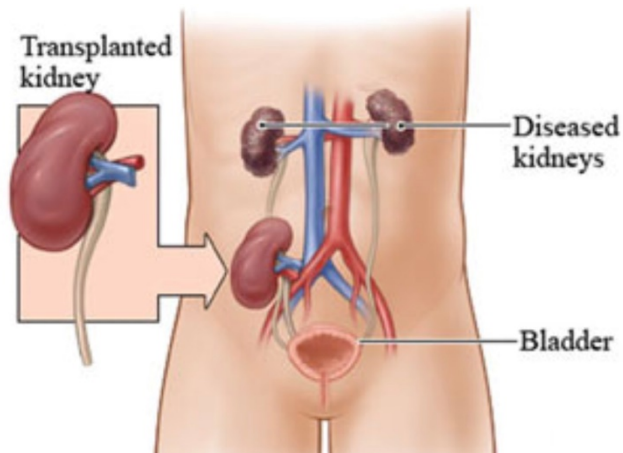
Anesthesia for Kidney Transplant



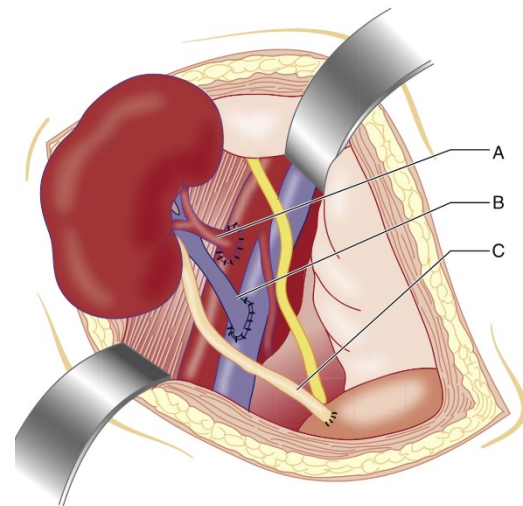
Vertical

Curvilinear incision

- adequate analgesia
- depth of anesthesia
- adequate muscle relaxant



**Donor kidney placed
in the iliac fossa in
situ**



Anastomoses

- Renal V = external iliac V**
- Renal A = External iliac A**
- Ureter kidney = bladder**

Anesthesia for Kidney Transplant

- ▶ **Heparin** : administered **before clamp the vessel**
- ▶ During **anastomosis** of renal Vessels : **expansion of intravascular volume**
- ▶ **Furosemide and mannitol** : administered **before reperfusion to stimulate diuresis**

Anesthesia For kidney Transplant Donor

Living donor

- Elective procedure
- Timing of an operation flexible
- KT from living donors show an increased graft survival
- Evaluated both psychologically and medically

Cadaveric donor

- Donor after circulatory death(DCD)
- Donor after brain death(DBD)
 - Heart beating organ donation
- Urgency surgery due to cold ischemic time effects graft function and survival

Anesthesia For kidney Transplant Recipient

ใครที่ปลูกถ่ายไตไม่ได้

Contraindication

1. อายุมากกว่า 60 ปี
2. ขาดความรับผิดชอบต่อตนเอง เช่น รับประทานยาไม่สม่ำเสมอ ไม่มาพบแพทย์ตามที่นัด
3. ผู้ป่วยที่ติดยาเสพติด โรคจิตเภท
4. ผู้ป่วยที่มีการติดเชื้อในกระแสเลือด
5. การติดเชื้อไวรัสที่มีอาการรุนแรง เช่น โรคไวรัสตับอักเสบบี - ซี, โรคไวรัสเอดส์
6. ผู้ป่วยที่มีโรคประจำตัวเดิม เช่น เบาหวานระยะลุกลาม โรคตับอักเส��ยะรุนแรง โรคหัวใจล้มเหลวระยะรุนแรง แผลในกระเพาะอาหารระยะรุนแรง ตับอ่อนอักเสบ โรคเอสแอลอีระยะรุนแรงกำเริบอยู่ มะเร็งระยะลุกลาม
7. ความผิดปกติของระบบทางเดินปัสสาวะที่ยังแก้ไขไม่ได้

The matching Process

1. Blood group matching

- ABO matching

2. HLA type matching

- 6 antigen(MCH) at 3 loci A,B and DR
- 6 antigen match : best outcome

3. Testing donor T cells against recipient serum

- Final crossmatch : lymphocytotoxicity crossmatch between donor lymphocytes and recipient

Preservation of the harvested organ



Cold ischemic
time(CIT)



Warm ischemic
time(WIT)

Preservation of the harvested organ

▶ Cold Ischemic Time(CIT)

- ▶ preserved by storing at **1-10 °C**
- ▶ Initiation of cold preservation of donor organ to restoration of warm circulation in the organ recipient
- ▶ **Lower CIT improve graft function and survival**
- ▶ **For cadaveric graft safety within 24 hr**
- ▶ Cold storage solutions : oxygen radical scavengers
- ▶ Delayed graft function: a requirement for dialysis in the first week after receiving a transplant.

Preservation of the harvested organ

▶ Warm ischemic time

- ▶ Begin when kidney is placed in the recipient, and terminates when the vascular anastomosis is complete and perfusions by the recipient begins
- ▶ Incidence ATN increases with its duration

Preoperative Assessment



Cardiovascular
evaluation



Preoperative
hemodialysis

Cardiovascular Evaluation

- ▶ **The major focus : identify occult ischemic heart disease**
- ▶ Silent MI : more frequently in patients in ESRD
- ▶ History
- ▶ Physical examination to identify any active cardiac conditions
 - ▶ Unstable coronary syndrome
 - ▶ Severe valvular disease
 - ▶ Significant arrhythmias
- ▶ Assessment of function status

Cardiovascular Evaluation

- ▶ Non-invasive stress testing
 - ▶ Should be considered without active cardiac disease
 - ▶ Have 3 or more risk factors associated with CAD
 - ▶ DM
 - ▶ Prior cardiovascular disease
 - ▶ Duration of dialysis > 1 yr
 - ▶ LVH
 - ▶ Tobacco use
 - ▶ Age > 60 yr HT, Dyslipidemia

Cardiovascular Evaluation

- ▶ The likelihood of structural cardiac abnormalities and the potential for LV dysfunction is significant
- ▶ Echo : appropriate for preoperative assessment of left and right ventricular function

Preoperative Hemodialysis

- ▶ Hemodialysis : maintained on schedules
- ▶ If possible, dialysis should be performed immediately prior to surgery
- ▶ Focus on
 - ▶ Potassium levels
 - ▶ Acid-base status
 - ▶ Volume status
- ▶ reduces perioperative mortality and delay graft function



Choice of Anesthesia

- ▶ GA with ETT with controlled ventilation
 - ▶ RSI is indicated in gastroparesis, DM, obesity
 - ▶ Esmolol : blunt hemodynamic response
- ▶ Regional anesthesia : concern!!
 - ▶ Increased risk of epidural hematoma
 - ▶ Infection
 - ▶ Prolong surgery



Preoperative Preparation



Standard monitoring

- ▶ EKG
- ▶ NIBP
- ▶ Heart rate
- ▶ Oxygen saturation
- ▶ ETCO₂
- ▶ Temperature

Special Monitoring

- ▶ C-line
 - ▶ Help ensuring adequate hydration during anesthesia
- ▶ A-line
 - ▶ For advance comorbid condition require close BP monitoring or acid-base status
- ▶ Urine output

Preparation and Premedication

- ▶ NPO
- ▶ Informed consent
- ▶ Warmed IV fluid : crystalloid
- ▶ Blood component : LDPRC 2 U
- ▶ Postop ICU
- ▶ Aspiration prophylaxis : omeprazole and plasil
- ▶ **New all equipment and drugs including sodalime**
- ▶ Pre-Med : manidipine(10) 1 tab oral

Intraoperative Management

	Use	Avoid
IV induction agents	Propofol Thiopental	Etomidate ketamine
RSI	Succinylcholine Rocuronium 1.2 mg/kg	
NMBA	Cisatracurium Atracurium	Pancuronium Sugammadex
Volatile	Desflurane Sevoflurane Isoflurane	Enflurane
Opioids	Fentanyl and analogues	Morphine Oxycodone Meperidine

Intraoperative Management

- ▶ **To optimize cardiac output and renal blood flow**
 - ▶ Volume expansion : isotonic balanced-salt crystalloid
 - ▶ SBP : 130-160 mmHg
 - ▶ CVP : 10-14 mmHg
 - ▶ Mean PA pressure 18-20 mmHg
- ▶ It is critical that patients are well hydrated, as renal function is critically dependent on renal perfusion

Intraoperative Management

- ▶ **Vasopressor**
 - ▶ Dopamine, ephedrine > norepinephrine
- ▶ **Immediate postreperfusion hypotension**
 - ▶ 25% of CO to renal graft, vasoactive mediator
 - ▶ Partial systemic absorption of vasodilators that injected to vessels grafts(eg. papaverine, verapamil)

Intraoperative Management

- ▶ Promote early diuresis and protection against ischemic injury
 - ▶ **20% manitol**
 - ▶ 200-250 ml immediately **before reperfusion**
 - ▶ Along with adequate intravascular volume resuscitation : decrease ATN
 - ▶ Improve renal perfusion pressure
 - ▶ Furosemide role is controversial

Postoperative Management

- ▶ extubated and transferred to a high-dependency unit
- ▶ Supplement O₂
- ▶ avoid hypotension and hypovolemia
 - ▶ Continuous monitoring : PPV,ABP and CVP
- ▶ Strict monitoring of urine output
 - ▶ Sudden decrease in urine output
 - ▶ Pre-renal : aggressive intravascular volume resuscitation
 - ▶ Post-renal : ureteral anastomosis , early re-exploration

Postoperative Management

- ▶ Nephrotoxic agents should be avoided
- ▶ Postoperative pain control
 - ▶ Synthetic opioids without active metabolites
 - ▶ Most opioids : dose reductions
 - ▶ PCA : good choice
 - ▶ Combination block: ilioinguinal-Ilioypogastric and intercostal nerve blocks)
 - ▶ TAP block

Immunosuppressive drugs

Prevent graft rejection

Steroids

- Dexamethasone

Calcineurin inhibitors(CNI)

- cyclosporin, tacrolimus

Target of rapamycin(TOR) inhibitors

- Sirolimus, everolimus

Polyclonal Ab

- Anti-lymphocytoglobulin

Monoclonal Ab

- IL-2, daclizumab, basiliximab, OKT3

Purine synthesis inhibitors

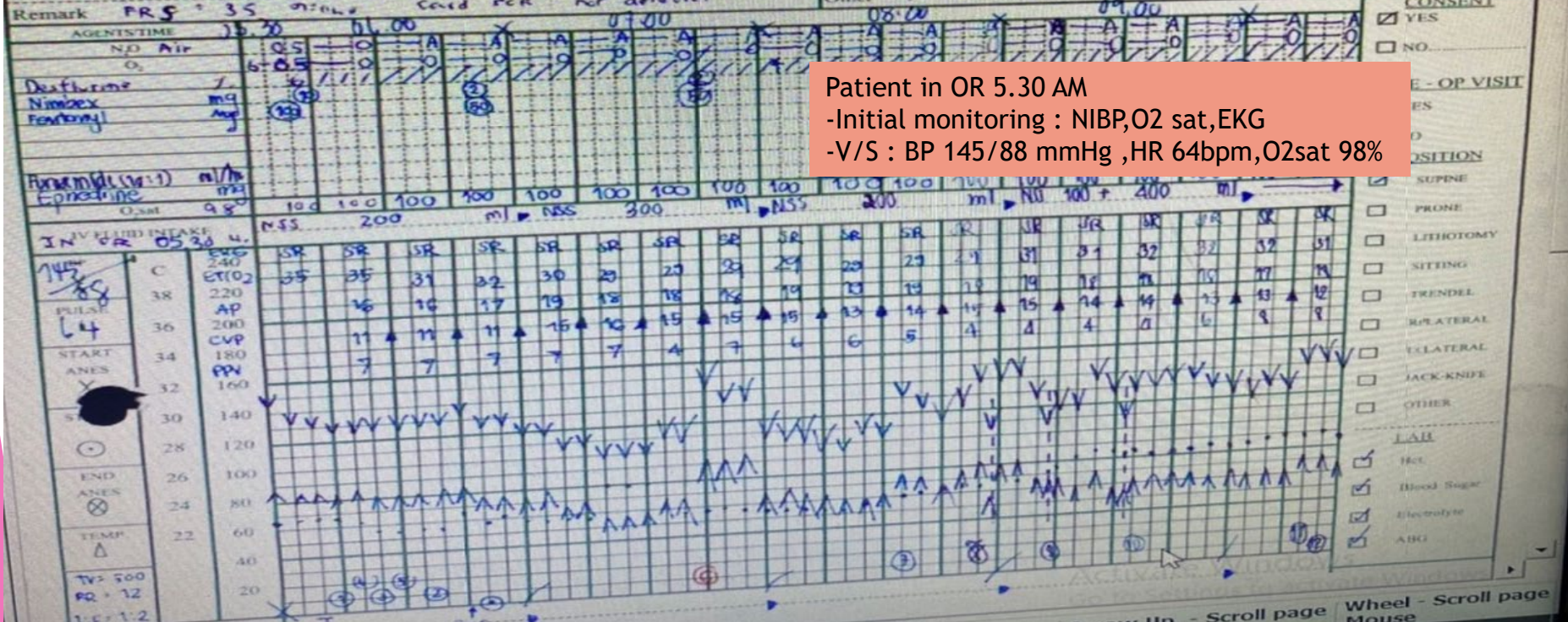
- azathioprine



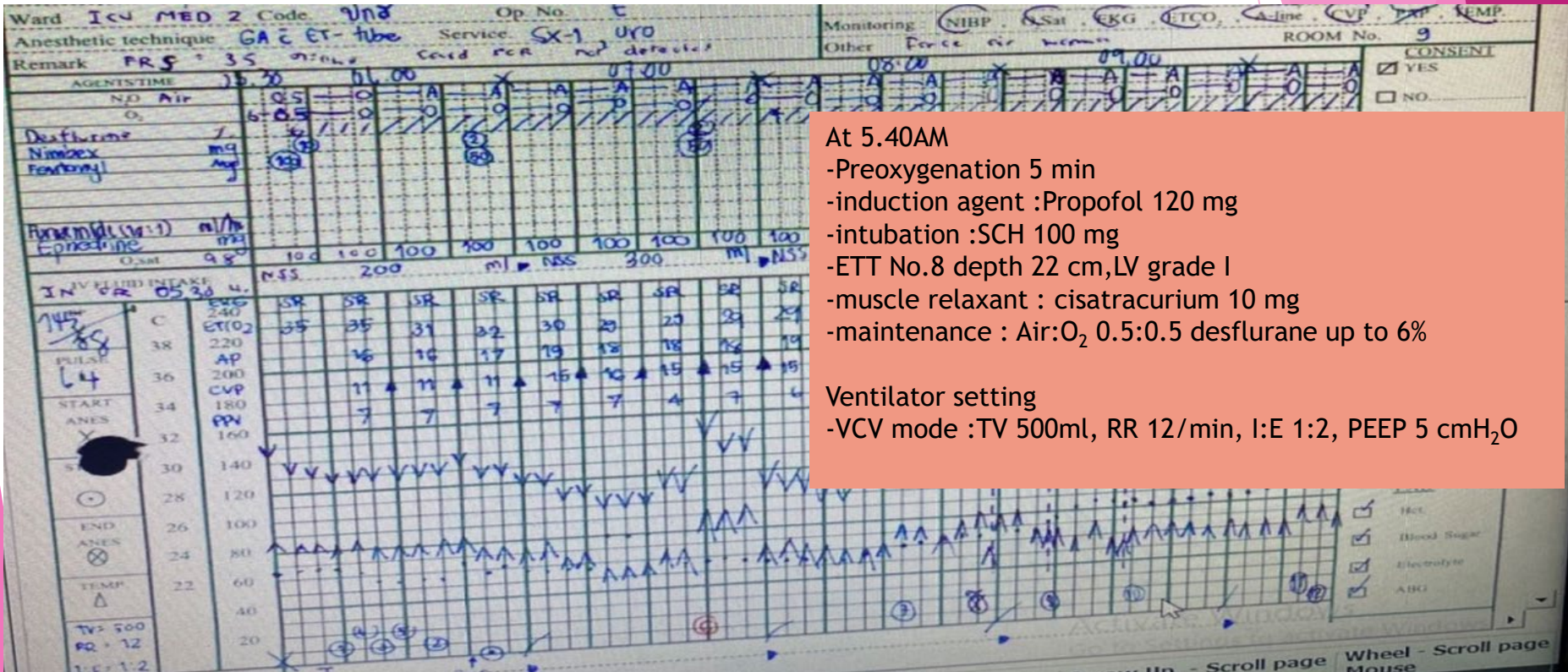
Intraoperative Management



Ward ICU MED 2 Code UN3 Op No. E
 Anesthetic technique GA & ET-tube Service SX-1 URO
 Monitoring NIBP, NSat, EKG, ETCO₂, A-line, CVP, PAP, TEMP.
 Remark PRS = 35 m:ALV Card PCR not detected Other Force air incision ROOM No. 9



Patient in OR 5.30 AM
 -Initial monitoring : NIBP,O2 sat,EKG
 -V/S : BP 145/88 mmHg ,HR 64bpm,O2sat 98%

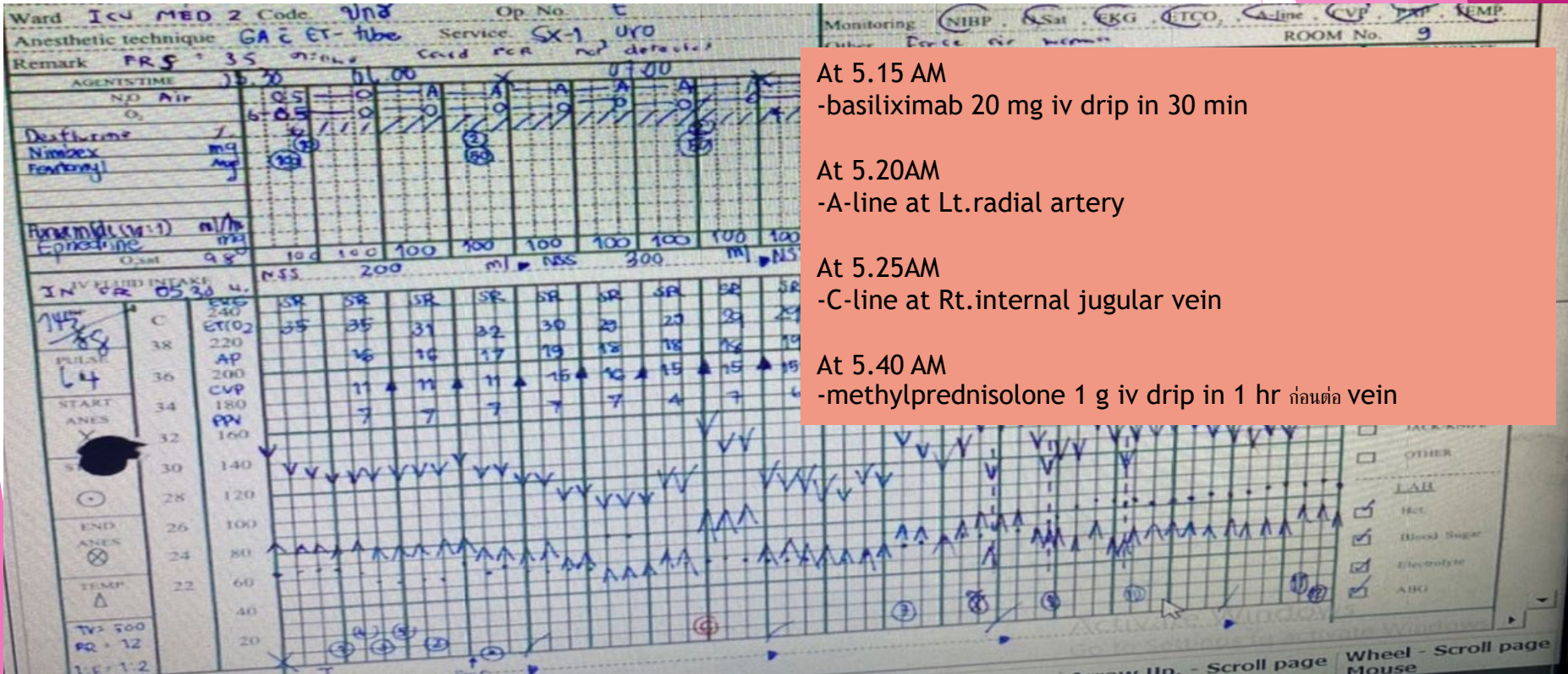


At 5.40AM

- Preoxygenation 5 min
- induction agent :Propofol 120 mg
- intubation :SCH 100 mg
- ETT No.8 depth 22 cm,LV grade I
- muscle relaxant : cisatracurium 10 mg
- maintenance : Air:O₂ 0.5:0.5 desflurane up to 6%

Ventilator setting

- VCV mode :TV 500ml, RR 12/min, I:E 1:2, PEEP 5 cmH₂O





Postoperative Management



Postoperative Day 1

- ▶ S: ผู้ป่วยตื่นดี ไม่มีหายใจเหนื่อย นอนราบได้ ปัสสาวะออกน้อย ปวดแผลเล็กน้อย
PS at rest=2 PS at movement=3
- ▶ O : BP 132/82 mmHg, HR 80 bpm, RR 18/min BT 37.2 °C O2Sat 100
HEENT : pale conjunctivae, no icteric sclerae Heart : normal S1 S2, no murmur
Lung : clear and equal BL Abd : soft, no active bleeding per gauze Ext : no pitting edema
I/O 4200/400
- ▶ Lab : Hct 29% plt 107,000. Cr 12.1 K 6.7
- ▶ A: S/P CDKT postop d1 : delay graft function
- ▶ P : hemodialysis
irradiated LDPRC 1 u
Fentanyl 50 mcg iv prn for pain q 4 hr
serial Hct q 8 hr
Observe urine output Keep >30 ml/hr
Continue immunosuppressive drugs

Postoperative Day 2

- ▶ S: ผู้ป่วยตื่นดี ไม่มีหายใจเหนื่อย นอนราบได้ ปัสสาวะออกมากขึ้น ปวดแผลเล็กน้อย
PS at rest=2 PS at movement=3
- ▶ O : BP 135/82 mmHg, HR 82 bpm, RR 18/min BT 37.1 °C O₂Sat 100% CVP 10
HEENT : pale conjunctivae, no icteric sclerae Heart : normal S1 S2, no murmur
Lung : clear and equal BL Abd : soft, no active bleeding per gauze Ext : no pitting edema
I/O 4200/800
Lab : Hct 24% plt 97,000. Cr 12.0 K 4.0
- ▶ A: S/P CDKT postop d2 : delay graft function
- ▶ P : irradiated LDPRC 1 u+LPPC 1 u
serial Hct q 8 hr
Observe urine output keep>30 ml/hr
Continue immunosuppressive drugs

Postoperative Day 3

- ▶ S: ผู้ป่วยตื่นดี ไม่มีหายใจเหนื่อย นอนราบได้ ปัสสาวะออกน้อยลง ปวดแผลเล็กน้อย
PS at rest=2 PS at movement=3
- ▶ O : BP 137/88 mmHg, HR 80 bpm, RR 18/min BT 37.0 °C O₂Sat 99%
HEENT : not pale conjunctivae, no icteric sclerae Heart : normal S1 S2, no murmur
Lung : clear and equal BL Abd : soft, no active bleeding per guaze Ext : no pitting edema
- ▶ I/O 3800/300
- ▶ Lab : Hct 31 % plt 120,000. Cr8.3 K 6.2
- ▶ A: S/P CDKT postop d3 : delay graft function
- ▶ P : Hemodialysis
Keep urine output > 30 ml/hr
Continue immunosuppressive drugs

Postoperative Day 6

- ▶ S: ผู้ป่วยตื่นดี ไม่มีหายใจเหนื่อย นอนราบได้ ปัสสาวะออกน้อยลง ปวดแผลเล็กน้อย PS at rest=0 PS at movement=1
- ▶ O : BP 135/83 mmHg, HR 80 bpm, RR 18/min BT 37.2 oC O₂Sat 98%
HEENT : not pale conjunctivae, no icteric sclerae Heart : normal S1 S2, no murmur
Lung : clear and equal BL Abd : soft, not tender Ext : no pitting edema
I/O 3000/2400
lab : Cr 7.2 K 4.2
Kidney biopsy : acute tubular injury, no evidence of rejection
- ▶ A: S/P CDKT postop d 6 : clinically stable
- ▶ P : Keep urine output > 30 ml/hr
Continue immunosuppressive drugs

Postoperative Day 11

▶ S: ผู้ป่วยตื่นดี ไม่มีหายใจเหนื่อย นอนราบได้ ปัสสาวะออกน้อยลง ปวดแผลเล็กน้อย

PS at rest=0 PS at movement=1

▶ O : BP 136/82 mmHg, HR 78 bpm, RR 18/min BT 36.8 oC O₂Sat 98%

HEENT : not pale conjunctivae, no icteric sclerae Heart : normal S1 S2, no murmur

Lung : clear and equal BL

I/O 2500/2200

Lab : Cr 6.8 K 3.8

▶ A: S/P CDKT postop d11 :clinically stable

▶ P : D/C

Take Home Message

- ▶ Knowledge of pathophysiologic change in ESRD is required to optimal care for kidney transplant
- ▶ Cold ischemic time should be minimized for preventing graft delay function
- ▶ Maintenance of renal perfusion in perioperative period is critical for kidney graft function
- ▶ Consider the effects of renal failure on drug handling

References



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Clinical Anesthesia, Eight Edition, Paul G Barash



Yao and Artusio's Anesthesiology, Ninth Edition, Fun-Sun F.Yao

Thank You!!

