

UCSF Anesthesia Resident Pearls: Renal Transplant

A. *How a patient gets on the UCSF Transplant list*

- 1) **Evaluation-** Transplant nephrologists, transplant surgeon, psychiatrist, social worker, financial counselor begin the evaluation
- 2) **Testing-** Hematology, CV, Pulmonary, Infectious, Immunologic, Dental testing, etc.
- 3) **Immunologic evaluation-** ABO blood group determination, human leukocyte antigen (HLA) typing, screening for antibodies to HLA phenotypes, and cross-matching.
- 4) **Additional Consultants-** Determined by individual patient's co-morbidities. i.e. GI consult/colonoscopy looking for cancer in pts older than 50
- 5) **Listing-** In our area, kidneys get allocated primarily by waiting time. Usual waiting times range from 5-8 years. Available organs get allocated via this list Locally->Regionally->Nationally.
 - ~85,000 patients on list in 2007
 - 6037 living donor and 10082 deceased donor transplants in 2007
 - UCSF
 - 2008- 167 deceased donor allografts and 115 live donor allografts
 - 2009- 218 deceased donors and 109 live donors
 - Most common causes of ESRD requiring kidney transplant:
 - Diabetes
 - Hypertension
 - FSGS, IgA nephropathy, SLE
 - Congenital defects (children)

B. *Day of Surgery Pre-op Assessment*

- 1) **State of Dialysis-** Should be reviewed: last dialysis, type of dialysis, serum potassium, bicarbonate, and dry weight prior to OR.
- 2) **Associated co-morbidities-** Should have been extensively worked-up in above evaluation. Since a few years may have passed since the last exam, a thorough re-cap is needed.
 - **Cardiovascular Risk-** Fully evaluate the extent of the patient's coronary artery disease and overall cardiac function: Stress test, Echo with global EF, PA systolic pressure, Coronary Angiogram? Pacemaker? When depressed EF is secondary to uremic state, cardiac function recovers after transplantation
 - **Hypertension-** Review medications taken DOS? The surgeon, for allograft perfusion, typically requests "permissive" hypertension.
 - **ACEIs & ARBs-** Check to see if your patient has taken one of these. The Prep clinic generally tells other surgical patients to not take these drugs due to concern for refractory hypotension on induction. Because the timing of receiving a deceased donor kidney is unpredictable, these patients are more likely to have already taken these meds. Discuss with your attending the utility of vasopressin to treat hypotension if your patient is on an ACEI/ARB.
 - **Diabetes-** Check serum glucose, start insulin infusion once glucose greater than 150 mg/dl. Start with 4 units/hr and recheck every 30 minutes for first hour.
 - **Electrolytes-** K⁺ and HCO₃⁻ before surgery.
 - **Hematologic-** CBC, Coags. Anemia currently better treated with erythropoietin. A preop CBC to document the **platelet count**. Uremia can cause coagulopathy even with low normal counts.

➤ **Confirmation Match** of patient and donor kidney blood/HLA to be done as additional safety check prior to transfer to OR. Yes, it's done by others, but you should do it too!

C. *Immunosuppression*

- 1) **Oral Agents-** Verify that the **ordered** oral immunosuppressants have been given in pre-op holding prior to going to the OR.

- **Tacrolimus**- Otherwise know as FK506 or Prograf. Keystone of immunosuppressive maintenance. Check to see if it needs to be given pre-op.
 - **Mycophenolate mofetil (Cellcept)**- Adjunctive oral maintenance that you should check to see if it was ordered and given pre-op.
- 2) **Intravenous agents**- All of these intravenous medications need to be given as an infusion. Although rare, **side effects of IV bolus administration can be life threatening...** It is ideal to load these medications on an infusion pump, and then start them after induction is complete.
- **Methylprednisolone**- 500mg IV x1 infused over 20-30 minutes.

One of the following is given as well post-induction....

- **Basiliximab (Simulect)**- Give as an infusion over 20-30 minutes. Watch for hypotension as severe acute hypersensitivity reactions have been observed.
- **Thymoglobulin (Rabbit Anti-thymocyte globulin)** - IV administration by slow infusion with or without a prior test-dose. Watch for hypotension as thymoglobulin can result in a SIRS-like response from activation of T-cells. It was first approved to be given to patients with steroid-resistant rejection post-operatively. Symptoms in awake patients are HA, fever, arthralgias, rigors, and hypotension. ***Administration over 6 hours.***

D. Anesthetic/Intra-operative Management

- 1) **Intravenous Access**- Commonly challenging IV starts. One reliable, small (20-22 G) PIV adequate for most inductions. 2nd larger PIV placed asleep. 2- or 3- lumen CVCs very rarely done at UCSF except in poor access cases. Reasonable to discuss with surgeon if you plan on a central line. **Dialysis Catheters**- Could potentially be used for induction in poor IV access patients. Typically locked with 3ml of **heparinized saline**. Protocol for hep-lock is generally 1000 units/ml of heparin in each port after saline flush. (Volume of heparinized saline is typically printed on access ports) You **MUST** withdraw the heparinized saline until you get blood back before accessing. Discuss attending how to remove heparin from dialysis catheter.
- 2) **Monitoring**-
- **Arterial Line**- Very rarely used for hemodynamic monitoring (<5% of living donor kidneys done at UCSF in a retrospective study). May be indicated due to individual patient concerns, though not generally needed for graft success.
 - **CVP**- As above for intravenous access, CVP monitoring not shown to affect graft function. Could be used if central line placed due to poor access. CVP goal 10-15 mmHg
 - **AV Fistula Checks**- Document checks Q15-30 minutes. It is important to monitor for a thrill and to avoid prolonged hypotension. If the AV fistula loses its thrill or pulsation, you must discuss this with the surgeon. Dialysis may be needed post-op.
- 3) **Induction**-
- **Hypnotic**- Up to the Anesthesia team, and depends on patient indications, since propofol, thiopental, etomidate are all liver metabolized. Propofol is by far the standard induction agent at UCSF. Note-likely to see significant hypotension post-induction ->Consider smaller induction dose.
 - **Muscle Relaxant**- Cisatracurium (Nimbex) is the mainstay. If increased concern for reflux, rocuronium can be used in a modified-RSI, with cisatra for maintenance. Concern for hyperkalemia with succinylcholine. It has limited use in ESRD, but has been safely used if potassium level is normal. (i.e. post-dialysis).
 - **Antibiotics**- Discuss with surgeon. Typically Kefzol is given. If anaphylaxis to any drug is suspected, please remember to obtain a serum tryptase level.
 - **Esmolol**- Consider esmolol for induction as a substitute for large opioid doses. Frequently, esmolol doses far greater than recommended dose of 0.5 to 1 mg/kg may be required.
 - **Opiates**- Up to the Anesthesia team, though fentanyl is the mainstay. Consideration needed for use of morphine or meperidine due to active morphine metabolite and normeperidine seizure potential. Consider opioid loading at the end as opposed to front-loading. Once fascia divided, very little surgical stimulus. Average amount of fentanyl 200-250 mcg/case.
 - **Anesthetic Maintenance**- Inhalation agent is common but intravenous (TIVA) can be used.

Theoretical risk of Compound A/Sevoflurane, renal toxicity not shown in human studies.

- **Phenylephrine/Ephedrine-** Used in ~25% of living donor cases at UCSF. Theoretical concern for vasoconstriction in allograft potentially worsening function. Retrospective study at UCSF did not show relation to delayed-graft function. Discuss with attending and surgeon if needed for hemodynamic support.
 - **Fluid Management/ Transfusion Requirements** Retrospective analysis revealed ~40ml/kg of crystalloid by the end of surgery. Discuss this with the surgeon.
 - Colloids rarely given.
 - Discuss LR versus NS with the anesthesia faculty.
 - Blood transfusion in less than 2 %.
 - **Hemodynamic Goals- “Permissive hypertension” Keep between baseline-> +20% in most cases.** Discuss with surgeon or attending if patient has a relatively “low” BP or is significantly hypertensive at baseline.
- 4) **Transplanting- Have these drugs ready**
- **Furosemide-** Slow IV infusion of 100mg over 30 minutes +/- continuing infusion. 100mg given in the vast majority of cases. Check with anesthesia attending or surgeon regarding when to start it.
 - **Mannitol-** 30 minute IV infusion of 12.5 grams or more depending on surgeon. Check vials for crystal precipitation ->Warm if needed and infuse through reliable IV d/t concern for extravasations.
 - **Both mannitol and furosemide are given during the warm ischemia time (once kidney is out of slush).** Average warm ischemia time is approximately 25 mins.
 - **Dopamine-** Used in ~25% of living donor cases. May be requested by surgeon to keep blood pressure elevated for allograft perfusion. Also used as low dose (1-3 mics/kg/min) infusion for theoretical renal protection. Emerging evidence of decreased post-transplant dialysis when low dose is used in brain-dead donors prior to organ harvesting.
- 5) **Post-clamping to Closing**
- **Urine Output-** Circulating nurse will typically monitor urine output (UOP) q15 minutes after ureter anastomosis to bladder.
 - No Urine? -Delayed Graft Function (DGF) is a common event, especially in Deceased Donor kidneys. Your anesthetic is most often not a major contributing factor to this. See below.
 - **Muscle Relaxants-** You walk a fine line, relaxation during closure versus full muscle strength for post extubation respiratory function.
- 6) **Emergence**
- **Pain management-** We do not do epidurals for these patients. The mainstay of pain management is IV fentanyl.
 - **Antiemetics-** Zofran typically. Additional antiemetics per patient history.

E. *Post-operative*

1) **Transfer**

- Average case length is ~232 minutes.
- **PACU-** Barring serious complications or failure to extubate, vast majority of recipients go to the PACU. Typical PACU report to the nurse.

F. *Complications and Considerations*

1) **Anaphylaxis**

- Antibiotics are likely the most frequent cause, but muscle relaxants are also known to cause anaphylaxis. With so many iv agents unique to these cases, anaphylaxis, or a severe anaphylactoid reaction is possible. Epinephrine and iv fluids remain the treatment of choice. If such a reaction is suspected, remember to obtain a **serum tryptase level**.

2) **Rejection**

- **Hyperacute-** This happens quickly in the OR after clamps are released or the following hours. Complement-mediated with recipient pre-existing antibodies. The graft is usually removed to

prevent severe systemic inflammatory response syndrome (SIRS). Rare now with better matching techniques.

- **Accelerated Acute-** Subset of acute rejection that can be seen within the first week post-op. Cellular and/or antibody-mediated. 10-15% incidence.

3) **Delayed Graft Function**

- 4-6% incidence of delayed graft function (DGF) in living donor recipients reported at transplant
- 15-20 % DGF for deceased organ recipients; Increased with extended criteria donors (ECD).
 - Wide variation in reporting
 - Loose definition- Urine output<1L first 24hrs, Serum Cr>3mg/dl 5th day post-op, Dialysis in 72hrs, etc.
- **Donor Factors (ECD donor)**
 - HTN, CrCl<80, Weight, Atraumatic Death, Increased age
- **Recipient Factors**
 - Pre-sensitization, ethnicity, Pre-OR pro-inflam cytokines, MAP<100
- **Surgical Factors**
 - Cold, Warm, Anastomotic time, Preservation solution

4) **Survival**

- **Living Donor**
 - 1yr->96%, 5yr->81%, 10yr->58%
- **Non-Expanded Criteria Donor (Deceased)**
 - 1yr->92%, 5yr->71%, 10yr->45%
- **Expanded Criteria Donor (ECD-Deceased)** [Diseases or conditions the donor has that might affect the donor kidney function or longevity, such as cirrhosis, etc.]
 - 1yr->85%, 5yr->55%, 10yr->28%

Written by: Jake Pletcher, M.D.
Anesthesia Faculty Advisor: Bill Shapiro, M.D.
Contributions by:
Ryutaro (Ryo) Hirose, M.D., Transplant Surgeon
Claus Niemann, M.D., Transplant Anesthesiologist
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