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## ADMINISTRATION OF ANESTHESIA TO PATIENTS WITH RENAL FAILURE

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1. Never place a central line in the same extremity where the arteriovenous access (primary AV fistula or GORE-TEX® graft) is present.
2. Do not administer large amounts of intravenous (IV) fluids to patients with end-stage renal disease (ESRD) or acute renal failure (ARF)-oliguric patients (i.e., no more than 1 mL/kg) for minor procedures and during stable clinical conditions.
3. Choose the proper IV solution during anesthesia (0.9% or 0.45% NaCl) according to the following serum electrolyte levels:
  - normal saline (NS) if  $N_A^+ < 140$  mEq/L
  - $\frac{1}{2}$  NS if  $N_A^+ > 140$  mEq/L or in patients receiving large amounts of exogenous  $N_A^+$  in the form of fresh, frozen plasma. May alternate one liter of each during prolonged surgical procedures, particularly if large amounts of volume are needed. Add 5% dextrose in NS or  $\frac{1}{2}$  NS in nondiabetic patients or in diabetics who receive pre-op insulin.
4. Severe intraoperative hyponatremia can frequently happen while receiving hypotonic solutions (< 0.9% NaCl). At highest risk are patients with:
  - a. ESRD or ARF-oliguria,
  - b. post-transurethral resection of the prostate using glycine with or without renal failure, or
  - c. endometrial curettage/ablation with or without renal failure.
5. Do not treat hyperkalemia unless levels of potassium are 6.0 mEq/L or above, in which case use:
  - a. dextrose in water (D/W) 50% 50 mL intravenous push (IVP) followed by 5 units (U) IVP regular insulin as the quickest way to reduce K<sup>+</sup> levels by increasing cellular uptake. Do not use hypertonic glucose with blood sugar levels > 200 mg/dL. Use regular insulin alone; correction of hyperglycemia results in improvement of hyperkalemia. May use sliding scale for blood sugar as follows (using Accu-Chek® every 15 min):
    - 201-250 mg/dL 3 U regular insulin IV
    - 251-300 mg/dL 5 U regular insulin IV
    - 301-350 mg/dL 7 U regular insulin IV
    - 351-400 mg/dL 10 U regular insulin IV
    - 400 mg/dL 15 U regular insulin IV
 Conversely, if blood sugar < 100 mg/dL, hyperkalemia should improve with administration of hypertonic glucose alone (50 mL of 50% D/W IVP) without insulin.
  - b.  $\text{NaHCO}_3$  50 mEq (1 amp) IVP unless pH is alkalemic (pH > 7.48), in which case do not administer.
  - c. Calcium gluconate 1 gm IVP, particularly if EKG findings of hyperkalemia are present. Watch for hyperkalemia intra-op if:
    - radiographic contrast is used (particularly in ARF-oliguric patients, as a consequence of “solvent drag effect”),
    - large amounts of mannitol are given under the same circumstances as above, or
    - cardiovascular collapse develops with ensuing lactic acidosis (resulting in acidemia, “shifting,” and hyperkalemia).
6. For intra-op hypertension in ESRD and ARF patients, avoid ACE inhibitors and beta-blockers as antihypertensive drugs since they can lead to hyperkalemia. Instead use calcium channel blockers, which may have a nephroprotective effect in ARF patients.
7. In patients with acute ongoing metabolic acidosis and acidemia (pH < 7.30), D/5W 1 liter with 3 amps of  $\text{NaHCO}_3$  could be used as the solution of choice instead of 0.9% NaCl. Some of these patients could be hyperchloremic; moreover, “expansion acidosis” could further compound the situation. If the patient is hypernatremic ( $\text{Na}^+$  levels > 150 mEq/L), tris-hydroxymethyl aminomethane (THAM) is the preferred solution to provide buffer and prevent further worsening hypernatremia obligated by  $\text{NaHCO}_3$  infusion.
8. Large amounts of citrate administered via multiple blood transfusions can lower  $\text{Ca}^{++}$  levels, for which calcium gluconate 1 gm IV should be administered for every 3 U of blood.  $\text{Ca}^{++}$  levels need to be followed closely to prevent high calcium-phosphorus double product and risk for calcium-phosphorus precipitation in vital organs.
9. In the unusual event of severe hypophosphatemia ( $P < 2.0$  mg%), replace  $\text{NaHPO}_4$  10 mmol IV over 1 hour or  $\text{KHPO}_4$  10 mmol over 1 hour according to the situation.
10. Avoid drugs with potential nephrotoxicity in ARF patients; modify doses of medications according to reduced renal function (glomerular filtration rate (GFR) < 5 mL in ESRD). Formulas such as MDRD eGFR and Cockcroft-Gault ( $140 - \text{age in years}$ )  $\times$  ( $\text{weight in kg}$ )/ $\text{SCr} \times 72$  are of no use in ARF to calculate GFR since anuria is GFR 0 regardless of serum creatinine levels; this formula is only useful when renal function is at a steady state and not changing daily as with ARF.