Learning Objectives

To understand:

1. Risk factors for perioperative renal dysfunction
2. Strategies for renal protection
3. Treatment options for perioperative oliguria and acute renal dysfunction

Case Presentation

The patient is a 63 year old, 82 kg man scheduled for emergency coronary artery bypass grafting (CABG) and mitral valve repair or replacement (MVR) on cardiopulmonary bypass (CPB).

He has a long history of hypertension and insulin dependent diabetes mellitus (IDDM) and he is a long time smoker. His long term medications include NPH insulin, metoprolol, lisinopril and furosemide.

The patient presented to the emergency room (ER) with a history of sudden onset of shortness of breath, progressively worsening over the last few hours. ECG showed elevated ST segments in the anteroseptal leads. A chest-x ray showed mildly increased pulmonary vascular markings and cardiomegaly. A transthoracic echocardiogram (TTE) revealed severe hypokinesis of the anterior, antero-septal and lateral wall, severe mitral regurgitation (MR), and severely decreased left ventricular (LV) function with an estimated ejection fraction (LVEF) of 25%. He was taken for urgent cardiac catheterization that confirmed diffuse coronary artery disease with obstructive lesions in the LAD (80% ostial), D1 (80%), OM1 (90%), RCA (65% distal), severe MR and LVEF 25%. Hemodynamics: Cardiac output (CO) 3.6 L/min, cardiac index (CI) 1.8 L/min/M².

The patient was admitted to the CCU but continued to complain of chest pain and had ECG changes despite a nitroglycerin infusion. He was scheduled for emergency CABG + MVR.
Physical Examination and Laboratory Findings:
The patient was awake, alert, orientated but quite anxious. He was in sinus rhythm at 88/min, blood pressure (BP) 162/78 mmHg, respiratory rate 24/min, SpO₂ 96% on nasal cannula 2L/min. His airway exam was normal. Auscultation revealed a 4/6 pansystolic murmur in the left anterior chest.
Hct 49%, WBC 9.3k, Platelets 256k
Na 145 mEq/L, K 4.9 mEq/L, Total CO₂ 28 mEq/L.
BUN 32 mg/dL, serum creatinine 2.1 mg/L. Blood glucose 253 mg/dL.
ECG sinus rhythm with LVH; 2 mm ST elevation in leads I, AVL, V2-4.

Questions:
1. What are your perioperative concerns for this patient?
2. Do you require any further information prior to proceeding with the case?
3. Would you postpone or cancel this case? If so, why?
4. If you decide to proceed, would you alter your standard anesthetic plan in any way?
5. Is pharmacologic renal protection indicated, and if so, what agents would you choose?

Anesthetic Management and Operative Course
After an uneventful anesthetic induction and endotracheal intubation, anesthesia is maintained on fentanyl, midazolam and isoflurane. A dopamine infusion of 2 mcg/kg/min was started prior to CPB. The perfusionist added an additional 25g of mannitol to the pump prime. The patient was hemodynamically stable throughout the pre-CPB period and the urine output was 100 ml/hr.

Questions:
1. Is the dopamine infusion warranted? Would fenoldopam, N-acetyl cysteine or nesiritide have been more appropriate, and why?
2. Is there any benefit to adding additional mannitol to the pump prime?
3. How might the use of aprotinin, if it were still available, potentially benefit or harm the patient?

Revascularization is tedious and mitral valve repair difficult – ultimately the decision is made to do mitral valve replacement. CPB time is 3 hr 45 min and aortic cross-clamp time is 2 hr 30 min. The patient is weaned of CPB with difficulty. He is in a junctional rhythm at 45 beats/min and is now AV paced at 90 beats/min, with BP 90/60, PAP 45/24 (PAOP 18), CVP 12, CO / CI 5.4 / 2.3 on milrinone 0.5 mcg/kg/min, dobutamine 3 mcg/kg/min, norepinephrine 0.06 mcg/kg/min (5 mcg/min) and vasopressin 2 u/hr. Urine output, which had fallen to 30 mL/hr during CPB, remains at this level.

Questions:

1. What do you think is going on? What are the factors contributing to the oliguria?

2. How would you evaluate the patient’s renal function? Is there a role for NGAL?

3. What are the treatment options for his oliguria?

3. If the patient ultimately requires dialysis, is there any advantage of one mode over another (peritoneal vs. hemodialysis vs. continuous veno-venous hemodialysis)?
RECOMMENDED READING