Peritoneal dialysis in AKI post cardiac surgery (PCB)

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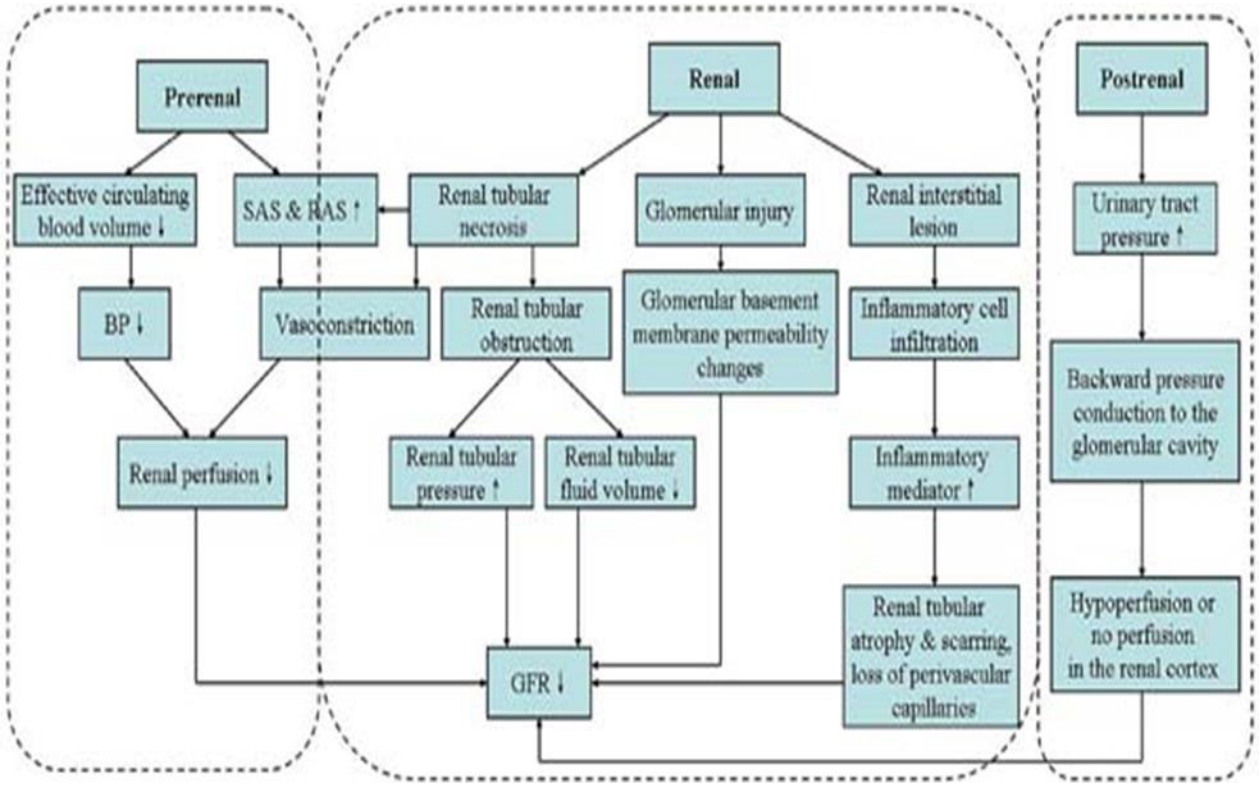
Acute kidney injury (AKI) is a common and severe complication after cardiac surgery with an incidence of 3.4%; 1.9% of which requiring dialysis treatment

The incidences of AKI in patients receiving isolated conventional coronary artery bypass grafting (CABG) and off-pump coronary artery bypass are 2.9% and 1.4%, of the AKI patients requiring dialysis

A conceptual model of the pathophysiology of acute kidney injury after cardiac surgery



Who ?

Acute kidney injury (AKI) is a well-known complication which faces treatment challenges after pediatric cardiac surgery.

Risk factors of AKI and the need for renal replacement therapy include

1.young age,

2.complex cardiac lesions,

3.long cardiopulmonary bypass time,

4.and a low cardiac output state after surgery.

Although the choice of renal replacement therapy is controversial

Risk factors for acute renal dysfunction following cardiopulmonary bypass

RISK FACTORS	SIGNIFICANCE
Age >70	An independent risk factor for AKI following CPB
Female	An independent risk factor for AKI following CPB
Smoking	An independent risk factor for AKI following CPB
LVEF<35%	An independent risk factor for AKI following CPB
Congenital heart disease	Children with congenital heart disease are at high risk of AKI happening
eGFR<60ml/min/1.73m	An independent risk factor for AKI following CPB
S>Cr>2.5	An independent risk factor for AKI following CPB

Risk factors for acute renal dysfunction following cardiopulmonary bypass

RISK FACTORS	SIGNIFICANCE
Genetic polymorphisms	Patients with the rs1617640 TT risk allele are more likely to develop AKI following CPB
Hb ,<9mg/dl	An independent risk factor for AKI following CPB
Hemodilution to Hct<24%	An independent risk factor for AKI following CPB
Oxygen delivery	Increasing oxygen might be protective against AKI following CPB
During 24 h of exposure to contrast agents	Restricting angiographic examination on the day of operation reduced the AKI rate

Risk factors for acute renal dysfunction following cardiopulmonary bypass

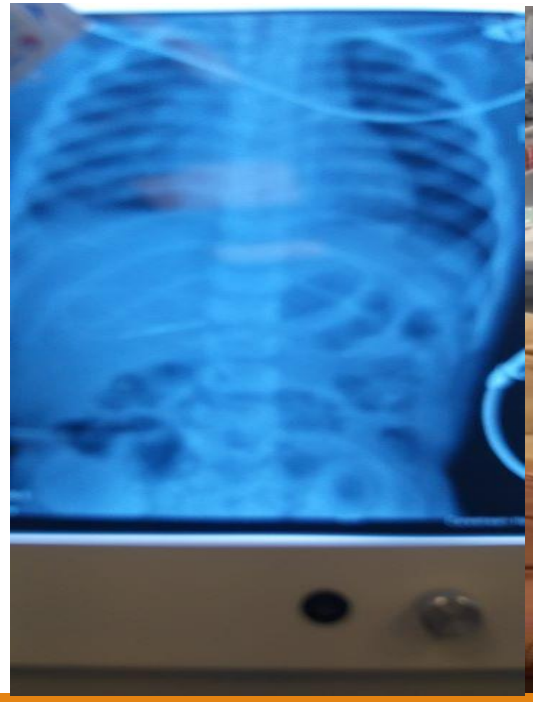
RISK FACTORS	SIGNIFICANCE
High dose of contrast agent	An independent risk factor for AKI following CPB
Prolonged surgery duration	Prolonged time on CPB might be associated with increased risk of developing AKI following CPB

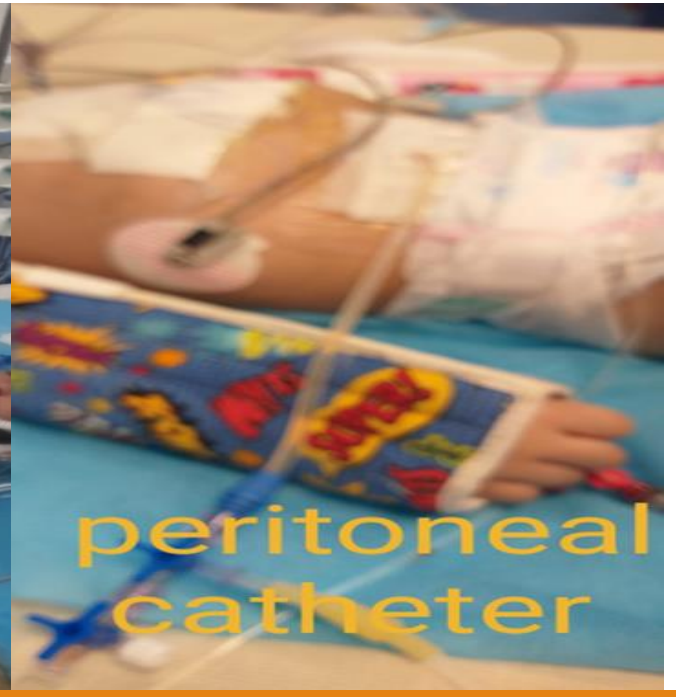
The early institution of both peritoneal dialysis (PD) for AKI and low cardiac output after cardiac operations removes fluid, thus easing the fluid restriction and improving cardiopulmonary function.

In infants at high risk of developing AKI, PD catheter placement has also been shown to be safe, and it is associated with an earlier negative fluid balance, earlier extubation, improved inotrope scores, fewer electrolyte imbalances requiring correction, and improved clinical outcomes

In general, dialysis-associated complications have not been observed during PD

When PD was contraindicated, the use of two small single-lumen catheters in separate veins enables consistent and effective hemodiafiltration in neonates and infants with challenging vascular access, allowing an excellent normalization of the blood flow of metabolic derangements and significant fluid removal





Dose and follow-up in PICU post CPB

10 - 20ml/kg

TIME	INPUT	DWELL TIME	OUTPUT	Negative balance

It has been demonstrated that the use of the low-volume peritoneal dialysis technique

(10 mL/kg cycled each hour) and a short indwelling time may have attributed to a low peritoneal irritation and caused less acute hemodynamic disturbances.

In addition to PD, continuous RRT (CRRT) and hemodialysis (HD) are other suitable RRTs for the treatment of AKI

CRRT is a safe and effective method for fluid and electrolyte homeostasis that allows hyperalimentation in infants and children after cardiac operations

In addition, perioperative prophylactic HD also decreases operative mortality and morbidity rates in high-risk patients

Furthermore, modern CRRT and HD machines are equipped with exact volumetric systems that direct fluid removal and online solute clearance monitoring, providing obvious superiority and improving physician “comfort” compared with PD that contributes to potentially unpredictable fluid removal rates and possible inadequate solute clearances

The early institution of ultrafiltration in the operating room and RRT during the postoperative period may decrease the activity of the proinflammatory milieu and the resulting systemic effects

The early initiation of RRT may prevent fluid overload and result in improved infant outcomes.

Despite the theoretical advantages of using RRT and the effective control of uremia, the mortality associated with AKI following CPB remains high, and it is most likely determined by the number of failed organ systems.

Thus, the management of CPB-associated AKI should be aimed at relying on more comprehensive interventions.

Why?

Peritoneal dialysis (PD) has been shown to be useful because

of the ease of application,

effectiveness in fluid removal and

avoidance of additional vascular access

and

anticoagulation.

PD is a dependable, safe and effective method for treating AKI in young children in the postoperative period after open heart surgery.

AKI in this subset of patients mostly related to the complex congenital pathology requiring longer extracorporeal circulation time for repair of the defects, the cyanosis, CPB induced inflammation and sepsis

Early PD initiation seemed to have advantages in terms of reducing the total duration and subsequent morbidity

The thirty-day mortality rate of patients with CPB-associated AKI who require RRT is 42%

How to prevent?

The detection of biomarkers is useful to prevent CPB-associated AKI

We must improve our understanding of the mechanisms involved in CPB-associated AKI to prevent this disease and to develop comprehensive interventions for managing CPB-associated AKI when it occurs

Peritoneal Dialysis Guideline in the Cardiac Patient in PICU

This guideline has been developed for the post-operative cardiac patient within the paediatric intensive care unit (PICU) requiring peritoneal dialysis (PD

The majority of peritoneal dialysis (PD) catheters are placed in the operating room.

For the PICU cardiac population a temporary PD catheter is placed during cardiac surgery and for other patients with renal impairment this will be a permanent Tenckoff catheter

Occasionally in acute situations or when a cardiac patient requires cross-flow PD, a temporary percutaneous PD catheter may be inserted in PICU by the intensivist or cardiac surgeon

Peritoneal dialysate should be warmed to body temperature for all renal patients

The PD catheter will be connected to a Baxter MiniCap PD Transfer set which is connected to a urine collection bag and on free drainage until it is required for use.

The PD drainage bag should be labeled clearly to avoid confusion with the patient’s urinary catheter bag.

Rarely a high risk patient may return to PICU and require immediate commencement of PD.

These patients will have a Fresenius catheter extension connected directly to their PD catheter, and a PD-Paed Plus Fresenius set connected to the catheter extension. Fresenius StaySafe balance dialysate fluid bag will be connected and primed through the set.

Remember ANY disconnection of the PD catheter needs to be a sterile procedure at ALL timesLow cardiac output syndrome

CONCLUSION

In patients with AKI after cardiac surgery, novel biomarkers have been recognized as reliable indicators for diagnosis, predicting the adverse outcome, and even mortality of postoperative AKI.

Renal replacement therapy should start early to achieve a promising prognosis.

In children, AKI after cardiac surgery can be managed with peritoneal dialysis, which may benefit them with better hemodynamic stability.

Appropriate management of peritoneal dialysis, which is ideal for neonates, infants, and young children following congenital cardiac surgery may improve the prognosis

peritoneal dialysis had a continuous improvement in hemodynamics, as evidenced by rising mean arterial blood pressure,

decreasing central venous pressure,

and decreasing requirement for inotropic support

Thanks