The Royal Melbourne Hospital

Perfusion Protocol – Retrograde Autologous Priming (RAP) – Blood Conservation Technique

TECHNIQUE

Retrograde Autologous Priming (RAP) as a blood conservation modality.

Hemodilution is the direct result of mixing the patient's blood volume with a crystalloid cardiopulmonary bypass (CPB) circuit prime. This is a unique and unavoidable feature of cardiac surgery as currently practiced that imposes a significant risk for requiring red blood cell transfusions.

Retrograde autologous priming (RAP) is a technique explored over the past two decades to conserve blood and minimise blood transfusions. Displacing some of the circuit prime at the initiation of CPB with the patient's own circulating blood in both an antegrade direction through the venous cannula and a retrograde direction through the arterial cannula has become known as retrograde autologous priming (RAP).

Once the patient is cannulated blood may be drained slowly back into the venous reservoir by slowly opening the clamp on first the arterial line stopping when blood has reached the y connection with the recirculation line and secondly the venous line until at least 350mls has been collected. Prior to going on bypass excess crystalloid should be returned to the plasmalyte fluid bag.

General Guidelines/Concerns/Considerations during RAP

- Communication among the cardiac team is of paramount importance during this procedure; discuss RAP with the Surgeon and Anaesthesiologist before instituting.
- A minimum RAP volume of 350 mL is needed for the procedure to be effective.
- While displacing the crystalloid prime monitor patient pressures
    - Systemic (AP)
    - Pulmonary artery
    - Central venous - If patient is dry (CVP low), RAP volume may be less than normal
- Monitor ECG, Stop RAP if ECG shows signs of ischemia.
- Announce updates of RAP progress with respect to % completed e.g. "50% completed, 80% completed, etc.
- *How much is more* - 10-20ml/kg (lucky to have 10ml/kg)
- Choose a circuit according to the patient's size. A 3/8 venous circuit for a small patient will aid reducing the priming volume and hemodilution.

Suitable Patients

1. Systolic blood pressure should be greater than 90mmHg
2. ECG - normal with no myocardial ischemia.
3. If the patient is small or has a low haemoglobin, special care should be taken watching the cerebral oximetry/NIRS whilst draining any blood.
4. Pulse Oximetry / cerebral oximetry (NIRS) is mandatory
5. Use caution with patients with aortic incompetency.
6. If patients have a haemoglobin >160g/d, it may be best practice for the anaesthetist pre-heparinisation to drain blood from the central line into a citrated blood transfusion bag. Blood should be drained to the venous clamp, and a blood collection bag connected to the three way tap in the venous line. Upon running on bypass, venous blood should be allowed to drain into the bag and saved to transfuse back later.

Benefits of RAP

1. Reduces the crystalloid prime in CPB circuit.
2. Reduces blood hemodilution and transfusion requirements
3. Higher HCT, limits fluid leak into lungs, running onto bypass prior to cross clamping.
4. Increases the oncotic pressure by increasing the amount of colloid in the prime and theoretically reduces third spacing of volume.
5. Slow mixing rather than rush of crystalloid overload.
6. Reduces platelet consumption, platelet activation and post-operative bleeding.
7. Excessive hemodilution can cause peri-operative stroke, as a result of embolic load.
8. Reduces dilution of drugs (Anaesthetic).
9. No extra cost, easy application, applicable to most operations.
10. RAP would be of greater benefit to patients with low BSA compared with the general population.

Potential risks

1. Increased viscosity and potential microcirculation damage
2. Hemodynamic instability
3. Potential for vaso-pressor requirement. A major concern with RAP is the possible need for vasopressor support during volume reduction. However, it's only transient with no long-term impact for patients.
4. Reinfusion of RAP volumes

RAP should potentially be used in all patients undergoing cardiopulmonary bypass. Reducing the need for blood products by avoiding hemodilution will have an impact regarding postoperative ventilation time, ICU stay, infection rates and morbidity. Adopting the RAP technique into the daily perfusion routine does not require sophisticated or expensive pharmacologic or technical modifications and is not related to increased peri- or post-operative patient risks.

References

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