The management of fluid balance in the first 24hrs post cardiac surgery on Cardiac Intensive Care Unit (CICU) at Derriford Hospital.

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Introduction

The following protocol refers primarily to the routine management of hypotension by providing a guide to fluid balance in patients post cardiac surgery.

The management of optimum fluid status in post operative cardiac surgical patients can be problematic and is different to general critical care patients. There are a number of confounding factors which need to be considered when assessing cardiac patients in the immediate post-operative period. Furthermore conventional parameters used for assessing cardiac output (CO) are often inaccurate in the peri-operative phase:

- A negative base excess maybe a post cardio-pulmonary bypass (CPB) phenomenon unrelated to inadequate CO
- The usual postoperative response to CPB is diuresis
- Patients may not be admitted to the CICU at their optimum fluid status
- A dilated ventricle may seemingly respond to fluid boluses but at the expense of worsening left atrial pressures (LAP) and pulmonary oedema, this may increase the period of IPPV, length of stay and worsen outcomes
- Post CPB vasodilatation, increased capillary permeability and diastolic dysfunction are common phenomena
- There may be a non-linear relationship between right atrial pressure and left ventricular end-diastolic volume (LVEDV) so central venous pressure may not be helpful
- Pre-operative drugs, particularly ACE inhibitors and B-blockers can obtund usual responses to hypotension
- Non-invasive CO monitors will often be unreliable in the presence of rhythm disturbances

Comprehensive clinical assessment of patient's fluid status and CO is key and multiple parameters such as peripheral perfusion, capillary refill time, heart rate, blood pressure (BP), respiratory paradox of arterial trace, urine output, pH, base excess, serum lactate and mixed venous oxygen saturation should be considered. The response to a fluid bolus is helpful in guiding management but should not deter from optimising other parameters.

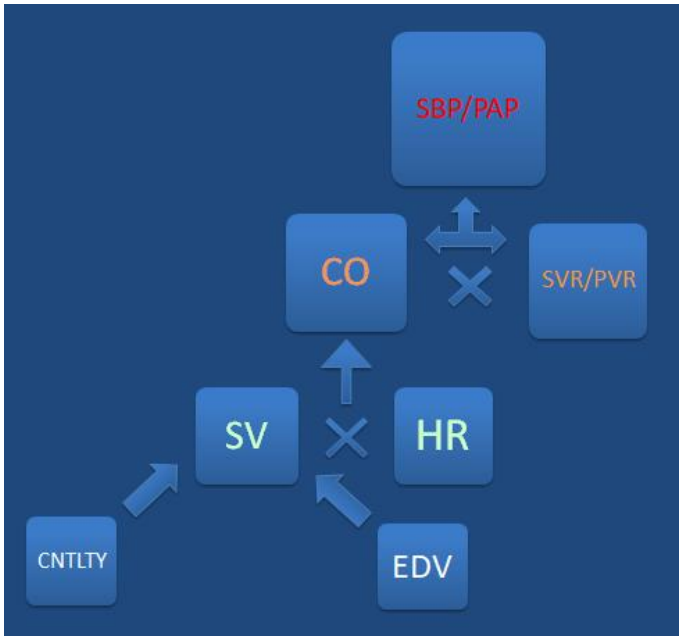
Portable CXR, pulse contour analysis, transthoracic and transoesophageal echocardiograms might be useful in assessing the adequacy of CO. Pulmonary artery catheter (PAC) provides the most accurate measurement of CO and LVEDP.

Management principles:

- The aim is to maintain systolic BP >100mmHg and/or mean BP >70mmHg and adequate vital organ perfusion whilst trying to maintain myocardial oxygen supply/ demand balance
- A dilated left or right ventricle will increase its oxygen demand
- Optimising heart rate and rhythm may significantly reduce the need to fill patients (pacing)
- Assessment of left ventricular systolic function as ejection fraction (EF) must be recorded on admission to CICU:

Poor	EF < 30%
Moderate	EF 30-50%
Good	EF >50%

- Intravenous fluid is one part of the management of hypotension
- Other causes of hypotension unrelated to relative hypovolaemia should always be considered:
    - obstructive, restrictive e.g tamponade
    - cardiogenic e.g ischaemia/failing myocardium
    - vasoplegia e.g. anaphylaxis/post CPB
- Basic relationship between BP, CO and systemic vascular resistance (SVR) may be helpful and is summarised below:
    - systolic BP ≈ CO x SVR
    - CO = HR x stroke volume (SV)
    - SV ≈ contractility (CNTLY) & Preload (EDV) ± arrhythmia



- **The fluid volumes in the protocol below should be used as a guide and not a target/goal**

CICU Fluid Management Protocol



- Hypotension managed initially by fluid boluses (250-500ml)
- Consider commencing low dose vasoconstrictor support before fluid review limit reached (Noradrenaline 2-4ml/hr)
- Document medical review with completion of Notes – General - **CVS/Fluid Review** in Innovian once fluid limit (30ml/kg) is reached
- Non-invasive CO monitoring/echocardiogram/pCXR should be considered if hypotension persists



- Hypotension managed by initial fluid boluses (250-500ml)
- Consider commencing inotropic support once half (12.5ml/kg) fluid review limit is reached (Dopamine, Dobutamine, Adrenaline, Milrinone)
- Consider adding low dose vasoconstrictor support (Noradrenaline 2-4ml/hr)
- Document medical review with completion of Notes – General - **CVS/Fluid Review** in Innovian once fluid limit (25ml/kg) is reached
- Non-invasive CO monitoring/echocardiogram/pCXR should be considered if hypotension persists



- Hypotension managed by initial fluid boluses (250ml)
- Early inotropic support required (Dopamine, Dobutamine, Adrenaline, Milrinone)
- Consider commencing vasoconstrictor support but only in conjunction with an inotrope
- Document medical review with completion of Notes – General - **CVS/Fluid Review** in Innovian once fluid limit (20ml/kg) is reached
- Low threshold for early CO monitoring (non-invasive CO, PAC); but mandatory to guide treatment if fluid limit reached

Early involvement of cardiothoracic surgical registrar is recommended, especially if cardiac tamponade or ongoing bleeding are suspected. Persistent hypotension should be discussed with consultant cardiac intensivist. The result of review may be to give further fluid boluses if this is the case regular reviews need to be completed and recorded.