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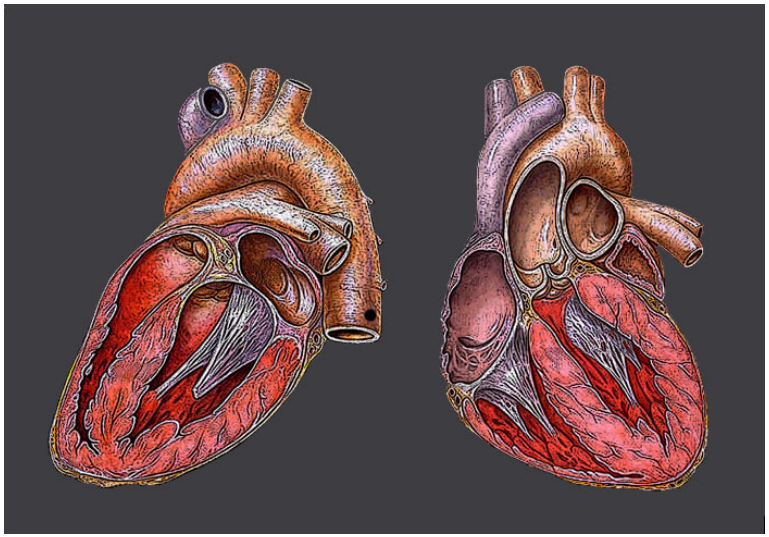

Neonatal Cardiovascular Care

Julia Petty

Cardiovascular system (CVS) assessment

- Colour
- Heart rate
- Capillary refill
- Skin perfusion
- Blood pressure
- Urine output

The Neonatal CVS

- Heart rate increases in response to compromise (as for respiratory rate), pain, stress, temperature.
- In the preterm neonate, bradycardia can be related to brainstem immaturity (<32-34 weeks) as well as apnoea (apnoea / bradycardia of prematurity)
- *Mean* blood pressure is observed.
- Neonates have a low absolute circulating blood volume which is easily depleted with blood sampling
- Hypotension is treated initially with volume (normal saline) with caution followed by consideration of inotropic support
- (Dasgupta and Gill (2003); Dempsey and Barrington (2007); Dempsey and Barrington (2006), Fanaroff and Fanaroff (2006); Gupta (2012) ; Johnstone and Smith (2008); Kent AL et al. (2009); Knight (2012)

The haematological system

- This system is closely related to the cardiovascular system
- Features of the neonatal blood; some examples –
  - High haemoglobin (Hb) & packed cell volume (PCV) in first days of life. Fetal Hb is broken down over next 4-6 months of life when adult Hb is formed
  - Hb can be lowered by regular blood sampling – sick neonates may need 'top-up' blood transfusions
  - Clotting factors can be low initially due to liver immaturity, esp. in the preterm neonate – Vitamin K is given at birth.

Cardiac defects

- Congenital cardiac defects in the neonate can be diagnosed antenatally (anomaly scan) or post-natally when clinical signs indicate compromise (e.g. breathlessness on feeding, cyanosis)
- Such defects can lead to cardiac failure

- Leach, 2012; Tidy, 2012

CAUSES of HEART FAILURE

- Structural heart defects – e.g. Patent Ductus Arteriosus, Hypoplastic left heart, coarctation of the aorta, Atrial septal defect (ASD)/ ventricular septal defect (VSD), aortic stenosis (Leach, 2012)
- Non-structural – myocardial ischaemia, myocarditis, polycythaemia, Hydrops, fluid overload, hypertrophic stenosis of the heart (diabetic mother), hypoglycaemia

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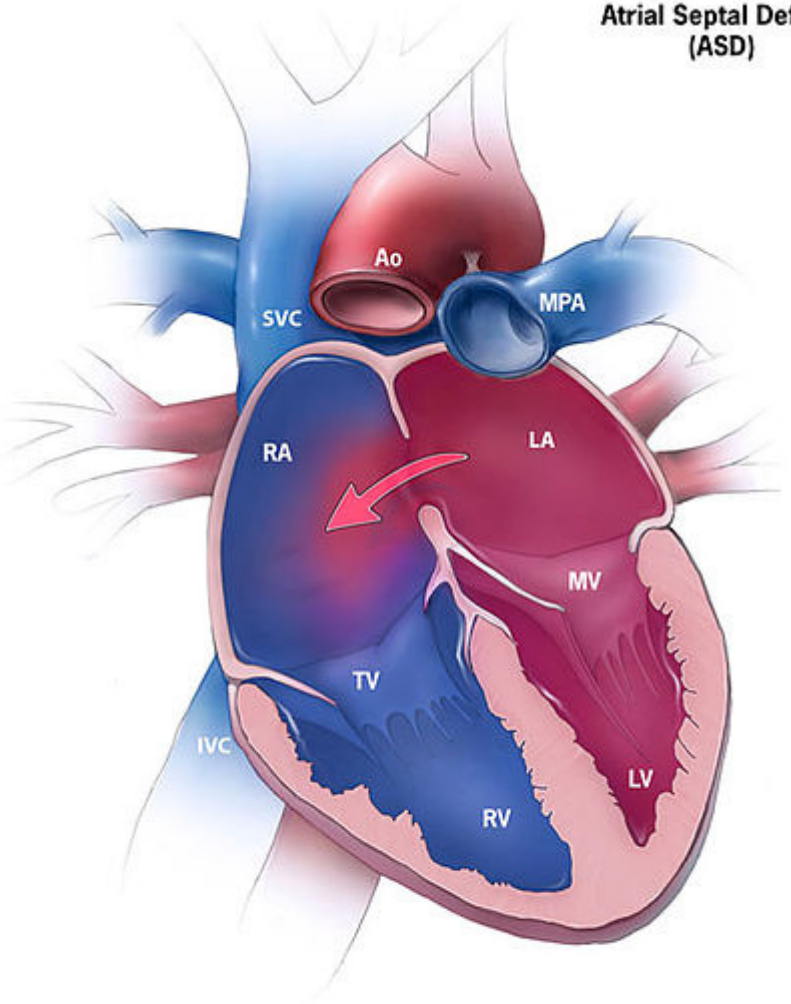
Atrial Septal Defect (ASD)



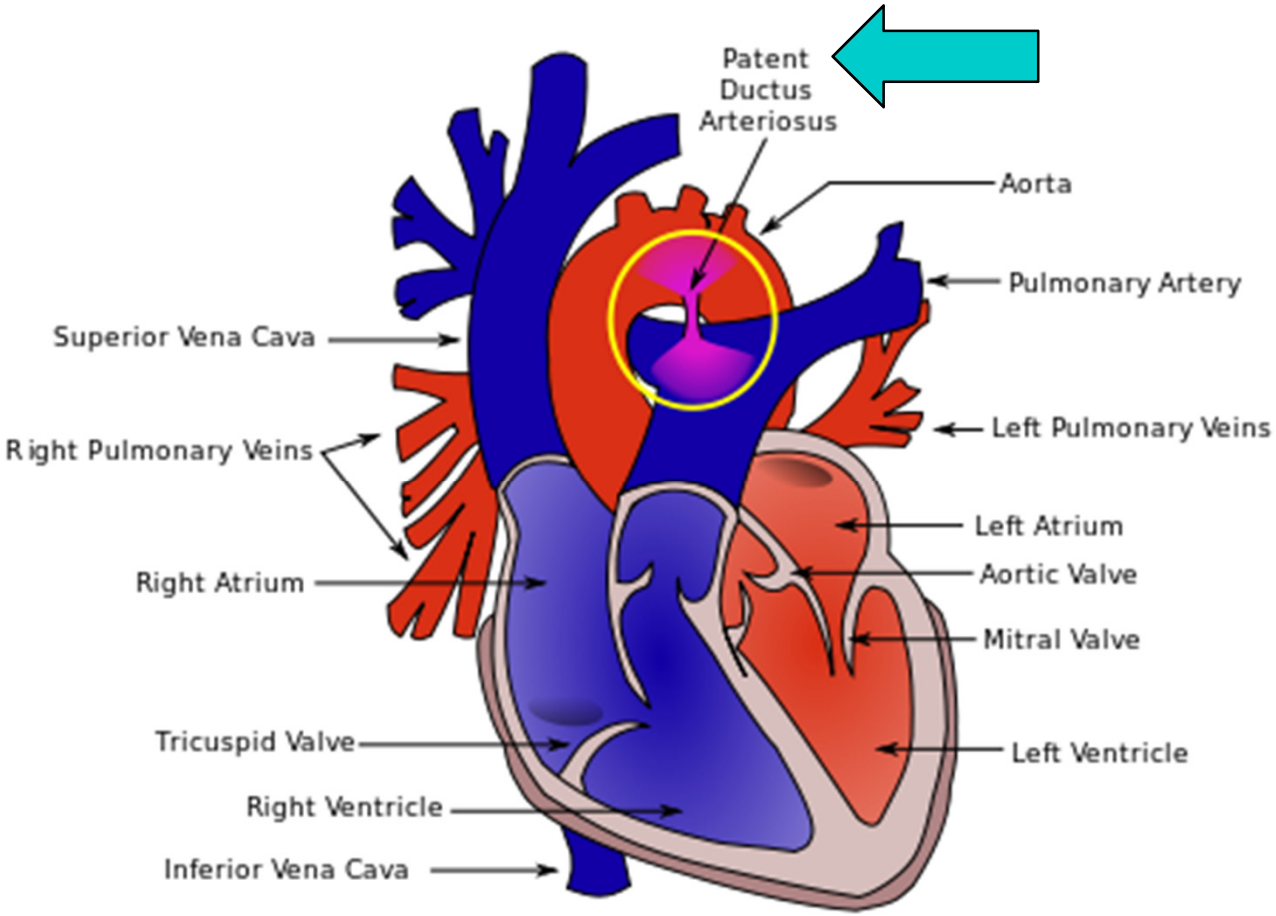
RA. Right Atrium
RV. Right Ventricle
LA. Left Atrium
LV. Left Ventricle

SVC. Superior Vena Cava
IVC. Inferior Vena Cava
MPA. Main Pulmonary Artery
Ao. Aorta

TV. Tricuspid Valve
MV. Mitral Valve

Patent Ductus Arteriosus (PDA)

- Can be seen in the preterm neonate
- A persistence of fetal vascular channel between the left pulmonary artery and the aorta. Normally, there is spontaneous closure by day 4 of life
- The left to right shunt causes an increase of blood flow to the lungs
- Between 30-40% of ventilated infants less than 1.5kg develop a persisting patency of the ductus, significant enough to interfere with respiratory management


Patent
Ductus
Arteriosus
Aorta
Pulmonary Artery
Superior Vena Cava
Left Pulmonary Veins
Right Pulmonary Veins
Left Atrium
Aortic Valve
Right Atrium
Mitral Valve
Tricuspid Valve
Left Ventricle
Right Ventricle
Inferior Vena Cava

Signs

- Tachycardia
- Bounding pulses
- Heart murmour or gallop
- Low diastolic BP
- Wide pulse pressure
- Enlarged heart
- Increased oedema
- Left ventricular hypertrophy
- Decreased cardiac output and pulmonary venous congestion

Management

- Diagnosis by listening, echocardiogram, clinical signs
- Fluid restriction
- Diuretics
- Ibuprofen or Indomethacin – beware side effects
- Surgical ligation if medical intervention is not effective

Heart Failure

- A clinical syndrome characterised by the inability of the heart to pump blood to meet the metabolic requirements of the tissues
- Results in inadequate perfusion of vital organs resulting in cardiovascular collapse or shock
- Causes – Structural OR non-structural (see previously)

Clinical Features

- Feeding & / or respiratory difficulties
- Excessive sweating
- Failure to thrive
- Tachypnoea, recession
- Enlarged liver
- Cardiomegaly
- Tachycardia, gallop rhythm / murmours
- Oedema
- Cyanosis

Treatment – Heart Failure

- Diuretics
- Oxygen therapy
- Avoid stress
- Fluid restriction
- Calories
- CHRONIC verses ACUTE
- ACUTE – stabilisation, ventilate, correct acidosis, volume replacement, inotropes, refer to specialist centre

SHOCK

- A MEDICAL EMERGENCY WHERE PROMT ACTION IS VITAL
- A generalised inadequacy of blood flow and tissue perfusion resulting in tissue damage
- Compensation followed by decompensation
- CAUSE – Septic, hypovolaemic, cardiogenic, anaphylactic and neurogenic
- However, features are similar for all types

Clinical features

- Pallor
- Cold peripheries
- Poor capillary refill
- Weak or absent pulses
- Tachycardia and hypotension
- Mottled & cyanosis
- Tachypnoea / laboured
- Acidosis
- CNS depression

Management

- Improve oxygen delivery to tissues
- Improve cardiac performance
- Determine & treat the likely cause – infection, cardiac, pulmonary

Further Reading

- Dasgupta SJ, Gill AB.(2003) Hypotension in the very low birthweight infant: the old, the new, and the uncertain. *Arch Dis Child Fetal Neonatal Ed*. 88:F450-F454.
- Dempsey EM, Barrington KJ. (2007) Treating hypotension in the preterm infant: when and with what: a critical and systematic review. *J Perinatol*.27:469-78.
- Dempsey EM, Barrington KJ. (2006) Diagnostic criteria and therapeutic interventions for the hypotensive very low birth weight infant. *J Perinatol*;26:677-81.
- Fanaroff AA, Fanaroff JM. (2006) Short- and long-term consequences of hypotension in ELBW infants. *Semin Perinatol*.30:151-5.
- Gupta, S. (2012) Shock and Hypotension in the Neonate. http://emedicine.medscape.com/article/979128-overview
- Johnstone I.C., Smith J.H. (2008) Cardiovascular monitoring in neonatal intensive care. *Infant*. 4(2): 61-65. http://www.infantgrapevine.co.uk/pdf/inf_020_esa.pdf
- Kent AL, Meskell S, Falk MC, (2009) Normative blood pressure data in non-ventilated premature neonates from 28-36 weeks gestation. *Pediatr Nephrol*. 24:141-6.
- Knight D. (2012) Newborn Services *Clinical Guidelines: Hypotension*. http://www.adhb.govt.nz/newborn/Guidelines/Cardiac/Hypotension.htm
- Leach, T (2012) Summary of Congenital Cardiac Abnormalities. http://almostadoctor.co.uk/content/systems/paediatrics/paediatric-cardiology/summary-congenital-cardiac-abnormalities
- Tidy, C (2012) Congenital Heart Disease in Children. http://www.patient.co.uk/doctor/congenital-heart-disease-in-children