Physiol-10B13 Describe the cardiovascular changes in the neonate that occur at birth.

Background

Birth is associated with significant cardiovascular changes as gas exchange is transferred from placenta to the lungs. This results in the change from fetal circulation to adult circulation.

**Fetal circulation** consists of 2 circulations in parallel:
- Blood is oxygenated at the placenta → single umbilical vein → IVC (50%) + ductus venosus (50%)
- RA → blood through foramen ovale → LV → aorta → head, neck and upper limbs
- RA → RV → pulmonary artery → ductus arteriosus → lower limbs
- Fetal pulmonary circulation = high pressure, low flow

**Adult circulation** consists of 2 circulations in series:
- RA → RV → pulmonary → LA → LV → aorta
- Adult pulmonary circulation = low pressure, high flow

**Circulatory Changes at Birth**

1. *Umbilical vessels are obliterated* when the cord is clamped externally → ↓ blood flow through IVC and ductus venosus.
2. *Ductus venosus closes* over 3 ~ 10 days.
3. First breath → negative intrathoracic pressure → oxygen enters lungs → opening of pulmonary vessels + ↓ hypoxic pulmonary vasoconstriction → dramatic fall in pulmonary vascular resistance.
4. ↓ pulmonary vascular resistance → ↑ pulmonary blood flow → ↑ venous return to left atrium → ↑ left atrial pressure → LAP exceeds RAP → functional closure of foramen ovale within minutes to hours of birth → all RA blood passes into RV.
5. Anatomical closure of foramen ovale occurs over several days.
6. Ductus arteriosus constricts (high PaO₂) and complete closure within 48 hours.
7. Other changes take several weeks after birth – ↓ RV wall thickness, ↑ LV wall thickness, etc.

**Factors that Modify Above Changes**

The cardiovascular changes above can be modified.

Elevation of RAP → persistence of foramen ovale
Decrease PVR → persistence of ductus arteriosus
Prostaglandins and hypoxia → inhibit closure of ductus arteriosus

**Examiner’s comments** – 90% of candidates passed this question.

The cardiovascular changes that occur in the neonate at birth was well answered with most candidates providing an adequate account of the effects of the first few breaths.
and cessation of umbilical blood flow on the pulmonary and intracardiac circulations, along with the sequence and timing of these events.

Extra marks were awarded for more detailed descriptions of the foetal circulation at term and neonatal haemodynamics at birth, and the factors that modify them (such as the inhibition of ductus arteriosus closure by hypoxia and prostaglandins).