



Adaptation of the newborn to Extra-uterine Life

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Aims

- To explain the changes that take place in the neonate at birth to the fetal circulation and respiratory system.
- Identify adaptive changes to other systems; namely thermal control, glucose homeostasis and fluid balance

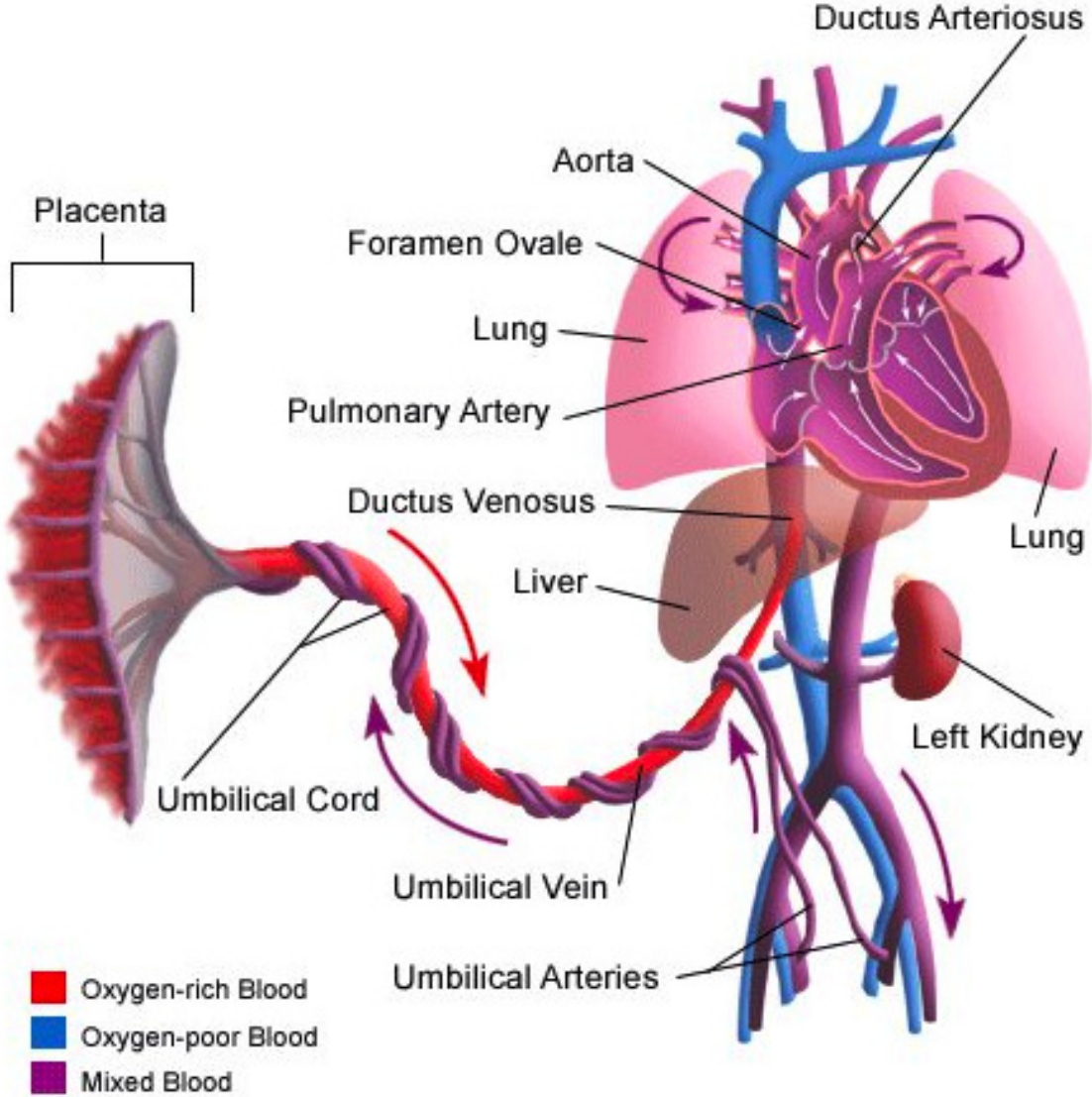
Fetal Circulation

- The placenta acts as the organ of respiration for the fetus
- The umbilical vein carries oxygenated blood from the placenta to the fetal heart.
- Blood crosses through the fetal heart ducts in a right-to-left direction with only a small % of blood flow passing to the lungs.
- Blood is then carried via the umbilical artery to the rest of the body (Askin, 2009; FCRA)

Changes at Birth

- The Birth process imposes a significant and unique physical challenge to the neonate
- Life tasks necessary comprise independent breathing, the transition from fetal to neonatal circulation and the metabolic adaptation of thermoregulatory and glucose homeostasis along with fluid balance.

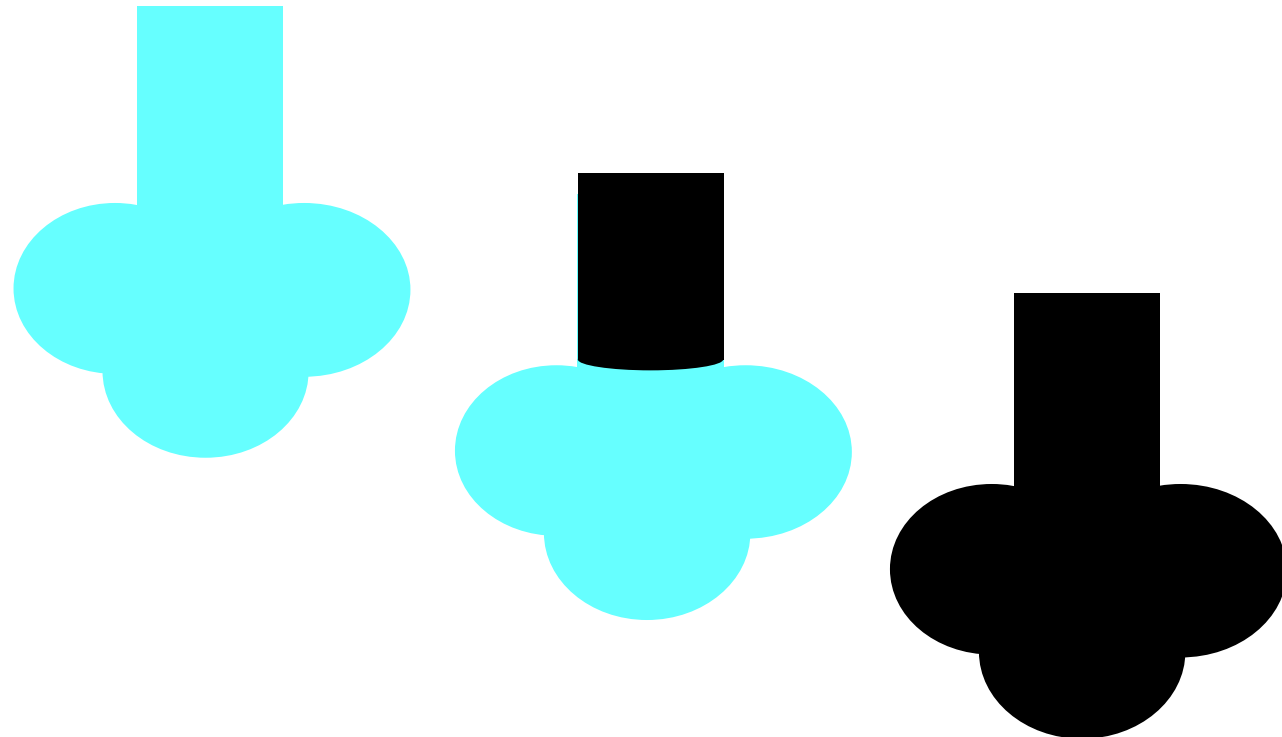
Fetal Circulation



Post natal circulatory changes

- The lungs become the primary organs of respiration.
- The lung blood vessels respond to the increase in the oxygen content of the blood by dilating.
- This encourages blood to flow to the lungs.
- The increased oxygen content of the blood encourages the heart ducts to close and so the pattern of *neonatal circulation* is established. (Askin, 2009;

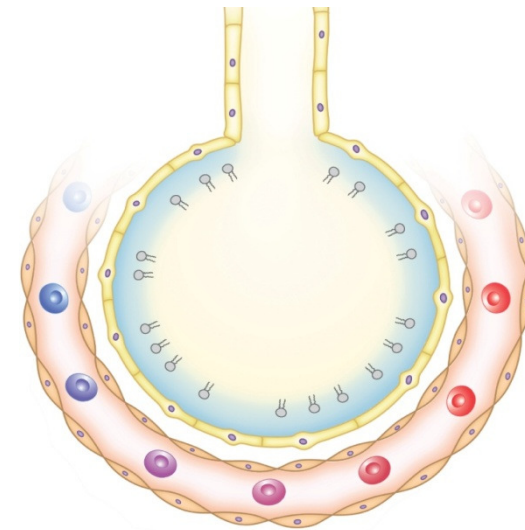
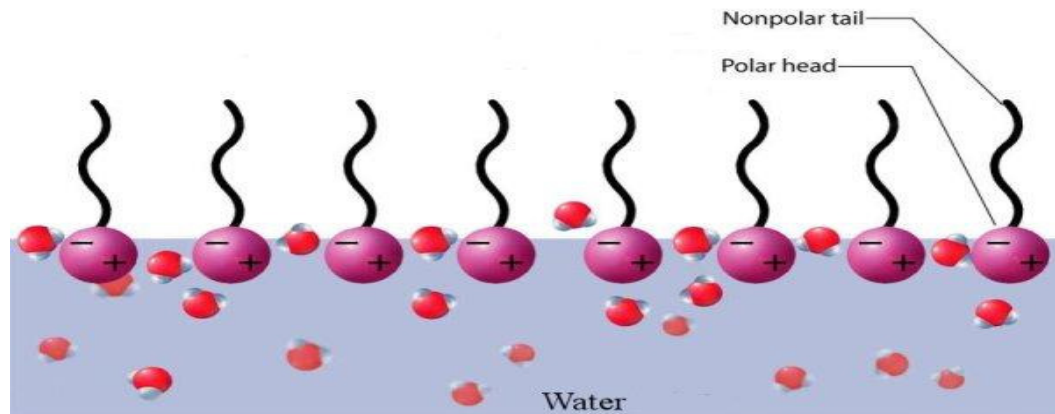
Normal changes at birth: air replaces lung fluid as the newborn takes their first breaths



This newborn has taken his first breaths and is crying vigorously. He has gone straight to be held by his mother and his colour is improving as he continues to cry and breath



Surfactant has been released into the newborns' lungs as depicted here at the air-fluid interface on the surface of the alveoli, opening these up and reducing surface tension. Lung fluid has been absorbed.



This newborn has just been delivered and even before the cord is cut, she is crying, centrally pink. She is wet and is yet to be dried which has implications for thermoregulation



Again, this newborn has taken his first breaths and successful transition has occurred. He looks cyanosed but with good skin to skin contact will be kept warm and colour should improve.



Here, the same newborn baby has improved colour wise and remains on the mother's chest



Thermal regulatory changes

- Once the baby is born, they have to achieve thermal stability independently.
- At birth, the intrauterine heat reservoir and heat exchange through the placenta is lost.
- They must adapt to this new environment by a process known as non shivering thermogenesis.
- In healthy newborns, it is important to keep them warm and dry straight from delivery.
- However, if a newborn is allowed to become cold then the brown fat stores will deplete and the newborn will become hypoxic and hypoglycaemic.
- (Waldron and MacKinnon, 2007)

Glucose homeostasis changes.

- At birth, the baby has to switch from obtaining glucose from the mother via the placenta to independent glucose production.
- Birth results in the newborn's blood glucose levels falling. (Platt and Deshpande, 2005)
- Provided a term baby is kept warm and fed within the first few hours of birth, they should be able to control their own blood glucose as they mount protective responses to falls in blood sugar and increased availability of alternative substrate or fuel for the brain if glucose is low (Hawdon, 2005; Petty, 2010)

Fluid Balance changes:

- In fetal life, there is interplay between the urine, amniotic fluid and lung fluid production to maintain adequate fluid balance and lung tissue growth.
- Fluid balance undergoes significant postnatal adaptive changes at birth.
- All newborns undergo extra-cellular fluid contraction after delivery and neonates will lost up to 10% of their birth weight.

SUMMARY

- Overall, thermal and glucose homeostasis together with the ability to breathe normally without assistance are critical physiological functions that are closely interrelated (Aylott, 2006 a and b; Askin, 2009).
- A change or difficulty in one of these variables affects the other-The 'Metabolic Triangle' Aylott, 2005
- For more detail and resources, go to the online resource.... Unit 2C (normal) and 3C (problems with adaptation).....
- http://www.cetl.org.uk/learning/neonatal/unit_2c/player.html
- http://www.cetl.org.uk/learning/neonatal/unit_3c/player.html

Further Reading

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- Aylott, M. (2006a) The Neonatal energy triangle part 1; Metabolic adaptation. *Paediatric Nursing*. 18(6):38-42.
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- Hawdon JM (2005) Blood Glucose levels in infancy- clinical significance and accurate measurement *Infant*, 2, 2, 24-27. http://www.neonatal-nursing.co.uk/pdf/inf_001_bgl.pdf
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- Platt, M. W. and Deshpande, S. (2005) Metabolic adaptation at birth. *Seminars in Fetal and Neonatal Medicine*. 10(4):341-350
- Waldron S and MacKinnon R (2007) Neonatal thermoregulation *Infant* 3, 3, 101-104. http://www.infantgrapevine.co.uk/pdf/inf_015_nor.pdf
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- <http://www.frca.co.uk/Documents/Foetal%20circulation.pdf>
- <http://www.studentmidwife.net/educational-resources-35/midwifery-glossary-and-definition-terms-41/3464-fetal-circulation.html>