



Neonatal Thermoregulation

Julia Petty

Neonatal Physiology

- **Neonatal physiology predisposes to poor thermal control**
- Wet skin at birth and high surface area to body ratio – lost heat via skin surface.
- Immature hypothalamus
- Lack of subcutaneous fat (term) and/or adipose tissue or brown fat (preterm)
- Poor energy stores and limited brown fat = limited thermogenesis (heat production)

Neutral thermal environment (NTE)

- ❖ NTE – is the optimum environmental temperature to ensure the lowest oxygen and energy expenditure (Merenstein & Gardner, 2006)
- ❖ The neonate may have to cope with either of two extremes – ‘THERMAL STRESS’
- ❖ Excessive HEAT LOSS or excessive HEAT GAIN, both of which are stressors.
- ❖ Sherman et al, 2006; Bissinger & Annibale, 2010

Methods of heat loss

- ❖ EVAPORATION – heat loss through wet skin
- ❖ CONVECTION – heat loss from cooler air circulating around warmer skin particularly when exposed
- ❖ CONDUCTION – heat loss through direct contact with a cold surface (e.g. scales, unwarmed mattress)
- ❖ RADIATION – heat loss from heat radiating towards a cooler surface (e.g. a cold window, wall or incubator wall)

This baby will lose heat by evaporation through a wet skin after birth. Drying and wrapping OR skin to skin contact plus a hat is required



This baby is exposed so may lost heat via conductive air currents particularly if the room is cool

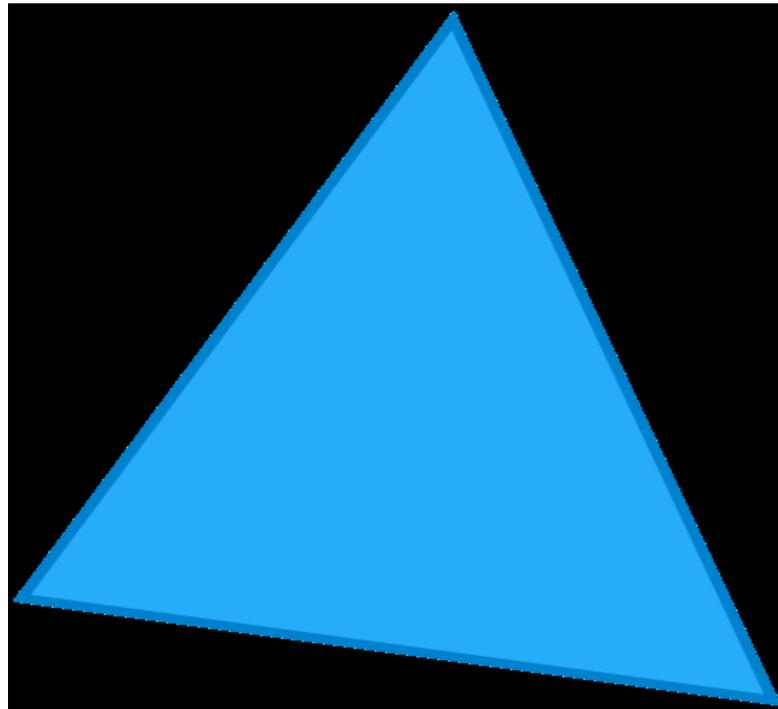


This baby may lose heat by both convection and conduction via direct contact with cool scales



The Metabolic triangle (Aylott, 2005 a&b)

- There is an important relationship between maintaining adequate oxygenation, temperature and blood glucose levels. A change in one affects the other.



Effects of Cold

- Decreased Surfactant efficiency
- Increased oxygen consumption – respiratory distress
- Increased utilisation of calorie reserves - hypoglycaemia
- Increased postnatal weight loss

Thermal care

- Monitor temperature & observe for instability
- Methods to keep baby warm / prevent heat loss – skin-to-skin contact, cover/wrap, hats, plastic wrapping for preterm neonates in delivery suite and then humidification
- Maintain the neutral thermal environment
- Incubator / Babytherm / Cot ?
- Sinclair et al, 2009; Allen, 2011

Prevention of hypothermia

Prevention of hypothermia

Sources of heat loss	Preventive measures
Conduction	Warming blanket Drapes or blankets Head covering Warmed solutions
Convection	Room temperature to 26.6°C (80°F) Incubator Keep neonate covered
Radiation	Radiant warmer Wrap neonate Warm room
Evaporation	Heated, humidified inspired gases AND body humidification Plastic bags / wrap for preterm (<28-30 weeks)- (Resus Council 2010)

Wearing a hat is important as significant heat may be lost through the head



Image Source: © Darren Brode (Photographer) | Dreamstime.com

Skin to skin contact so that baby can gain conductive heat from the mother. Early breast feeding can also commence



Pre-warm the incubator, if required, to the optimum NTE temperature. Humidity can be added for preterm neonates



Neonates born preterm are placed into plastic wrapping / bag at delivery until they are placed into a humidified incubator



Image with permission of the UK Resus Council

If attention is required at delivery, the radiant warmer on the resuscitator should be pre-warmed



Further reading

- Allen, K. (2011) Neonatal thermal care: A discussion of two incubator modes for optimising thermoregulation. A care study. *Journal of Neonatal Nursing*. 17, 2; 43-48
- Aylott, M. (2006a) The Neonatal energy triangle part 1; Metabolic adaptation. *Paediatric Nursing*. 18, 6, 38-42.
- Aylott, M. (2006b) The Neonatal energy triangle part 2; Thermoregulatory and respiratory *adaptation* *Paediatric Nursing*. 18, 7, 38-43
- Bissinger, R., & Annibale, D. (2010) Thermoregulation in Very Low-Birth-Weight Infants During the Golden Hour Results and Implications. *Advances in Neonatal Care*. 10, 5, 230-238
- British Association of Perinatal Medicine (2005) *Early care of the newborn infant. Statement on current level of evidence*
http://www.bapm.org/publications/documents/guidelines/RDS_position-statement.pdf
- Bredemeyer, S., Reid, S., & Wallace, M. (2005) Thermal management for premature births. *Journal of Advanced Nursing*. 52, 5, 482–489.
- Kent, A., & Williams, J. (2008) Increasing ambient operating theatre temperature and wrapping in polyethylene improves admission temperature in premature infants. *Journal of Paediatrics and Child Health*. 44, 325–331.
- Knobel, R. & Holditch-Davis, D. (2007) Thermoregulation and Heat Loss Prevention After Birth and During Neonatal Intensive-Care Unit Stabilization of Extremely Low-Birthweight Infants. *Journal of Obstetric, Gynecologic, & Neonatal Nursing*. 36, 3, 280-287.
- Laptok, A., Salhab, W., Bhaskar, B., & Neonatal Research Network (2007) Admission Temperature of Low Birth Weight Infants: Predictors and Associated Morbidities. *Pediatrics*. 119, 3, 643-649.

Continued...

- Laroia, N., Phelps, D., & Roy, J. (2007) Double wall versus single wall incubator for reducing heat loss in very low birth weight infants in incubators. *Cochrane Database of Systematic Reviews* 2007, Issue 2. Art. No.: CD004215. DOI: 10.1002/14651858.CD004215.pub2.
- McCall, E., Alderdice, F., Halliday, H., Jenkins, J., & Vohra, S. (2010) Interventions to prevent hypothermia at birth in preterm and/or low birthweight infants. *Cochrane Database of Systematic Reviews*, Issue 3. Art. No.: CD004210. DOI:10.1002/ 14651858.
- Merenstein, G. & Gardner, S. (eds) (2006) *Handbook of Neonatal Intensive Care*. 6th ed. London: Mosby.
- New, K., Flenady, V., & Davies, M. (2008) Transfer of preterm infants from incubator to open cot at lower versus higher body weight. *Cochrane Database of Systematic Reviews*, Issue 1. Art. No.: CD004214. DOI: 10.1002/14651858.
- Sherman, T.I., Greenspan, J.S., St Clair, N., Touch, S.M. & Shaffer, T.H. (2006) Optimizing the Neonatal Thermal Environment *Neonatal Network* 25,4, 251`-260
- Sinclair, L., Crisp, J. and Sinn, J. (2009), Variability in incubator humidity practices in the management of preterm infants. *Journal of Paediatrics and Child Health*, 45: 535–540. doi: 10.1111/j.1440-1754.2009.01555.x