Neonatal Physiology

Normal respiratory rate in dogs and cats occurs at approximately 1 week of age. During the period from birth to 1 week, the respiratory rate is increased. Respiratory system innervation is complete by 14 days of age. Parasympathetic innervation of the cardiovascular system is mature at birth while sympathetic innervation develops over the first 2 weeks of life and reaches maturity at 14 days in dogs and 11 days in cats. The baroreceptor reflex is active as early as 4 days of age.

Neonates are much more susceptible to hypoxemia due to a larger metabolic oxygen requirement, resulting in a compensatory increase in tidal volume and respiratory rate. Neonates have increased chest wall compliance. The work of moving the neonatal diaphragm is greater and so is the need to generate increased negative pressure which results in respiratory depression that shortens the inspiratory phase.

Gastrointestinal motility in neonates is decreased until approximately 40 days of age. Metabolism and excretion of drugs depends on liver and kidney function. Cytochrome P-450 activity is approximately 85% of that in an adult at 4 weeks of age. Hepatic metabolic activity is adequate by 5 to 8 weeks of age.

Plasma protein levels in neonates are decreased compared with adults. In particular, albumin levels are lower in young animals but reach parity with adult levels by 8 weeks of age. Protein-bound drugs administered to young animals have a higher fraction of unbound and thus active drug in their plasma.

The kidneys are functionally and morphologically immature at birth and continue to develop for 2 to 3 weeks after birth. Glomerular filtration rate (GFR) and renal plasma flow (RPF) are lower in the neonate than the adult. GFR and RPF increase as arterial blood pressure increases. Urine concentrating ability also matures at approximately 6 weeks of age.

Neonates able to feel pain from birth. Additionally, overproduction of peripheral sensory neurons increases the perception of pain neonates. Pain management strategies should take these factors into account. Additionally, analgesic drugs may not be metabolized at the same rate as in adults. Pain assessment may also be more difficult in these patients due to an unfamiliarity with neonatal behavior.

Neonatal Analgesia and Anesthesia

Determination of drug protocols in neonates should take into account their effects on the cardiovascular, respiratory, and nervous systems. The effects of drugs may be more profound in neonates due to their immature renal and hepatic systems, for example respiratory depression is more common in neonates, particularly following the administration of opioids. Drug-related side effects are also more common in the immature animal. Lower albumin levels may result in more unbound, thus more active circulating drug. Lower doses of anesthetic drugs may be used in neonates, though each patient should be assessed individually.

Anesthetic protocols should be determined on an individual basis. Care should be taken to maintain body temperature, normal glucose levels, and IV fluids should be administered only as necessary due to altered sodium excretion (decreased renal blood flow) and an relative increased likelihood to overhydrate on a ml/kg basis. Use of drugs that are reversible allows for a rapid return to consciousness or treatment of negative side effects (such as respiratory or cardiovascular depression) while allowing the drug to metabolized over a longer period of time.
**Geriatric Anesthesia and Analgesia**

Geriatric patients may have more concurrent medical problems and multi-systemic diseases. Age, in itself is not a disease. Older patients with no abnormalities on physical or laboratory examination should not necessarily be treated differently than a younger patient with similar physical examination findings. Anecdotally, older patients may seem easier to handle, tend to be less excitable, and may require lower doses of anesthetic drugs due to their overall calm demeanor. Choice of drugs in geriatric patients should be determined following using a holistic approach.

In the event of multi-systemic or concurrent disease processes, the anesthetic and analgesic protocol should be based on the diseases not the age of the animal.

**Reference**