Sleep Disordered Breathing in Infancy

- Characterized by intermittent partial or complete airway obstruction with resultant sleep disruption
- Blood oxygen saturation of less than 90% (SpO2) is not a normal finding in healthy infants
- A study of 35 healthy infants reported the mean SpO2 = 97.7% and the nadir SpO2 = 90.1% 
  Montgomery-Downs and Gozal 2006
- Only 11% of subjects desaturated below 90% during sleep, as measured by pulse oximetry in a cross-sectional study of healthy infants in the first 9 months after birth. 
  Horemuzova 2000
- Another study found 64 healthy term infants, during the first 6 months of life, to generally have a baseline SpO2 >95% during nocturnal sleep. 
  Hunt 1999
- Paucity of published data describing the oxygen profiles in infants with congenital anomalies including craniofacial abnormalities such as cleft palate. 
  Beresford 2004

CLEFT PALATE: SLEEP DISORDERED BREATHING

- Airway obstruction reporting in children with cleft palate (CP) has concentrated on the period following palatal repair and the impact of surgical technique upon subsequent airway compromise. 
  MacLean 2008, 2009
- Risk of SDB following CP repair is well established, but there is evidence emerging that severe SDB may also be found in infants before surgery. 
- Overall prevalence of symptoms suggestive of OSA in children with CP during early childhood is 30%. 
  MacLean 2009
- Suggested that sleep disturbance is under-reported, & therefore under-treated, in children with CP. 
  Munte 2008
- A questionnaire based study designed to explore the prevalence of symptoms of OSA in pre-school children with cleft palate has reported that only 30% of children with a questionnaire diagnosis of OSA had undergone previous sleep investigation. 
  MacLean 2009

- Reduction of airway size in children with CP means that they are at increased risk of SDB and OSA. 
  MacLean 2008, Inoue 2002
- Upper airway obstruction (UAO) in infants with isolated CP ranges from a potentially life threatening condition to intermittent partial airway collapse.
- Nasopharyngeal airways (NPA) are used in children with CP who exhibit UAO to prevent an airway occlusion resulting from prolapse of the base of tongue over the laryngeal inlet. 
  Boorman 1998
- The use of NPAs requires, expertise from the clinician when determining sizing and subsequent clinical benefit, parental training to manage and reinsert displaced NPAs at home. 
  Anderson 2007
- NPAs may not be tolerated by some children with moderate to minor airway occlusion.
WHAT ARE THE CONSEQUENCES OF SDB

- Obstructive events during sleep can lead to acute and chronic changes in BP and HR [MacLean 2009]
- Severe cases being associated with pulmonary hypertension and cor pulmonale [Horemuzova 2000]
- SDB can also have a significant deleterious effect on:
- In general, children with CP are at increased risk of impairment in 'learning, memory and cognition' [MacLean 2008]
- Studies in infants with PRS have reported an improvement following successful treatment of SDB, in feeding difficulty and subsequently weight gain [Lidsky 2008]

The effect of position on UAO in children

- Lateral positioning has been postulated as a simple therapeutic intervention to improve airway patency in children with OSA and those undergoing sedation
- Benefit of the lateral position on upper airway collapse has been demonstrated in children undergoing general anaesthesia
  - Arai 2004 - first reported that the lateral lying position combined with airway opening manoeuvres (chin lift and jaw thrust) significantly improved airway patency compared with airway opening manoeuvres alone for children in the supine position
  - Arai 2007 - a second study (n=20) demonstrated benefit to the airway from lateral positioning as opposed to the supine position, in a further group of children undergoing adenotonsillectomy for OSA
  - Arai 2005 - demonstrated the lateral position to improve airway patency endoscopically (and clinically) in a group of children (n=18) undergoing adenotonsillectomy

The effect of position on UAO in children

- Similar benefits to airway patency have been demonstrated in children undergoing sedation
  - Litman et al investigated the differing total upper airway volumes found in children, placed in the lateral and supine positions, whilst under sedation for planned MR imaging [Litman 2005]
  - Lateral positioning resulted in increased total upper airway volume measured using T1 axial scans in 16/17 children studied with the difference in mean volume between positions reaching statistical significance (p<0.001)

UK guidelines suggest that infants should sleep on their back to reduce the incidence of Sudden Infant Death Syndrome (SIDS). Pierre Robin Sequence is a notable exception to this advise due to the severity of UAO. However, all infants with CP may be at increased risk [http://www.lullabytrust.org.uk]

There is currently no clinical evidence to inform parents or clinicians of the optimum sleep position for infants with CP, and no evidence regarding the extent of UAO, resulting in variability in advice given by UK cleft lip and palate networks

Based on the clinical experience of Clinical Nurse Specialists working with this condition, some UK networks recommend ‘supine lying’ and others ‘side lying’ when positioning their infant for sleep.
In children with CP there is a tendency towards Eustachian tube dysfunction (ETD).

ETD can contribute to the development and persistence of negative middle ear pressure and the accumulation of mucoid or serous fluid within the middle ear space, i.e., OME.

Tendency to develop OME is greater, and persists for longer, in children with CP.

Approximately 75% of children with CP will have a history of non-trivial OME.

Approximately 2% of children with CP will develop cholesteatoma.

The consequences of persistent OME include:

- Increased tendency to develop ear infections (acute otitis media, AOM)
- Long-term middle ear problems (chronic otitis media, COM, cholesteatoma)
- Hearing loss, which can have a negative impact on speech and language development, communication, behaviour and educational attainment.

Impact is greater in CP as the risk of impairment in 'learning, memory and cognition' is already increased.

MacLean 2008

There are several approaches to the management of OME in children with cleft palate:

- Watchful waiting
- Conventional hearing aids (HA)
- Insertion of ventilation tubes (VT)
- Bone conduction hearing devices (BCHD)

Evidence underpinning decision making in children with CP unclear.

If the underlying tendency towards OME likely to last over 1 year, hearing aids may be a better option than VTs.

Children with CP can be expected to outgrow OME, but it may last into adolescence. [cf. approx. 1% incidence in 11 year olds without medical conditions]

In general, when considering which intervention is the most appropriate, consideration must be given to several key factors, including:

1. Is the OME associated with significant retraction of the tympanic membrane (TM). Retraction of the TM may be associated with the development of chronic ear disease, and although strong evidence of efficacy is currently lacking, many clinicians will advocate the use of VTs in this scenario.

2. Likely compliance with the treatment. This is more important when HAs are being considered. It is felt that HAs are more likely to be acceptable to the child when they are younger (nursery or pre-school), with acceptability and compliance decreasing during primary school years.

3. The age of the child and co-morbidities associated with the tendency towards OME lasting longer.
DECISION MAKING IN OME

2 illustrative examples of children who may not have ‘out-grown’ the tendency towards OME by the time a ventilation tube extrudes, and may be better served by HAs:

a. A 2-year-old child with no other health needs and no ear infections, may avoid repeated VT insertions under general anaesthesia

b. A 6-year-old child with a repaired cleft palate may be better served by HAs, as Eustachian tube dysfunction (ETD) often persists into adolescence

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