

# SIDS (cot death) and positional asphyxia

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**U**nexpected, infant deaths have been happening since recorded history. They are sudden, catastrophic events.

Their epidemiology is remarkably consistent.

- **AGE:** The age of the baby is rarely more than six months. Deaths peaks at two months.
- **SLEEP:** Babies are found dead after a period of sleep. They are not seen to die.
- **SILENT DEATH:** There is no noise to wake an adult, even when mother and baby are sharing a bed. So we presume they are unable to cry or make a sound.
- **HEALTHY:** There has not been an illness sufficient for parents to fear a fatality. Most often the baby is described as having been 'perfectly healthy'.
- **AUTOPSY:** This shows signs of an asphyxial death - oedema of the lungs, petechial haemorrhages on the intrathoracic organ surfaces, fluid blood in the heart.
- **SLEEP POSITION:** Deaths are most common for babies who were put to sleep on their fronts - or who have turned to that position. Next most at risk are babies who have been sharing a bed with an adult, usually the mother, but sometimes a sibling or others. These bed sharers feel perfectly well when they awake.

## Sudden Death can be:

1. Cerebral: Bleeding or head injury.
2. Cardiac: Heart muscle failure to send blood to the brain. May be a primary heart defect, or the heart may fail because of failure of lung action to oxygenate heart muscle.
3. Respiratory:
  - a) 'Rebreathing'. This is using up all the oxygen in a confined space, as when the baby gets thin plastic over its face

b) No chest movement. (The infant may be held so tightly that the chest can't expand).

c) Airway obstruction. Air cannot get into the lungs although the chest is expanding strongly.

## Airway obstruction may be due to:

- i) Anatomical narrowing as in the Pierre Robin sequence with palatal cleft etc.

Micrognathic infants usually have reduced upper airways if their tongue size is normal - and this space is normally narrower at six weeks than at birth. Infection or allergy may increase mucosal thickening and thus compound narrowing.

- ii) Positional factors (positional asphyxia)

The infant anatomy of the head and spine is very different from that of an adult. The back of an adult head is usually in line with the shoulders and the buttocks. The infant has a large head, a quarter of the entire body length, and the back of the head - the occiput - protrudes well behind the spinal line which is almost straight. Thus when an infant is laid on its back on a hard surface the head is forced to flex forward if it cannot turn sideways.

The infant jaw is also very different from the adult. The lower jaw bone - the mandible - is almost flat and is loosely hung under the skull so that it can readily be pushed backwards and upwards under the upper jaw and skull. The ear drum is actually on the surface of the skull. Since the infant's large tongue is situated within in the jaw it moves backwards with jaw movements and when the jaw is pushed back the tongue may cause complete blockage of the upper airway behind the soft palate and below it. In this situation the baby would be unable to breathe air into the lungs - or to cry.

## Causes of airway positional obstruction:

### Imposed by outside agencies

Thus upper airway obstruction may be imposed by outside forces as when the baby is held in an over-flexed position, or when the jaw itself is forced back - for example during carrying, or when winding a sleeping baby over a shoulder, or when feeding a baby.

## "The infant anatomy is very different from that of an adult"

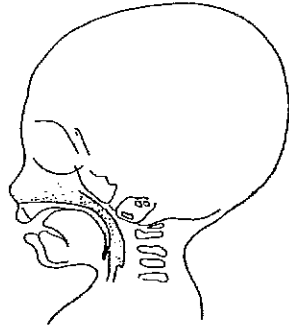
### Self-imposed

Airway obstruction may also occur because the baby's head just falls forward and the short neck allows the unstable chin to be pressed upon by the baby's own chest. In the muscle relaxation of sleep this chest pressure on the chin (jaw) can, in turn, push the tongue back onto the soft palate and any space below it. This displacement of tongue and palate can entirely block the upper airway. Some baby-holding devices wherein the baby is held semi-upright - as in car seats - may also be dangerous when the baby falls asleep if the head can then drop forwards. Co-sleeping deaths also can be explained as being due to 'positional asphyxia'. They are unexpected, silent, occur during sleep, and at autopsy signs of asphyxia are present.

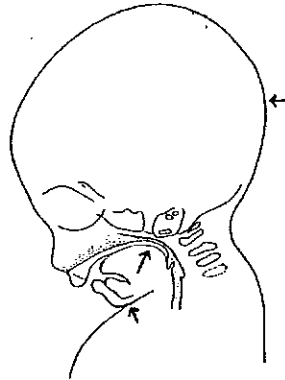
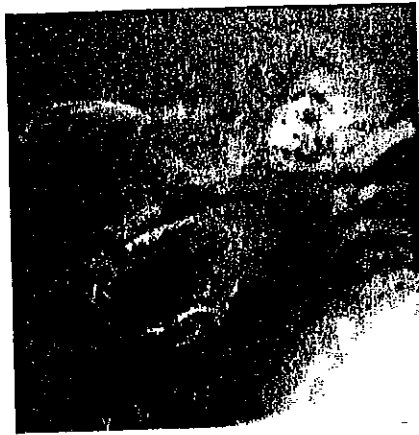
## Why do deaths occur only during sleep?

The muscle relaxation of sleep would facilitate asphyxia in all these circumstances - especially the selective pharyngeal muscle complete relaxation of REM Sleep which is not present in Quiet Sleep. It should be noted that the complete blockage of air flow is not needed for the heart muscle to fail from insufficient oxygen.

## SIDS head positions



1. Radiograph of a six-week-old 'ALTE' baby with the head in the Frankfort plane (lower margin of the eye socket and external auditory meatus at 90 degrees to the spinal axis). The baby has a normal upper airway space. He has a prominent occiput (back of head). The line drawings emphasise his normality.



2. Radiograph of the same baby after his mother has gently raised the back of his head so that now the back of his head is in line with his spine and now his chin is pressed onto his chest. (The mother said the head would go a lot further forward!) It can be seen how the jaw has been displaced backwards and upwards carrying the tongue into the pharynx and narrowing the upper airway. (This baby was lying on his back when the inspiratory radiographs were taken but it is easier to appreciate the contrasts when the films are held upright).

### Age of SIDS deaths: why the narrow age range of deaths?

As a baby ages the tempero-mandibular joint stabilises, and can no longer be so displaced during sleep. The jaw grows downwards as space is made for the erupting teeth in the mouth. This creates space over the tongue allowing easy mouth breathing (previously it was usually possible only during stress, crying or gasping) and allowing the beginning of speech, as the oral muscles let the baby modify the passage of air through the mouth. This usually happens at about five to six or seven months of age.

**"Preterm babies are well known to have oxygenation problems when placed in car seats for the journey home."**

### Evidence for this hypothesis

Studies have been carried out on 'ALTE' babies. These used to be called 'near misses' and were babies who had been found not breathing, grey or white and were able to be restored to normality by caregivers. Such babies usually showed evidence of their hypoxia by their electrolytes. They were of the same age as SIDS babies (under six months) and when the circumstances of the event were obtained, many parents confirmed histories of possible positional asphyxia. Radiographs of such a baby who became cyanosed when being carried by a sibling - who had one hand under his head and the other under his napkin - are reproduced in figures 1 and 2. These figures show how his airway was narrowed when his head was bent onto his own chest and that, in turn, pushed his jaw and tongue backwards and upwards to narrow and impede his upper airway.

Studies were also carried out on premature babies restrained in a car seat. Preterm babies are well known to have oxygenation problems when placed in car seats for the journey home. These babies were studied in two positions - with the body in the usual flexed position and the head pushed more forwards by the back of the car seat, and secondly with a modification to the seat to allow the baby's head to move back to assume its normal relationship to the rest of the body.

This study recorded simultaneous inspiratory upper airway radiographs and polygraphs of heart and lung function, nasal airflow and body oxygenation. Of the 17 babies studied 14 had narrowed airways when their heads were flexed forwards during sleep. This narrowing was usually accompanied by abnormal polygraphic tracings with many severe hypoxic episodes.