Apparently life threatening events in infant car safety seats

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Young infants should not be left unattended to sleep in standard car safety seats

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Infant car safety seats are vital to protect young infants from injury and death in motor vehicle accidents.[1] Preterm infants and term infants with pre-existing health conditions are at risk of oxygen desaturation and secondary central apnoea while they are restrained in recommended semi-reclining infant car seats.[2 3] Recent studies have shown that mild oxygen desaturation can affect some full term infants,[4 5] although others found no effect on average saturation.[6] None of these studies reported overt apnoea or bradycardia in full term infants during these mild events, but according to anecdotal reports term infants as well as preterm infants have died while in semi-reclined car safety seats.[7 8]

To further investigate whether or under what circumstances these observations translate to a real risk for healthy full term infants, we prospectively examined all infants referred to the Auckland Cot Monitoring Service after an apparently life threatening event in early infancy.

Case reports

In the 18 months between July 1999 and December 2000 a total of 43 infants were referred to the service for evaluation after apparently life threatening events and were examined by one of the authors (SLT). All infants had been seen on one or more occasions to develop cyanosis or to turn pale, and the caregivers thought the infants were not breathing. Nine infants had been restrained in a car safety seat appropriate for their age; all but one seat was rear facing and semi-reclining.

The histories of these infants were evaluated for speed of onset, previous events, and potential contributory factors including mother's smoking and previous respiratory or gastrointestimal problems (such as reflux). The infants were closely examined for evidence of anatomical abnormalities of the face and upper airway.

The median age at presentation of the nine infants was 5 weeks (range 3 days to 6 months); their mean birth weight was 3149 (SD 1085) g (details of seven cases are given in the table). One infant was preterm; the remainder were term infants with normal growth. Five of the mothers were smokers. One of the infants was referred by a general practitioner and eight had been admitted to the Auckland Children's Hospital and were referred after inpatient investigation. Resuscitation is described in the table. All caregivers had been sufficiently alarmed to seek medical help. Four of the nine infants were reported to be "limp and less responsive" for some hours after the event. None of the full term infants had had any known medical complications, and no infants had any previous symptoms; all infants were completely normal on examination, with normal jaw size and no evidence of laryngomalacia or other airway problem. In all cases the event had occurred with no apparent warning. In case 7, the infant was in a rear facing safety seat in the front passenger seat and had been watched by the mother before the event.

The scene was reconstructed, using the infant's own car seat, to establish the precise position of the infant when the event occurred. In each infant the effect of this position on jaw position, colour, and breathing (rate and intercostal recession on inspiration) was documented. The position was maintained only long enough for the caregiver to recognise the beginning of the signs that had caused concern. When the infants, quietly awake, were placed in the position of the original episode, the infants' heads flexed forward, typically with the jaw pressed down on the chest, and this was associated with intercostal recession on inspiration in all cases.

Table 1 Characteristics of infants with apparently life threatening event

Case No	Sex	Birthweight (g)	Gestation (weeks)	Age at event (weeks)	Mother smoked	History	Resuscitation
1	Male	785	25	10	Yes	Found blue in car seat in kitchen	Picked up, artificial respiration*
2	Female	2320	37	5	No	Noticed very blue in car seat on floor at home, "scrunched up"	Picked up, artificial respiration*
3	Male	3660	39	5	Yes	Noticed to be blue in car seat on floor between mother and father	Picked up, shaken
4	Male	3690	39	2	No	Found to be blue in car seat, with "head forward"	Picked up, laid flat, shaken
5	Female	3400	40	0.4	Yes	Found "not breathing" and blue in car seat at home	Picked up, shaken, laid flat on lap
6	Female	4200	42	1	No	Found blue in car seat in home	Picked up, laid on knees, patted on back
7	Male	4080	41	3	No	Stopped breathing and went blue in car seat while mother was driving	Stopped car, picked up, patted on back

Two further cases were seen, but permission to publish could not be obtained as the families could not be traced.
*Mouth to mouth-and-nose breathing or mouth-to-nose.

All infants were followed up on apnoea monitors,[9] and the parents were given advice on appropriate positioning, including not leaving the infant for excessive periods in the car seat.[10] None of the infants had any further reported episodes of apnoea or cyanosis over the subsequent 12 months.

Discussion

Although additional, unreferred, cases of apparently life threatening episodes may have occurred, at the time of the study the Auckland Cot Monitoring Service was the only infant monitoring service in the Auckland Region, which has approximately 15 000 births each year. Eight of the cases were healthy, full term infants, suggesting that the episodes of mild oxygen desaturation reported in recent studies[4 5] can lead to clinically important consequences. All but one case occurred when the infants had been left in the car seats indoors, allowing them to fall asleep restrained in a relatively upright position.

The prevalence of leaving sleeping infants in car seats is not high: in the New Zealand cot death study, a nationwide case-control study of sudden infant death syndrome, 1.2% of control infants were sleeping in a car safety seat in the specified sleep time (matched to the times when cases were found) (EA Mitchell, personal communication). The increased incidence of oxygen desaturation in premature infants placed in semi-upright infant car seats compared with when they are lying in cribs or in supine "car beds"[2 3] has been shown to be associated with flexion of the head on the body and consequent marked narrowing of the upper airway.[3 11] Providing a gap behind the head for the occiput allows infants to avoid bending the head, with reduced frequency of episodes of desaturation.[3] Modifying car safety seats so that head flexion is unlikely could avoid the risk of apparently life threatening events.

We also noticed that infants' heads were bent when they were restrained in their car seats, placed on a flat table. The relatively large head and prominent occiput of many infants tended to promote flexion of the head. Several factors may have acted to increase the impact of this on respiration. The infants were very young, when head control is not well developed. They were reported to be asleep at the time of the events; the pharyngeal muscles relax during active sleep.[12] Half of the mothers in our study were smokers, and nicotine exposure could have reduced hypoxic arousal.[13] Repeated episodes of mild hypoxia may lead to an "habituation" effect, with failure to arouse to subsequent episodes.[14] Only two infants in this series had more than one documented episode, but unobserved episodes cannot be ruled out.

The study was conceived by SLT and AJG. SLT and SAV examined the infants; SAV performed radiographs of the airways; SLT undertook the scene reconstruction. LB reviewed polygraphic records of the infants. AJG wrote the first draft of the paper. SLT is guarantor.

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A patient who changed my life

A costly lesson

In India, patients pay for their prescriptions. Government employees can claim the cost back, but this is not the case for most self employed people or labouring classes who live on a day to day basis. In the first year of my postgraduate training in India, I was asked to help in the medical outpatient clinic. I gave a patient a prescription for antibiotics to deal with his urinary tract infection. Six hours later, I finished the clinic and went to the hospital canteen. I was surprised to see the same patient, with his wife and toddler, still in the hospital building. When I asked the reason for his staying, I was told, "It is very hot, and the heat burns the feet as we don't have the shoes. When the sun goes down, we will go, buy the medicines, and go home."

I suddenly realised that I had written a costly prescription for a patient who could ill afford it and who could put the money to better use. I therefore arranged a prescription from a pharmaceutical charity shop. The whole exercise took me an extra couple of hours, but when I went home for dinner (having missed my lunch), I had a sense of achievement.

I practised for another two years in India and always asked patients if their prescription costs were reimbursable by the government. I always carried the charity shop's prescriptions booklet, just in case. I don't know if I was able to help anyone to be able to walk without fear of burning their feet or having to worry about their evening meal after paying for a costly prescription, but, 16 years on, I can still see that patient and his family sitting in the hospital's waiting area, waiting for the sun to set.

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