Over heating in infancy

'The first great Mistake is that they think a new-born Infant cannot be kept too warm: from this Prejudice they load it and bind it with Flannels, Wrappers, Swathes, Stays, etc.' So wrote Dr William Cadogan in 1748 and the prejudice he noted has changed little over the years. It is folklore, especially among the less educated, that babies should always be wrapped up well so that they do not 'catch cold', and that they should be kept warm particularly when they are ill. But in temperate climates exposure to cold, although a hazard in the first few weeks of life, is today an uncommon cause of death or serious illness in older babies, for whom over zealous attempts to prevent it may well do more harm than cold itself.

Recognised ill effects

When a child is ill over heating adds to discomfort and contributes to loss of fluid and salt. Sometimes a febrile convulsion is provoked because parents have piled on extra blankets or taken their unwell child into bed with them. About 1 child in 30 will convulse with fever, but a surprising number of mothers are ignorant of this fact until they come upon their own convulsing child—a terrifying experience. Even if febrile convulsions seldom cause neurological damage they bring much disturbance and worry, and for the child with a pre-existing cerebral lesion fever may entail a special risk by triggering a seizure of damaging duration.

Over heating and encephalopathy

There have recently been suggestions that over heating may occasionally bring more serious hazards. In Newcastle,¹ in the winters of 1977-9, 5 babies aged from 3 to 8 months were seen with a catastrophic encephalopathy that resulted in death or severe brain damage. Extensive bacterial and viral studies were negative and no other cause for the illness was found. The one common factor was that all the babies had been unusually well wrapped or warmed during the night and it was suggested that their inability to dissipate the heat engendered by an incipient infection might have provoked heatstroke—of which all their clinical and pathological features were typical. There was also a distinctive lesion of the small gut epithelium not previously reported. Heatstroke in children has been described in India and in babies left in cars parked in the sun in the United States. Although

it may seem incredible that heatstroke could occur in the middle of a European winter, a similar observation was in fact made in France over 40 years ago.²

Many similar cases have probably occurred elsewhere and have attracted other diagnoses such as prolonged febrile convulsions, viral encephalitis, septicaemia, or Reye's syndrome. The Newcastle babies did not fit Reye's original description but criteria for the syndrome have since widened. Reye acknowledged that it might have several causes and in infants, over-heating may perhaps be one of these. Several cases in the National Childhood Encephalopathy Study that had been categorised as Reye's syndrome³ had a similar illness to the Newcastle babies, though details of clothing or heating were not usually recorded. Clarification may come from a current study of Reye's syndrome that inquires specifically about clothing and temperature in children under 1 year old. The recently reported⁴ syndrome of haemorrhage, shock, and encephalopathy also seems very similar to the illness of the Newcastle babies.

Over heating and cot deaths

It has also been suggested that over heating may be among the causes of cot death. Stanton *et al.*⁵ found a history of excessive clothing in 15 of 34 cot deaths and some of these infants had the distinctive changes in the small gut epithelium noted in the babies with encephalopathy. Bass⁶ investigated 4 instances of simultaneous cot death in twins and found over heating to be the outstanding common factor. Cot deaths are commonly preceded by mild infection and often the rectal temperature is still high several hours after death. The mode of death may be apnoea, cerebral ischaemia, or unobserved convulsions.

Sunderland and Emery⁷ point out the cross over in incidence of cot deaths and of febrile convulsions at about the age of 6 months. They suggest that 'thermolabile cerebral ischaemia' mediated by the vagus nerve may be the common mechanism and that the age of the infant determines which reaction occurs. Some cot deaths have been linked with malignant hyperpyrexia.⁸

Pathogenesis

It is striking that babies whose death or encephalopathy have been attributed to over heating have all

been in a narrow age band of between 2 and 10 months. This may be a period of potential thermoregulatory imbalance, as heat production in proportion to surface area reaches a maximum by about 5 months of age,⁹ while ability to lose heat by sweating seems to develop more slowly over the first year of life.¹⁰ In addition, older babies are better at throwing off their coverings when they feel too hot. Type and method of clothing are also relevant—synthetic materials are less permeable to sweat, and all-enveloping suits, sleeping bags, or tightly swaddled blankets prevent any circulation of air. If heat loss is entirely prevented, the temperature of a healthy resting adult rises by 1°C per hour: a faster rise is likely in a restless baby with an infection.

The degree and duration of over heating required to produce heatstroke have not been determined. Hyperpyrexia is arbitrarily defined as a temperature above 41°C, but many babies seen are hotter than this and come to no harm. With regard to duration, 30 minutes in a hot car was sufficient to cause heatstroke in 1 infant.¹¹ Other factors than temperature may also be pertinent. The baby's temperature when he is found may not be relevant since cooling will usually have occurred meanwhile, and contrary to traditional teaching, the presence of sweating does not preclude the diagnosis.

Implications

Although these suspicions are unproved, their implications are so important that they cannot be dismissed lightly. Here, possibly, may be a cause of death and brain damage that might largely be prevented by better education of parents, and regardless of the question of heatstroke, all mothers should at least be taught, before it happens, that over heating may cause convulsions. In infants with acute febrile encephalopathy, heatstroke should be included in the differential diagnosis and details of clothing and covering should be sought. If the child is still very hot he should be cooled urgently. Often the damage will already have been done,

but the outcome may possibly be improved by anticipation and early treatment of cerebral oedema, renal failure, and disseminated intravascular coagulation. If the baby dies, histological examination of the small gut may be informative—as it may also be in cot death.

We need to know more about how babies are normally clothed and covered in various sections of the community and whether those that are kept warmer have a higher incidence of convulsions, encephalopathy, and cot death. We also need to find more certain ways of diagnosing heatstroke in babies so that these suspicions may be established, or refuted, beyond doubt.

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C J BACON
Friarage Hospital,
Northallerton,
North Yorkshire DL6 1JG