

Vehicular Entrapment and Heat Stroke in Three children: Is it a Form of Child Neglect?

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Abstract:

The medical records of three children who were entrapped inside vehicles are reviewed and their outcome following the incidents were assessed in this report. The children developed heat stroke following the incidents and survived after several days in coma but with severe cognitive functions impairment. Two of the children were left with hyperactivity and attention deficit, while the third had active epilepsy.

Vehicular entrapment heat stroke is one of the preventable brain injuries in children. Several children get entrapped in cars or other vehicles yearly and survivors are left with significant brain damage. The usual cause for brain damage is heat stroke the lesson learned was to never leave children unattended in cars.

Therefore, it is essential to double check that doors are locked when leaving children unattended near vehicles.

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Introduction

Heat related brain injuries range from minor syndromes to life threatening emergencies. Over the years, the number of children suffering from heat-related illness has significantly increased. The National Association of Medical Examiners defines heat stroke as exposure to high temperatures and reasonable exclusion of other causes of hyperthermia.¹

Three types of situations can result in heat stroke. Firstly, intensive and prolonged exercise in hot and humid atmosphere or exposure of labourers/workers in hot climates. Secondly, seasonal heat wave exposures of old or handicapped people. Thirdly, when children are exposed to high temperature inside vehicles.² Children may also suffer damage to the brain as a result of infection leading to hyperthermia in familial dysautonomia.³ Heat stroke in children in the Gulf region should be common due to the prevailing hot conditions, fortunately there have not been many such reports.

Children suffer heat stroke due to unawareness of the consequences of leaving vehicles unlocked by the parents or care givers. Minor forms as well as severe types of such incidents leading to death may not be accounted for anywhere. The aim of this report is to increase the awareness of a preventable heat injury to brain in children as a result of vehicular entrapment.

Case reports

Case I: A 7 yrs old normal boy did not reach home after school. He was nowhere to be found. When the parents and school teachers looked for the child, he was found unconscious inside the school bus. The bus driver and supervisor were not aware of his presence

as he slept on the bus on the way back from school. He was inside the bus for approximately two hours. The boy was unconscious, dry and hot. He developed features of heat stroke resulting in multiorgan failure. He was managed in ICU and required ventilation for about 15 days.

After extubation, he had severe neurologic regression. He was aphasic with loss of vision and hearing. The EEG revealed a bihemispheric low voltage graph. MRI revealed bihemispheric damage in watershed distribution. The child recovered in three years. There was no physical residue but he was left with severe cognitive impairment and hyperactivity.

Case II: A 4 yrs normal child was admitted to the pediatric intensive care unit (PICU) at Sultan Qaboos University Hospital, after he was found unconscious inside a car. The father had left the car unlocked and the boy went inside and got trapped. It took several hours for the parents to find the child trapped inside the car. He was deeply comatose and was mechanically ventilated for four weeks. Except the brainstem, all brain functions were absent. Visual evoked potentials (VEP) were flat but brain stem auditory evoked potentials (BAEP) were present.

The EEG revealed very low amplitude graph. While MRI revealed bihemispheric (parietooccipital) damage in watershed distribution, (Fig. 1). Single photon emission computerized tomography (SPECT) study showed decreased perfusion in the regions of the brain observed on the MRI. Over two and half years, the boy's motor function fully returned but he was left with severe cognitive impairment, epilepsy and hyperactivity. He is currently on antiepileptic drugs and methylphenidate.

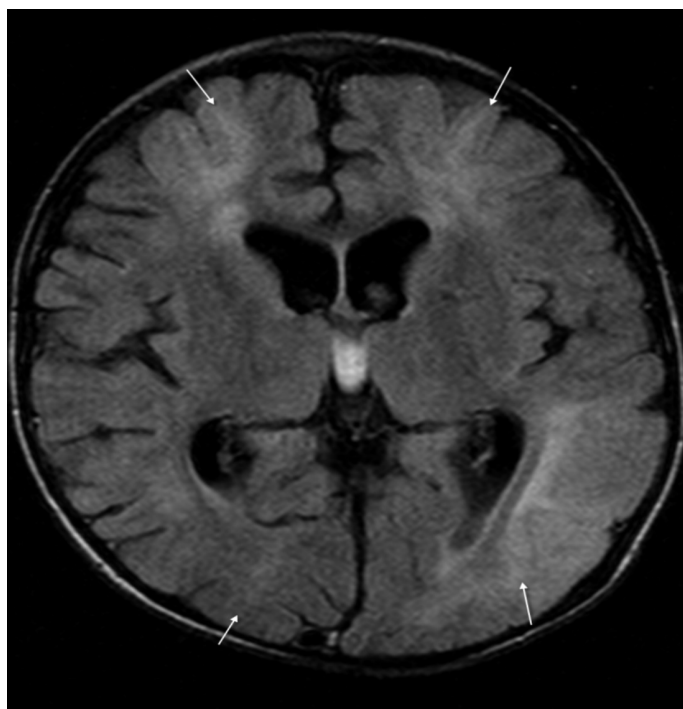


Figure 1: Axial FLAIR image at the level of the lateral ventricles demonstrating edema of the watershed zones in bilateral ACA-MCA and MCA-PCA territories in the frontal and parieto-occipital regions respectively (arrows). The changes are more pronounced on the left side.

Case III: A normal 3 yrs 9 months old child went to play with his cousins and after half an hour, the parents realized that he was missing. The parents found him one and half hours later in his father's car unconscious, excessively sweating and very warm to touch. The father recalled that he had forgotten to lock the remote operated car and the windows were closed.

Upon arrival to the local hospital, the boy had hyperthermia, bradycardia of 20/minute, Glasgow coma scale of 3/15 and severely acidotic with a pH of 6.4. He developed seizures (convulsive status epilepticus) and multiorgan failure. He required two weeks of mechanical ventilation, anticonvulsants (intravenous Phenobarbital and midazolam infusion) and intensive supportive care. The deranged liver and renal functions were normalized within 3-4 week.

CT scan of the brain showed subtle decreases in the density of the parieto-occipital and temporal regions on both sides. On neurological evaluation three weeks post heat stroke, the child was aphasic, had cortical blindness and only startled on loud sound. He continued to have choreathetosis and myoclonic seizures. There were bipyramidal signs, grade 3/5 power in extremities with exaggerated deep tendon reflexes and up going planters. The MRI

of the brain revealed high intensity areas on both sides of parietal and occipital regions on the left more than the right.

The brain SPECT showed decreased uptake in areas corresponding to the MRI lesions. BAEP was normal but VEP was absent on both sides. When VEP was repeated after three months, the waveform and latencies had returned and were normal. At present, the child has mild right side weakness and myoclonic seizures. He could recognize his parents and language is returning. He was on clonazepam for control of seizures. A repeat MRI of the brain revealed improvement in the previous lesions.

Discussion

Heat illness most seriously affects the poor urban dwellers, young children, those with chronic physical and mental illnesses, substance abusers, the elderly, and people who engage in excessive physical activity under harsh conditions.² A car becomes an oven when left in the open or shaded area at high temperatures. If the outside temperature is 93 degree F (33.9 °C), after 20 minutes, the inside temperature reaches 125 degree F (51.8 °C) and after 40 minutes it reaches 140 degree F (60 °C). A car parked in direct sunlight can reach 131 degree F (55 °C) to 171degree F (77.1°C) in 15 minutes.⁴ In 2003, 42 children died, of heat stroke, as a result of being left inside a vehicle.⁵

Leaving children unattended in or around vehicles is a serious problem and a form of neglect. More than 1000 cases involving injury or death have been documented so far from USA.⁶ Between 35 - 40% of victims aged 14 and under do not survive. There is an overall fatality rate of 20 - 25% of all victims after entrapment episodes. In France, two children died of heatstroke after fathers left them locked in cars due to tragic lapse in care. They went to work thinking the outside temperature was only 25°C.⁷ Meanwhile in the US a four year old boy died on his mother's wedding day after she left him locked in her car while she went for a manicure. The big day turned into a tragedy when she came out of the beauty salon 3 hours later to find her son, who she thought was at a relative's house, slumped inside her parked vehicle.⁷

The mechanism of heat stroke in two of our reported children was leaving car doors unlocked and the children getting access into them, without parents realizing the entrapment, and heat stroke occurring. This constitutes a form of unawareness of the parents that such serious brain injuries could develop. These three cases reported needed intensive care management and survived with residual brain damage.

On the other hand, there are reports of children having been found dead inside cars and never reached medical care.⁷ In our reported cases, the remote keys were contributory in two cases. The parents thought the cars were locked but actually were not.

A few car manufacturers have plans to equip family cars with infrared devices to detect heat and motion. When the detector senses a person inside, it will automatically unlock the trunk or raise alarm. Equipping cars with the device will add cost to the buyer. However, short of that precautions can save children. Such precautions include never leaving a vehicle unlocked. Never let children play in or around unlocked vehicles. Never leave a child in an unattended car, even with the windows down. Never leave children alone in a vehicle to run a quick errand.⁸ Also, another precaution is to prefer mechanical keys over remote keys.

Leaving children behind without knowing the consequences can be regarded as ignorance, but has to be considered child neglect in medico legal terms. In the first case, it was due to negligence of the bus supervisor not checking the school bus if all the children had alighted down the bus. In second and third cases, the parents had used automatic keys to lock the cars, which were actually not locked. This again is a form of child neglect, not manually checking that the car doors were locked properly. However, one could also assume that the parents did not realize the full capacity of the harm it could cause.

Conclusion

This report highlights the need to increase the public awareness that vehicles are lethal to children if left unlocked. Every effort should be made to lock cars properly. This should be highlighted in radio and television broadcasts as warnings for the common public.

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