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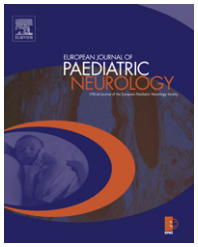

Invited papers presented at the EPNS 2011 Cavtat meeting

Cardiac arrest and post resuscitation of the brain

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ABSTRACT

Primary out-of-hospital cardiac arrest in childhood is rare but survival is a little better for children than for adults, although the prognosis for infants is very poor. Hypoxic-ischaemic encephalopathy after in-hospital cardiac arrest in children undergoing complicated treatment for previously untreatable conditions is now a common problem and is probably increasing. An additional ischaemic insult worsens the prognosis for other encephalopathies, such as that occurring after accidental or non-accidental head injury. For near-drowning, the prognosis is often good, provided that cardiopulmonary resuscitation (CPR) is commenced immediately, and the child gasps within 40 minutes of rescue and regains consciousness soon afterwards. The prognosis is much worse for the nearly drowned child admitted to casualty or the emergency room deeply unconscious with fixed dilated pupils, requiring continuing CPR and with an arterial pH <7, especially if there is little recovery by the time of admission to the intensive care unit. The use of adrenaline, sodium bicarbonate and calcium appears to worsen prognosis. Neurophysiology, specifically serial electroencephalography and evoked potentials, is the most useful tool prognostically, although neuroimaging and biomarkers may play a role. In a series of 89 patients studied after cardiac arrest in three London centres between 1982 and 1985, 39% recovered consciousness within one month. Twenty seven percent died a cardiac death whilst in coma, and the outcome in the remainder was either brain death or vegetative state. EEG and initial pH were the best predictors of outcome in this study. Seizures affected one third and were associated with deterioration and worse outcome. The advent of extracorporeal membrane oxygenation (ECMO) and the positive results of hypothermia trials in neonates and adults have rekindled interest in timely management of this important group of patients.

Contents

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1. Introduction

Unexpected cardiac arrest in a previously well child is uncommon,[1–4] but occurs in infants (sudden infant death syndrome),[5] occasionally during exercise or as a consequence of accidents such as trauma, near drowning, electrocution and strangulation. In a North American study, the incidence of paediatric out-of-hospital cardiac arrest was 8.04 per 100,000 person-years (72.71 in infants, 3.73 in children, and 6.37 in adolescents) versus 126.52 per 100,000 person-years for adults. Survival for all pediatric out-of-hospital cardiac arrest was 6.4% (3.3% for infants, 9.1% for children, and 8.9% for adolescents) versus 4.5% for adults ($P = 0.03$). In a Korean study, the incidence of paediatric out-of-hospital cardiac arrest was 4.2 per 100,000 person-years (67.1 in infants, 2.5 in children, and 3.5 in adolescents).[4] The improvement in the management of complex conditions in children means that in-hospital paediatric cardiopulmonary resuscitation is now commonplace in casualty, on the ward, in theatre and in intensive care.[6,7] Kirkham[10] studied 89 children with HIE presenting to three London hospitals between 1982 and 1985, only 4% of whom had suffered an out-of-hospital arrest. The underlying aetiology was cardiological in 72%, respiratory in 15% and neurological in 6%. If ventilation is available, the prognosis for in-patient paediatric cardiac arrest is better than for out-of-hospital resuscitations, with an overall hospital survival of 20.9% and 16.1% having favorable neurological outcomes in one study.[8] However, survival is unusual without ventilation.[9]

2. Specific causes of hypoxic-ischaemic encephalopathy

2.1. *Trauma*

Accidental and non-accidental traumatic brain injury is common; cardiorespiratory arrest may be secondary to the severity of the head injury, to haemorrhage from associated injuries or to brain stem or spinal cord damage and is a very poor prognostic sign.[11–15] In a recent series, 3/28 (11%) survived to hospital discharge, 2 with respiratory arrest neurologically intact; none survived if CPR was required for $>$ 20 mins.[11]

2.2. *Near drowning*

Even in water-oriented societies, immersion accidents are relatively rare (incidence 3–6 per 100,000,[16] but over half the children admitted to hospital survive[17,18] and they often require intensive management. The prognosis for the child pulled from the water apparently dead is excellent, provided