

Cardiopulmonary Resuscitation in Children Admitted to the Emergency Room Without a Pulse following Out-of-Hospital Cardiac Arrest: Too Little Too Late?

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Key words: cardiopulmonary resuscitation, cardiac arrest, emergency room, pediatrics

IMAJ 2000;2:692-694

Throughout my years of practice in the pediatric intensive care unit, I have seen countless changes in the protocols of drug administration – from low dose to high dose and vice versa, and sometimes as radical as from "first line" to "contraindicated." These wide fluctuations in the medication pendulum have not been reflected by any encouraging changes in the survival rate from cardiopulmonary resuscitation in children. In this issue of the journal, Broides et al. [1] present the results of a clinical study which yet again bespeak of a poor survival rate among children with out-of-hospital cardiac arrest [1]. Their discouraging message is that the administration of CPR in the emergency room to pediatric victims of out-of-hospital cardiac arrest is futile.

What can we learn from this pediatric resuscitation study with its exceptionally grim outcomes? I believe the lesson is twofold. The first concerns the need to return to basics and strengthen the "pediatric chain of survival." The second is the growing body of compelling and disturbing evidence of inferior medical care for Bedouins, one of Israel's indigenous minority groups. Their infant and child mortality rate is distinctly higher than that of the majority Jewish population, certainly an insupportable situation in a nation that prides itself on having an advanced health system that is mandated to serve all its citizens equally.

Weak links in the pediatric chain of survival

The chain

Modeled after the adult form, this is based on the concept that each link in the chain must be functional in order for the victim to survive cardiac arrest [2]. The pediatric chain of survival differs from the adult version by including prevention as a link and in delaying access until after a trial of early CPR. This difference is based on the greater likelihood of the etiology being associated with respiratory conditions and the lower likelihood of ventricular fibrillation in the pediatric patient compared with the adult.

The links in the pediatric chain of survival have a specific order: First is prevention, second is early CPR, third is access to, and fourth is administration of advanced life support [3]. By starting with "prevention," emphasis is placed on the role of injury in the etiology of out-of-hospital cardiac arrest. It should also include early recognition and treatment of respiratory distress, potential respiratory failure, and respiratory arrest. Respiratory conditions are the underlying cause of most pediatric cardiac arrests, and patient outcome is better when cardiopulmonary arrest is obviated by early treatment of the underlying respiratory disease. "Early CPR" is the second link in the pediatric chain and will most likely involve parents or child-care providers. The guidelines recommend that the single rescuer should provide CPR for one minute to the unresponsive non-breathing pediatric patient. "Access" is the possibility of calling emergency medical service providers for help in order to set in motion the provision of the fourth link, "advanced life support."

The milieu

From 60 to 70% of cardiac arrests occur outside the hospital [4]. It follows then, that one of the most important areas upon which to focus our attention is that of pre-hospital care for children. In a study of out-of-hospital children with CPA, Hickey et al. [5] demonstrated that patients not experiencing return of spontaneous circulation in the field were unlikely to survive. Overall, only 27% of their patients survived, and all but one of these had restoration of spontaneous circulation in the field. Only one of 33 patients who arrived in the emergency department in full CPA survived, and this patient was neurologically devastated.

A study by Kumar et al. [6] revealed the appalling fact that pediatric patients were significantly less likely to receive advanced life support interventions than matched adult cases of CPA, and that intravascular access was attempted in only 3% of the children who arrived to the

CPR = cardiopulmonary resuscitation

CPA = cardiopulmonary arrest

emergency services compared with 94% of the adults. Attempt at intubation was made in only 62% of the children versus 86% of the adults. This discrepancy is probably the fault of the difference in training and maintenance of the skills and knowledge necessary for pediatric CPA.

Bystanders – the real unsung heroes?

Bystander CPR is another important issue in pre-hospital care. Early initiation and effective performance of CPR by bystanders has been clearly proven to be beneficial to the survival and final outcome of cardiac arrest victims. Approximately one-third of pediatric arrests are witnessed, and one-third of these children receive bystander CPR. Bystander CPR is an important link in the chain of survival before more advanced interventions are available at the scene. This has been recognized worldwide, and CPR training programs for lay people have been organized in many countries. Studies of adults with out-of-hospital cardiac arrest have demonstrated improved survival rates among patients who receive bystander CPR before the arrival of emergency medical treatment. Few pediatric studies, however, have directly addressed the issue of bystander CPR. The investigation by Hickey et al. of children with out-of-hospital arrest showed that 32% of patients who received bystander CPR survived to discharge [5]. Thus, if we want to make real progress in improving the outcome of children with CPA, we are compelled to establish intensive training programs for pre-hospital care providers.

CPR – futile in pediatric out-of hospital cardiac arrest?

Broides et al. described the futility of CPR in patients with out-of-hospital cardiac arrest who arrive at the emergency room. This automatically raises the question whether resuscitation efforts should still be carried out in each of these patients without exception. The root of the word "futility" with its immutable failure and inherent frustration is derived from ancient mythology [7]. According to Ovid, the daughters of Danaus were condemned to draw water in leaky buckets from which the liquid would inevitably spill. If CPR is literally futile, then not attempting resuscitation is reasonable. However, given that most pediatric deaths in the emergency department are unexpected and tragic events, there is an almost atavistic reluctance to limit pediatric resuscitation to the pre-hospital setting. There are no definitive guidelines on how long or how aggressively pediatric CPA victims should be resuscitated, but some evidence has accumulated regarding the likelihood of a poor outcome with prolonged resuscitation efforts [8]. In contrast to adult patients in whom a cardiac dysrhythmia is often the precipitating event in an arrest, children usually have an arrest secondary to hypoxia. If the hypoxic insult has been of sufficient duration and severity to stop the heart, the severe anoxia suffered by the central nervous system often precludes a neurologic recovery except in the setting of

hypothermia. The duration of resuscitation in children after a cardiac arrest was assessed by Barzilay and colleagues [9], who found improved survival after out-of-hospital cardiac arrest if the duration of CPR was less than 5 minutes. Nichols et al. [10] reported this threshold to be 15 minutes, while Innes et al. [11] found no survivors if CPR lasted more than 30 minutes, and Schindler's group [12] reported no survivors if CPR lasted more than 20 minutes. Studies of adult cardiac arrest by Van der Hoeven et al. [8] and Gray et al. [13] suggested that patients who fail to respond to pre-hospital resuscitation efforts are also unlikely to respond in the emergency department. Thus, Van der Hoeven's team does not advocate transport to a medical facility and Gray et al. do not advocate continued resuscitation efforts in the emergency department. The American Heart Association Consensus Panel 1992 stated unequivocally that if the time from injury to access to the emergency medical treatment system is greater than 30 minutes, the efforts should be stopped [14].

The literature is fairly consistent in supporting the approach that resuscitation efforts for the survival of children with out-of-hospital cardiac arrest who arrive at the emergency department should be limited. We should bear in mind, however, that we may be able to support these patients for possible organ donations.

The social issue of discriminatory medical services

The second part of the lesson to be learned from Broides et al. is related to their finding that Bedouin children had a much higher risk of suffering out-of-hospital cardiac arrest than did Jewish children. Mortality rates among infants and children in industrialized nations declined throughout the twentieth century [15]. This decline stems from improved standards of living, a decrease in family size, availability of public health services, and modern individual medical care. However, not all members of a population have an equal share of these enhanced statistics. A growing body of compelling and disturbing evidence points to inferior medical care for minorities [16]. Even the risk of CPA is related to ethnicity. This is not a new finding: previous research has shown that ethnic child mortality differences are closely linked with economic inequality and with differential use of childhood health services [17]. In Israel, differences in access to treatment and quality of care are part of the reason why the death rate is higher in Bedouins than among Jews [18,19]. These results target the areas in which there is an urgent need for research and improvement: they include extending public knowledge and changing attitudes in the areas of nutrition, clean water, sewerage, immunization and individual health care.

Directions for the Future

We still have much to learn about CPR in children. We are all familiar with the harrowing possibilities that pediatric CPA may result from occult physical abuse, neglect or other

undisclosed factors – undisclosed because the child either cannot or is afraid to reveal them [20]. The controversy around sudden infant death syndrome has still not been put to rest.

Another special consideration is the ubiquitous respiratory/circulatory pathophysiological background of CPA in children, unlike sudden arrest characteristic among adults. Patients in pure respiratory arrest have a much better survival rate than those whose respiratory arrest degenerates into cardiac arrest [12]. The lesson here is clear.

The intense research that has been conducted over the past 40 years in the field of CPR has yielded only minor improvements in outcome of out-of-hospital cardiac arrest. We must be doing something wrong. As much as we delight in cutting-edge technology and state-of-the-art equipment, the answer may lie in the relatively "mundane" first link in the chain of survival for children, namely prevention. Perhaps we should take the homily "An ounce of prevention is worth a pound of cure" (*Henry de Brackton, circa 1240*) to heart, because we have barely so much as an ounce of cure to offer. Thus, research in the prevention of progression from the pre-arrest states to actual arrest may well be more beneficial than research in CPR itself.

The message by Broides et al. is sobering and the challenges are daunting, but let us not be accused of shirking our responsibilities by not continuing our search for answers. We need to know what procedures should be attempted by out-of-hospital rescuers, and if such attempts will result in improved outcomes. We need to delineate the optimal training and equipment specific to pediatric arrests. Finally, we must not limit ourselves to survival alone but extend our perspective to consider an improved neurologic outcome in order to ensure a good quality of life for the tens of decades yet to come in the life of a child.

Acknowledgement: The author thanks the staff of the Medical Library of the Sheba Medical Center for their continuing support in the preparation of this and many other manuscripts.

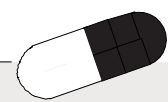
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Capsule



Fas(t) route to weight loss

The increasing recognition of obesity as a serious and costly public health problem has resulted in intensified efforts to understand the physiological mechanisms that regulate food intake and body weight. Loftus et al. have identified an unexpected link between appetite control and anabolic energy metabolism. Treatment of mice with a synthetic compound (C75) inhibited fatty acid synthase (FAS), an enzyme that catalyzes synthesis of long-chain

fatty acids under conditions of energy surplus, and led to rapid weight loss due primarily to inhibition of feeding. C75 was well tolerated by the mice and appeared to act in a leptin-independent manner by inhibition of neuropeptide Y in the hypothalamus.

Science 2000;288:2379