A case-based update: 2010 paediatric basic and advanced life-support guidelines

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In October 2010, the Heart and Stroke Foundation of Canada and the American Heart Association released new guidelines for cardiopulmonary resuscitation (CPR) (1,2) that were developed based on an extensive, evidence-based review of the resuscitation literature conducted by the International Liaison Committee on Resuscitation (3). The present article focuses on the highlights of the new paediatric guidelines. The neonatal guidelines are reviewed in a separate article in the current issue of *Paediatrics & Child Health* (pages 289-291). Access to the complete guidelines document and the International Liaison Committee on Resuscitation consensus on science and treatment recommendations is available online at http://heartandstroke.ca/CPRguidelines or http://circ.ahajournals.org/content/vol122/18_suppl_3/.

CASE 1: ASYSTOLIC CARDIAC ARREST (1-3)

A two-month-old girl presents to the emergency room with vomiting and dehydration. On assessment, the nurse determines that the infant is cyanotic and unresponsive. The infant is not breathing and has no pulse.

Compressions, airway, breathing: The new priority in initiating CPR

Previous CPR guidelines have recommended an airway, breathing, compression approach to victims of cardiac arrest. However, the 2010 guidelines recommend that rescuers start with chest compressions first. For in-hospital arrest, these roles can be performed by health care providers (HCPs) concurrently, with a focus on initiating chest compressions immediately, while another rescuer prepares to open the airway and provide ventilation. This approach avoids the delay in providing chest compressions that often occurs while rescuers set up and administer bag-mask ventilation. The recommended compression to ventilation ratio is unchanged at 30:2 for single-rescuer CPR and 15:2 for two-rescuer CPR. If an advanced airway is in place, compressions should be provided continuously (at least 100 compressions/min) without pausing for rescue breaths (eight ventilations/min to 10 ventilations/min).

What are the 2010 guidelines regarding the performance of chest compressions?

Chest compressions should be provided at an optimal compression depth of at least one-third of the anterior-posterior diameter of the chest, or approximately 4 cm in infants and 5 cm in children. Rescuers providing compressions should allow for full recoil, minimize interruptions, avoid excessive ventilation and rotate the compressor role every 2 min. Rescuers should allow for no more than a 5 s pause for compressor switches and limit pulse checks to a maximum of 10 s.

Is hands-only (compression-only) CPR appropriate for infants and children?

Paediatric cardiac arrest is primarily asphyxial in nature; therefore, ventilation is critical for the resuscitation of infants and children. Optimal CPR in infants and children includes both compressions and ventilations, which applies to both single-rescuer and two-rescuer CPR. However, early compressions have become the focus with compression-only CPR, which is preferable to no CPR at all.

CASE 2: VENTRICULAR FIBRILLATION (1-3)

An asymptomatic six-year-old boy with a family history of sudden death is being evaluated in the cardiology clinic. While visiting the hospital cafeteria, he suddenly collapses, becomes unresponsive and has only gasping respirations.

How should a rescuer decide whether CPR is necessary?

The 2010 guidelines have eliminated "look, listen and feel" as part of the CPR sequence. Lay rescuers should assess the victim for responsiveness and determine whether the patient is breathing normally. If the patient is unresponsive and apneic (or only gasping), the rescuer should initiate CPR immediately.

HCPs may additionally check for a pulse (brachial in an infant, and carotid or femoral in a child), but this may be unreliable. Therefore, a pulse check should be limited to no more than 10 s, and CPR should be initiated if no pulse is palpated or if the HCP is unsure of its presence.

Can automated external defibrillators be used for infants in cardiac arrest?

Automated external defibrillators (AEDs) can be used for infants and children. However, the recommended method of defibrillation for infants is manual defibrillation. If a manual defibrillator is not available, an AED with a paediatric dose attenuator is preferred (up to 25 kg or eight years of age). A standard adult AED without a dose attenuator can be used if this is not available.

What is the optimal shock dose for defibrillation?

The 2010 guidelines suggest an initial shock dose of 2 J/kg to 4 J/kg. Subsequent doses should be at least 4 J/kg, but should not exceed 10 J/kg.

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The patient is successfully resuscitated from the cardiac arrest event. Are there any postarrest care issues that need to be considered?

Hyperoxemia can be harmful because it enhances the oxidative injury during reperfusion (following ischemia). Postarrest, oxygen therapy should be titrated to maintain an oxygen saturation of between 94% and 99% as a saturation of 100% corresponds to a partial pressure of oxygen in arterial blood of between 80 mmHg and 500 mmHg. Therapeutic hypothermia at a temperature of 32°C to 34°C may be considered for children who remain comatose after resuscitation from cardiac arrest. Expert consultation should be considered to help guide this therapy.

CASE 3: WIDE-COMPLEX TACHYCARDIA (2,3)

A 10-year-old obese girl presents with a stable wide-complex tachycardia at 180 beats/min.

What is the appropriate next step in managing this patient?

The definition of wide-complex tachycardia has been changed to a QRS interval of greater than 0.09 s. Because this wide-complex rhythm can be ventricular or supraventricular in origin, adenosine can be used in stable patients to distinguish between the two. It should only be used for regular, monomorphic QRS rhythms and should be avoided if a patient with known Wolff-Parkinson-White syndrome presents with wide-complex tachycardia.

How should medication doses be calculated in obese children?

Doses for resuscitation medications in children should be based on the actual patient weight rather than the ideal body weight, up to the adult maximum. Length-based tapes with precalculated doses should be used if the weight is not known because they are more accurate than age-based or observer-based methods to predict the patient's weight.

CASE 4: SEPTIC SHOCK (2,3)

A previously healthy two-year-old boy presents to the emergency room with a four-day history of high fever and lethargy. On examination, the child is tachycardic, hypotensive and poorly responsive.

Which fluid is best for septic shock – colloid or crystalloid?

There are no clinically important differences in outcomes when comparing children in septic shock treated with colloid versus crystalloid fluid. The guidelines continue to recommend a rapid bolus (20 mL/kg) of crystalloid solution (eg, normal saline) as the initial choice for resuscitation fluid.

Should etomidate be used as the sedative during the rapid sequence intubation of a child in septic shock?

Etomidate is a sedative agent with minimal adverse hemodynamic effects. However, etomidate should not be used routinely in paediatric patients with suspected septic shock because adrenal suppression has been documented after its use in children and adults, and administration is associated with higher mortality rates.

What is the optimal endotracheal tube size?

Both cuffed or uncuffed tubes are acceptable for intubating infants and children. However, in certain settings, the use of cuffed endotracheal tubes may help to decrease the risk of aspiration and reduce the need for reintubation. For cuffed tubes, a 3.0 mm internal diameter (ID) tube should be used to intubate an infant younger than one year of age and a 3.5 mm ID tube should be used for patients one to two years of age. After two years of age, the cuffed tube size can be estimated using the following formula:

$$\text{Cuffed endotracheal tube ID (mm)} = 3.5 + (\text{age}/4)$$

For uncuffed tubes, select a tube size with an ID that is 0.5 mm larger than what is recommended for cuffed tubes for that age.

Is cricoid pressure recommended during intubation?

There is insufficient evidence to recommend the routine use of cricoid pressure to prevent aspiration during intubation because it may interfere with the speed or ease of intubation.

WHAT ELSE IS NEW IN THE GUIDELINES?

The new guidelines also provide management recommendations for infants and children with congenital heart disease (single-ventricle physiology and pulmonary hypertension), along with guidance on how to explore the potential cause of sudden, unexplained deaths. For details, refer to the complete guidelines document.

FUTURE DIRECTIONS: EDUCATION AND IMPLEMENTATION (1-4)

Out-of-hospital cardiac arrest survival remains poor. Bystander CPR is a major determinant of victim outcome but, unfortunately, most bystanders do not act, commonly citing panic or fear of harming the patient as their reason. CPR training may help overcome this problem and improve bystander response rates. Short 20 min to 30 min video-based self-instruction kits for basic life support (such as the Heart and Stroke Foundation of Canada's CPR Anytime Family & Friends kit) have demonstrated equivalent learning outcomes compared with longer instructor-led courses. This training format might be one method to increase the number of bystanders willing to respond, ultimately improving outcomes from cardiac arrest.

Survival from in-hospital cardiac arrests has improved dramatically over the past 25 years, but three-quarters of all in-hospital paediatric cardiac arrest victims still die. The etiology for most cardiac arrests in children remains asphyxial; thus, recognition of patients at risk and prevention of deterioration remains a priority. Medical emergency teams or rapid response teams can be considered as one method to improve in-hospital care. Before-and-after implementation studies of these teams suggest reduced respiratory and cardiac arrest incidence as well as reduced hospital mortality overall. Paediatric institutions require, at minimum, a continuous quality improvement process that systematically monitors cardiac arrests, resuscitation care and outcomes. The cycle of measurement, benchmarking, feedback and change is fundamental in narrowing the gap between ideal and actual performance.

Current resuscitation courses, such as paediatric advanced life support and the Neonatal Resuscitation Program, are adopting new educational methods in an attempt to improve long-term retention of knowledge and skills. Methods, such as team training with realistic patient simulators, debriefing with standardized scripts and video-based learning with a 'practice while watching' approach, may help to consolidate learning and, ultimately, lead to improved patient outcomes from cardiac arrest.

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