

of DNA transcription, thereby leading to maldevelopment, the potential exists that these mechanisms are targets of future preventive or therapeutic interventions.

DNA, we thought, was an iron-clad code that we and our children and their children had to live by. Now we can imagine a world in which we tinker with DNA, bend it to our will. It will take geneticists and ethicists many years to work out all the implications, but be assured: the age of epigenetics has arrived.

John Cloud, *Time*, January 2010.

References and further reading available at www.cmej.org.za

Defibrillation and cardioversion in children: demystifying the shock of shocking

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Health care practitioners looking after children are often uncomfortable about using direct current (DC) shock treatment on a child. This article emphasises practical points when using electrical shock therapy in children, but does not replace the value of attending an APLS course to gain hands-on experience.

The most common life-threatening dysrhythmias in children are non-shockable rhythms, mostly due to hypoxia. However, childhood shockable dysrhythmias cannot be considered as rare. These include ventricular fibrillation (VF), pulseless ventricular tachycardia (VT) and supraventricular tachycardia (SVT).

Recent reports indicate that as many as 25% of in-hospital cardiac arrests in children and 5 - 22% of out-of-hospital paediatric cardiac arrests are due to VF or pulseless VT. Shockable dysrhythmias are more likely to present in children with an underlying cardiac disease, or present as a sudden collapse.

Defibrillation

Defibrillation indicates a DC shock treatment aimed at depolarising a myocardium that

is not generating a co-ordinated, perfusing rhythm. Organised QRS complexes cannot be identified and the electrical current is delivered without synchronising with the patient's native rhythm. DC shock should not be delayed once a shockable rhythm is recognised. The longer the time delay the worse the outcome. CPR should continue while preparing the defibrillator. Care should be taken to clear all involved, and the oxygen should be cleared before discharging the current. CPR should resume (starting with compressions) immediately after the DC shock and continued for five cycles (2 minutes) before the next rhythm check.

Defibrillation energy dose

The optimal and safe defibrillation energy dose in children is unknown. The risk of myocardial damage when using higher electrical currents should be considered against using lower energy but wasting time before achieving a stable rhythm. The International Liaison Committee on Resuscitation recommends an initial dose of 2 J/kg, thereafter 4 J/kg. Evidence suggests that more than 4 J/kg (biphasic defibrillator) is effective and safe. Some defibrillators provide limited manual joule options. When dialling in the weight-based energy on the defibrillator, round the number *down* to the lower joule setting.

Modern defibrillators deliver biphasic shocks as opposed to monophasic shocks. Biphasic shocks are more effective and cause less myocardial damage. Biphasic currents are delivered in two phases: first a positive current in one direction and then a negative current from the opposite direction. Evidence in adults suggests a survival benefit in single shock versus stacked shocks.

Transthoracic impedance is the primary determinant of effective energy delivery. Measures to reduce the transthoracic impedance include: firm contact between the paddle and the chest, larger paddle size and electrolyte-containing gel.

Paddles and positions

Paediatric-sized paddles should be used in children under 1 year of age (<10 kg) and adult-sized paddles in those older than 1 year (>10 kg). One paddle should be below the right clavicle parallel to the sternum and the other parallel to the first paddle in the left axilla to optimise the energy transfer. Paddles should be applied firmly, parallel to each other, with at least a 3 kg force applied onto paddles for infants and a 5 kg force for children.

Defibrillation gel reduces the transthoracic impedance. KY jelly, sonar gel, alcohol- or saline-soaked gauze should *not* be used as alternatives. Take care that the gel does

not smear over the chest wall and cause potential arcing (i.e. the current flows over the chest between the paddles and not into the chest). DC shock should ideally be discharged on end-expiration to minimise impedance.

Larger paddles reduce impedance but risk arcing of the current if the paddles are too close. There should be at least 3 cm between the paddles. In the case of a small chest and large paddles, use the anterior-posterior paddle position to prevent arcing: one paddle is placed below the left scapula and the other parallel to the left of the sternum. It does not matter which paddle is placed in which position.

Cardioversion

The terms defibrillation and cardioversion are often wrongly used interchangeably. Cardioversion is applied to a myocardium with an abnormal rhythm that is able to generate a pulse, but insufficient for adequate perfusion. Defibrillation is used when there is no pulse or no perfusing rhythm. Cardioversion is used for patients with haemodynamic unstable SVT, VT (with a pulse), atrial fibrillation and atrial flutter.

The energy dose in cardioversion is less (0.5 - 2 J/kg) than in defibrillation (2 - 4 J/kg). In cardioversion the shock is discharged synchronously with the native R wave of the patient. Without synchronisation, VF can be induced if a shock is delivered during the refractory period of the cardiac cycle. The majority of defibrillators default to unsynchronised mode. It is therefore imperative to reset the synchronisation button before each discharge. Synchronisation with a broad complex VT can be difficult. Choose the lead with the best identifiable R waves. Synchronisation problems must be suspected when the defibrillator fails to discharge after pressing the shock button. In this case use unsynchronised cardioversion.

Children with congenital heart disease are now surviving into adulthood. Unfortunately cardiac surgery leaves atrial scars that may predispose the patient to dysrhythmias. Therefore life-threatening shockable dysrhythmias will be seen more often in the emergency setting. Healthcare practitioners should aim to deliver the first DC shock within 3 minutes after recognising the shockable arrhythmia.

Suggested reading available at www.cmej.org.za