

# Noninvasive pediatric pacing of children and infants

Bradycardia is the most common dysrhythmia in children and is usually secondary to hypoxic events. Although noninvasive pacing may be attempted, typically bradycardias of hypoxic etiology do not respond. First line therapy is prompt airway support, ventilation and oxygenation.

Although less frequent in occurrence, children and infants do experience heart blocks and bradycardias where treatment with noninvasive pacing is beneficial and could be lifesaving.<sup>1</sup>

Examples of conditions that may require pediatric noninvasive pacing are:

- bradycardias from surgically acquired AV blocks, congenital AV block
- viral myocarditis
- newborn complete heart block due to maternal lupus
- heart block secondary to toxin or drug overdose
- permanent pacemaker failure or lead wire fracture or epicardial pacing wire failure post cardiac surgery

Stand-by noninvasive pacing should be available during general anesthesia in patients with complete heart block, during pacemaker reprogramming, in the cardiac cath lab for potential AV block during anatomic study, and to treat bradycardia post electrical cardioversion of tachyarrhythmias.

## Noninvasive pacing procedure

As with any procedure, patient and family preparation is key to success. Before initiating the procedure, sedation should always be considered. The skeletal muscle contractions associated with noninvasive pacing, along with the discomfort associated with the procedure, is quite frightening to parents and child. Without sedation, patient cooperation can't be expected.

The landmarks for pacing electrode placement are the same for adults and children; however placement on a child is more challenging due to the limited size of the torso. Anterior/posterior is the most common pacing electrode placement. Anterior-lateral placement is also acceptable but will take up more space on an already crowded chest. In order to obtain a clear tracing on the monitor, ECG electrodes should be placed well away from the pacing electrodes. It may be even necessary to place the left and right arm monitoring electrodes on the back in order to get a clear tracing.

Pediatric pacing electrodes should be used in children who weigh less than 33 pounds. The larger "adult" size electrodes should be used as soon as they fit on a child's chest without overlap of the sternum, spine and diaphragm.

Capture thresholds in children are similar to those in adults. This may seem odd, given the much smaller size of children. Studies indicate no relationship between body surface area, weight, and capture thresholds and although most children will achieve capture between 50–100 mA,<sup>1</sup> higher current requirements are possible. The pacing rate must be set high enough to perfuse the patient.

## Potential complications/interventions

Burns have been reported in small children after noninvasive pacing.<sup>2</sup> Newborn skin is especially fragile and adult-like current passing through the smaller electrode surface produces relatively high current densities. Frequent inspections of the skin under the pacing electrodes should be done after 30 minutes of continuous pacing.

The skeletal muscle contraction associated with noninvasive pacing can be quite intense in the smaller child and can cause respiratory distress in infants and younger children. Ventilatory support should be available. If possible, position the electrode to avoid the diaphragm. The addition of neuromuscular blockers will eliminate the contractions and may be considered in intubated children.<sup>1</sup>

Although noninvasive pacing in adults has been well documented, the procedure has not been as well studied in children. One incident of ventricular tachycardia related to noninvasive pacing has been reported in the literature.<sup>3</sup> It involved a critically ill three year old boy in a state of cardiovascular collapse.

## Summary

Noninvasive pacing offers a rapid and effective way to institute ventricular pacing in children. It can be easily initiated by paramedics, nurses, and physicians. Smaller pediatric pacing electrodes make pacing of infants and small children possible. Although the effectiveness of noninvasive pacing in children is variable and the need is infrequent, the technique can be lifesaving in certain conditions.

Pediatric noninvasive pacing follows the same principle as adult pacing but special attention must be paid to the unique needs of infants and younger children.

#### References

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2. Pride H, McKinley D. "Third-degree burns from the use of an external cardiac pacing device." *Crit Care Med*. 1990;18:572-573.
3. Beland M, Hesslein P, Rowe R. "Ventricular tachycardia related to transcutaneous pacing." *Ann Emerg Med*. 1988;17:279-281.

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