Case Report

Percussion pacing in a three-year-old girl with complete heart block during cardiac catheterization

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Complete heart block frequently requires emergency pacing to restore systemic perfusion. We report the case of a 3-yr-old girl undergoing interventional atrial septal defect closure who suffered from transient complete heart block with circulatory arrest. Transthoracic mechanical pacing for more than 3 min provided temporary support, sustaining an adequate cardiac output until sinus rhythm resumed.


Keywords: anaesthesia, paediatric; complications, cardiac arrest; pacing, emergency; pacing, percussion

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Transcutaneous and transvenous electrical pacing modes are widely recognized as reliable emergency pacing techniques in bradyarrhythmic patients with critical systemic perfusion. Mechanical cardiac pacing, though easier and quicker to perform, seems to be less popular to most health care providers. In 1920 Schott published the case of a 60-yr-old woman in whom he successfully performed transthoracic mechanical pacing in complete atrioventricular (AV) block. Since then, several related case reports and series have followed, describing this technique as ‘percussion’ or ‘fist pacing’. However, to the best of our knowledge, this is the first successful reported use in a child.

Case report

In December 2002, a 3-yr-old girl (body weight 15 kg) with a large atrial septal defect of secundum type (ASD II) underwent interventional cardiac catheterization under general anaesthesia. During the procedure the occluder accidentally slipped off the small rim of the ASD and impacted in the right ventricular outflow tract. The device was retrieved with a snare catheter, but during withdrawal the septal leaflet of the tricuspid valve was injured. Subsequently complete heart block occurred with ventricular asystole (Fig. 1).

Transathoracic percussion pacing was commenced immediately by hitting the left lower edge of the sternum with the closed fist at a rate of approximately 80 beats min−1. This resulted in a succession of QRS complexes on the ECG (Fig. 2) which were associated with a clear plethysmographic signal on the pulse oximeter, indicating good mechanical coupling. Percussion-induced ventricular contractions were able to maintain an adequate cardiac output while atropine (0.3 mg) and epinephrine (0.15 mg) were administered i.v. Percussion pacing was continued for more than 3 min before complete heart block resolved and a sinus tachycardia ensued, providing haemodynamic stability. Later the same day the girl underwent surgical closure of the ASD and tricuspid valve repair. Repeated electrocardiograms during the following months showed no signs of residual AV block.

Discussion

Acute bradyarrhythmias can be associated with critical and compromised myocardial and cerebral perfusion. Compared with pharmacological treatment, electrical pacing of the heart has been shown to be both effective and safe. This applies particularly to arrhythmias which show a rather unpredictable response to drug intervention, such as complete heart block with or without ventricular escape rhythm. Apart from the well-established electrical pacing modes (transvenous, transcutaneous), percussion pacing has been described as a particularly quick and easy to perform emergency procedure. For obvious ethical reasons, no
prospective and controlled studies have been published on
this topic. Thus, all available data on percussion pacing
derive either from adult case reports or from a small number
of animal studies.

The physiology of percussion pacing is based on the phys-
ical phenomenon that the vital myocardium can respond to
a mechanical stimulus with an electrical impulse (electrical
coupling), visible as a broad QRS complex on ECG (Fig. 2).
However, more crucial is the association with a subsequent
myocardial contraction, capable of generating an appropri-
ate stroke volume. This mechanical coupling is clinically
well known from stimulation of the heart by surgical or
catheter manipulation. In the setting of percussion pacing,
a palpable central pulse, a good plethysmographic reading
on the pulse oximeter and regained consciousness in a
patient suffering a Stokes–Adams attack are regarded as
reasonable signs of adequate perfusion.

Although occasional reports have shown that a single
blow may terminate bradycardia, the majority of authors
recommend rhythmically performed percussion pacing at
a rate of 50–70 beats min⁻¹.²⁻⁵⁻⁸ Because of the complete
lack of paediatric data, it remains unclear whether a faster
rate would be advisable in children.

Compared with the technique of precordial thumping,
percussion pacing is applied with significantly less
mechanical energy. To judge the appropriate force, it has
been suggested to let the closed fist fall from approximately
20–30 cm above the thorax.³ Case studies of percussion
pacing under invasive monitoring have found that the
right ventricular pressure must rise by at least 10–15 mm Hg
to generate an electrical impulse at the myocardium.⁵
The best anatomical site for percussion pacing seems to
be the left lower sternal edge, presumably above the right
ventricle.³⁻⁴ However, both site and force of the fist blows
need to be titrated individually in each patient.

Chan and colleagues reported the case of an adult
patient, monitored with a Swan–Ganz catheter, who suffered
acute complete heart block with ventricular standstill.⁷
Initially they performed percussion pacing, followed by
transcutaneous electrical pacing before transvenous elec-
trical pacing could eventually be established. According
to their comprehensive haemodynamic measurements, the
three techniques showed similar effectiveness. Compared
with a calculated cardiac output of 20–30% of normal
with optimally performed chest compressions during
cardiopulmonary resuscitation, percussion-induced ventri-
cular contractions generate a significantly higher cardiac
output.⁵⁻⁷

Although electrical cardiac pacing is the treatment of
choice for most patients with unstable bradyarrhythmias,
percussion pacing can effectively provide short-term cardio-
circulatory support before more advanced treatment is
established or the bradycardia resolves, as seen in our
patient. This neglected procedure is quick and easy to
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Perform and may be indicated as a potentially life-saving technique in adults and in children.

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