Unusual diagnosis of a persistent third-degree atrioventricular block during anesthesia in a "healthy" pediatric patient

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ABSTRACT

We present an unusual diagnosis of a permanent third-degree atrioventricular block under general anesthesia in an otherwise healthy and asymptomatic child. This diagnosis of unclear causality represented a serious rare finding, requiring judicious management and resulting in the placement of a permanent pacemaker.

Key words: *Atrioventricular block, child, diagnosis, general anesthesia*

INTRODUCTION

Atrioventricular (AV) block, due to an anatomical or functional impairment in the conduction system can be transient or permanent. A persistent third-degree AV block, or a complete heart block, diagnosed under anesthesia is a rare condition posing a challenge to anesthesia care and management.

CASE REPORT

The patient is a 4-year-old boy, weighing 17.5 kg, with no relevant medical or surgical history and no documented allergy or medication intake, scheduled for circumcision. His preoperative vital signs were a heart rate 98 beats/min, blood pressure 100/56 mmHg, temperature 36.6°C, and a respiratory rate of 20/min. Chest was clear to auscultation and no cardiac murmur was identified. The anesthetic plan was explained to the parents and included general anesthesia and a penile block for postoperative pain management.

Anesthesia was induced in the presence of the parents with oxygen/nitrous oxide and sevoflurane administered through a face mask, with the patient breathing spontaneously. Propofol 40 mg and fentanyl 25 μg were administered after intravenous access. Anesthesia was maintained with sevoflurane at an end tidal concentration of 3.5% in a 1 L equal mixture of oxygen and air after securing the airway. The heart rate was noticed to be in the range of 80 beats/min, dropping to 60 beats/min. Ringer's lactate solution was administered at 10 mL/kg/h. A close observation of the electrocardiogram (ECG) tracing revealed a complete dissociation of P wave and QRS complex [Figure 1]. Blood pressure was normal and the patient was normothermic. The surgeon was notified, and

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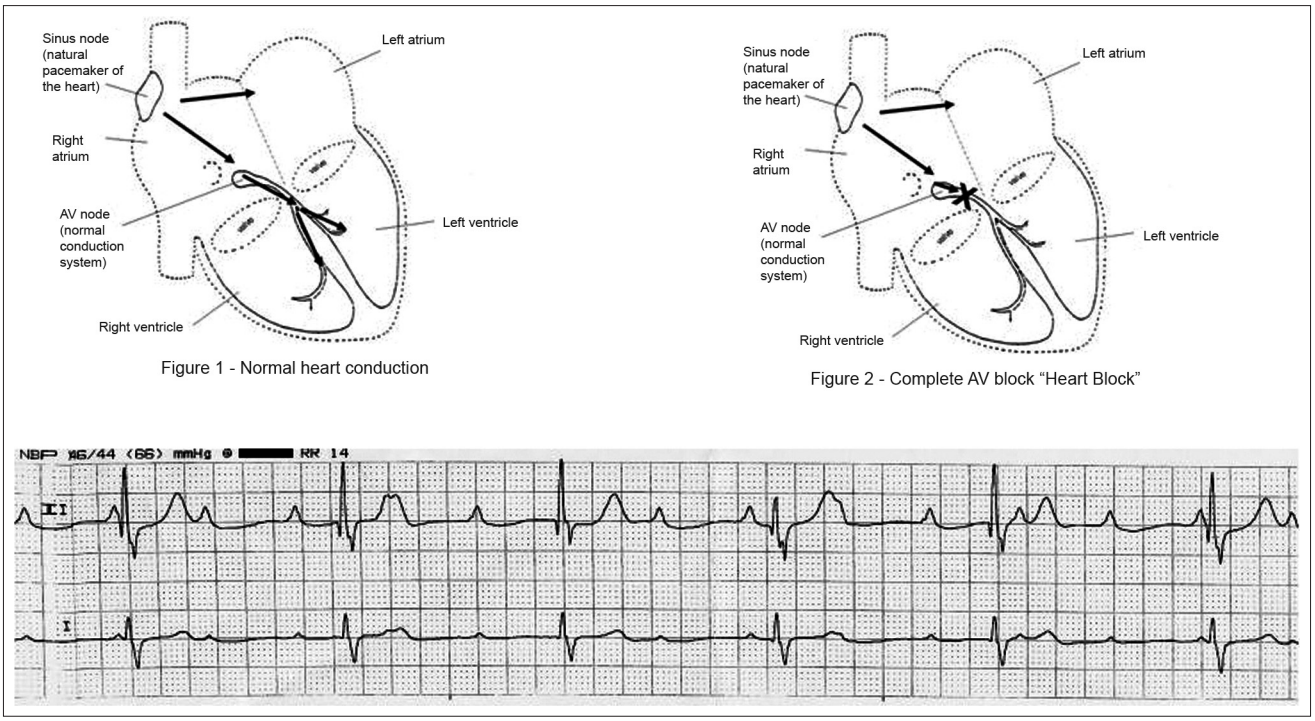

Figure 1 - Normal heart conduction

Figure 2 - Complete AV block "Heart Block"

Figure 1: A complete atrioventricular block

resuscitation equipment was brought to the room. A trial of switching from sevoflurane to desflurane did not produce any change in the heart rate and was equally tolerated by the patient. Inhalation agents were discontinued and propofol infusion started at 300 μg/kg/min for the remaining 25 min of the procedure. There was no change in hemodynamics or in the ECG tracing. Atropine 250 μg was administered intravenously for a heart rate below 60 beats/min with a transient effect of increasing the heart rate to 80 beats/min. A penile block, with 10 mL of 0.25% bupivacaine was performed at the end of surgery. The patient was transferred awake to the recovery room. An urgent 12 lead electrocardiogram with cardiology follow up were requested.

In the recovery room the heart rate averaged 58 beats/min and the electrocardiogram tracing showed a third-degree AV block with a QTc of 450 ms. Patient was admitted for further evaluation. The structure and the function of the heart were within normal range by echocardiography. Laboratory studies to rule out systemic inflammatory and connective tissue diseases were negative. A Holter monitor showed a third-degree heart block with maximum heart rate of 95 beats/min and slowest heart rate of 35 beats/min with an average heart rate of 52 beats/min. The heart rate was below 70 beats/min in 97% of the times during the Holter monitoring. The patient had a dual chamber pace maker placed after a third-degree AV block and episodes of bradycardia as low as 30 beats/min were read on a repeat postoperative ECG and Holter monitor, respectively.

DISCUSSION

In complete heart block or third degree AV block, there is no conduction through the AV node. Complete dissociation of the atrial and ventricular activity exists with QRS complexes being conducted independent of the P waves. Not all patients with AV dissociation have complete heart block; patients with accelerated junctional rhythms with escape rate faster than the intrinsic sinus rate may have AV dissociation. The association of bradycardia with AV dissociation and the ECG findings confirmed the diagnosis in this patient. The incidence of complete AV block has been documented to be around 1/22000 live births, and associated with a structural heart disease in 25%–33% of the cases. Most of these patients have structurally normal hearts. The most associated lesion is L transposition of the great arteries with ventricular inversion, abnormalities of atrial and ventricular septum formation and in isolated cases other cardiac abnormalities are also seen. A number of neuromuscular diseases are also associated with AV block. These include myotonic muscular dystrophy, Kearns–Sayre syndrome, Erb's dystrophy (limb girdle), and peroneal muscular atrophy. With a negative previous medical history or positive symptoms, such as syncope or fainting spells, the primary thought was that the ECG abnormality following anesthesia induction was related to the combination of inhalation agents and/or a vagal response. Conduction abnormalities have been reported with several anesthetic agents. Sevoflurane may prolong cardiac conduction and significantly prolong the QT interval by inhibition of

voltage gated sodium and L type calcium channels.[1,2] Torsades de pointes, nodal rhythm, and complete heart block following sevoflurane administration have been described.[3,4] Sevoflurane has also been suspected as the trigger of a third-degree AV block under general anesthesia.[5] Contrary to a previous correspondence, the prompt detection of the cardiac arrhythmia and the termination of sevoflurane administration with switching to a propofol anesthetic did not help manage the problem.[5] Propofol infusion has been reported to reverse sevoflurane-induced conduction abnormalities,[6] although a large bolus of propofol has been reported to cause AV block.[7] The stability of the blood pressure leads us to pursue the procedure with cardiology alert and the presence of a transcutaneous pacemaker in the room.

Pathophysiologically, in most cases of complete heart block (approximately 61%), the conduction block occurs below the His bundle. A block within the AV node accounts for approximately one fifth of all cases, whereas block within the His bundle accounts for slightly less than one fifth of all cases. Pacemakers above the His bundle produce a narrow QRS complex escape rhythm, whereas those at or below the His bundle produce a wide QRS complex. When the block is below the AV node, the escape rhythm arises from the His bundle or the bundle branch Purkinje system at rates less than 45 beats/min. These patients generally are hemodynamically unstable and their heart rate is unresponsive to exercise and atropine. When the block is at the level of the AV node, the escape rhythm generally arises from a junctional pacemaker with a rate of 45–60 beats/min. Patients with a junctional pacemaker are usually hemodynamically stable and their heart rate increases in response to exercise and atropine. We believe that our patient had the later type of AV block, which allowed him to be asymptomatic. With a few selected exceptions, electrophysiological studies are not necessary in patients with complete AV block.[8] The 2008 American College of Cardiology/American Heart Association/Heart Rhythm Society (ACC/AHA/HRS) offers guidelines and recommendations for placement of permanent pacemakers in patients with complete AV block.[9] Most patients with a complete heart block have an indication for pacemaker placement. All patients with associated symptoms, ventricular pauses ≥3 s, or a resting heart rate <40 beats/min, while awake have a Class I indication.

Although the causation is not fully understood, congenital complete AV block may show up as familial clusters. The association of collagen vascular abnormalities, sometimes subclinical, in the mothers of children with congenital complete AV block has been demonstrated. There now appears to be a clear association between SS–A/Ro or SS–B/La autoantibodies in the mother and congenital complete AV block in the child.[10] However, laboratory studies to rule out systemic inflammatory and connective tissue diseases were negative in this case.

In summary, the anesthesia preparation of a pediatric patient prior to induction does not allow sometimes for a baseline ECG tracing because of a negative clinical history and because the patient may not tolerate the placement of the ECG leads prior to anesthesia induction. The discovery of a third-degree AV block under anesthesia in an otherwise healthy pediatric patient is a very rare finding and a serious diagnosis. It requires judicious management with clinical choices of anesthetics based on literature suggestions. Anesthetizing "healthy" children requires vigilance and knowledge in addition to being always prepared to deal with catastrophes.

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