Atrial-Pacemaker Block, A New Electrocardiographic Syndrome Associated with Implanted Synchronous Pacemakers*

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Electrical stimulation of the heart for Adams-Stokes syndrome, due to failure of impulse formation or conduction has proved an effective method of therapy. The recent development of an implantable synchronous pacemaker (Fig. 1)

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Figure 1: The pacemaker is implanted in the subcutaneous tissue at the left upper quadrant region of the abdomen and electrodes are inserted on the left atrium and left ventricle through the thoracotomy. The atrial electrode picks up the atrial impulse and relays it to the pacemaker. With a delay of 0.10 to 0.12 seconds this impulse is sent to the ventricles through the ventricular electrode.

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for correction of complete heart block has added a more physiologic approach for control of the heart rate. It is now pertinent to comment on the occurrence of a transient atrial pacemaker block in patients with a synchronous type pacemaker. Fortunately, this interesting finding is not hazardous, since an automatic pacemaker of a fixed rate will take over the control of the ventricular stimulation.

CASE 1

A 79-year-old white man was admitted to the Hahnemann Hospital with a two-month history of recurrent Adams-Stokes seizures. The first available electrocardiogram in May, 1963, demonstrated a second degree atrioventricular heart block with 2:1 conduction. He was asymptomatic except for mild exertional dyspnea. The blood pressure was 200/70 mmHg and the pulse was 36 per minute. Neck veins were slightly distended and the carotid pulse was vigorous. The lungs were clear. The first heart sound varied in intensity.

Figure 2: (A) Preoperative tracing (Case 1) lead AVF. Sinus rhythm is present at 80/min. A high grade A-V block is present and ventricles are controlled by a passive nodal or His pacemaker at 36 per minute. (B-C) Lead AVF and V2. Twenty-four hours after implantation of synchronous pacemaker, sinus rhythm is present at a rate of 98 per minute and ventricles are activated electrically via the atrial pickup, except beats 5, 7, in AVF and beats 1, 3, 5 and 7 in V2. Prior to these beats, atrial impulses are not immediately followed by a pacemaker artefact and ventricular complex and pauses are terminated by pacemaker escape beats. Block is present between atrial muscle and atrial pick up of the electronic pacemaker (second degree atrial pacemaker block). (D) Five days following implantation a sinus rhythm is present at 85 per minute. All atrial impulses are followed by pacemaker artefacts (0.16 seconds). The atrial pacemaker block has disappeared.
sity. A grade II (grading I to IV) ejection systolic murmur was heard at the base. Bilateral pitting edema was present in the lower extremities. The chest x-ray examination demonstrated mild cardiac enlargement. Hemogram, urinalysis, blood sugar and blood urea nitrogen were normal.

The admission electrocardiogram showed complete A-V heart block (Fig. 2A). A synchronous pacemaker was implanted on November 4, 1963. The electrodes were inserted into the left atrium and left ventricle. The postoperative electrocardiogram showed periods of second degree sinoatrial block, (Fig. 2B after beat 4) and the ventricle was stimulated at a fixed rate by the pacemaker (Fig. 2B, beat 5). In addition, the sinus impulse was blocked at the site of the left atrial electrode. Stimulation of the ventricle was accomplished by the fixed rate mechanism of the pacemaker when it failed to sense the atrial stimulation (Fig. 2B, beat 7 and Fig. 2C, beats 3, 5, and 7). The atrial pacemaker block is transient since conduction of the sinus impulse by the atrial electrode was present five days later (Fig. 2D).

CASE 2

A 51-year-old man was admitted to the hospital with recurrent Adams-Stokes seizures six months following an acute myocardial infarction. The electrocardiogram showed left bundle branch system block with second degree A-V heart block (Fig. 3A). The blood pressure was 120/70 mmHg and the pulse varied from 40 to 76 per minute. Neck veins were not distended. The carotid pulse was vigorous. The chest was barrel-shaped and decreased excursion was prominent. Bronchial rales were heard in both lung fields. The heart sounds were barely audible. The remainder of the physical examination was unremarkable. The hemogram, urinalysis, blood urea nitrogen and blood sugar were normal.

A synchronous pacemaker was implanted on January 6, 1964 and an immediate postoperative electrocardiogram (Fig. 3—B1 and B2) revealed

![Figure 3](http://journal.publications.chestnet.org/pdfaccess.ashx?url=data/journals/chest/21420/)
sinus tachycardia (115 per minute) with a second degree block between the atria and the pacemaker after beats 3, 6 and 9 in B1 and after beats 2 and 5 in B2) engendering pauses with ventricular fusion complexes (Fig. 3—B2 beats 1, 2, 4, 5 and 7 through 12). On the eighth postoperative day, a sinus mechanism was present, with all atrial impulses transmitted to the ventricle via the electronic pacemaker (Fig. 3C).

**CASE 3**

A 63-year-old woman was admitted to Hahnemann Hospital on April 11, 1964, with exertional dyspnea and a pulse rate of 46 per minute. The blood pressure was 160/90 mm Hg. An ejection systolic murmur grade III was present at the second right intercostal space. The left ventricle was enlarged. The initial electrocardiogram was consistent with a persistent second degree A-V block (Fig. 4A). A synchronous atrial pacemaker was implanted on April 21, 1964 because of persistent congestive heart failure. The postoperative electrocardiogram (Fig. 4B) revealed an atrial pacemaker block with ventricles under the control of the fixed rate pacemaker. Occasional ventricular captures (QRS in Fig. 4B) were evident, which demonstrated the phenomenon of a supernormal ventricular excitation. The electrocardiogram taken two weeks later showed a sinus mechanism triggering the electronic pacemaker via the atrial electrode (Fig. 4C).

**COMMENTS**

From these observations, it is expected that more intricate methods of electrical stimulation would produce complex disturbances of impulse formation and conduction. The electrocardiograms in all three patients demonstrated that a second or higher grade of heart block may exist between the atrium and the atrial electrode. This was a transitory finding and is probably due to trauma or edema in the region of the atrial electrode. Asystole cannot occur, as the pacemaker is programmed to discharge automatically after approximately 1.1 seconds with a fixed rate impulse.

Following the implantation of a synchronous pacemaker in Case 2, a very interesting type of ventricular fusion beat was observed (Fig. 3—B2 beats 1, 2, 4, 5 and 7 through 12). The sinus impulse is conducted with a P-R interval measuring

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**Figure 4:** (A) Lead V2. Sinus rhythm is present at 75 per minute. Second degree A-V block is present with 2:1 conduction. (B) Following the implantation of synchronous pacemaker ventricles are under the control of a fixed rate pacemaker at the rate of 55 per minute. (P-QRS) complex demonstrating supernormal ventricular excitation. (C) Lead V2. Two weeks following implantation, a sinus rhythm is present at the rate of 80 per minute and all atrial impulses are followed by pacemaker artefacts and atrial pacemaker block has disappeared.
0.20 seconds. P-E* interval is prolonged to 0.36 seconds because of first degree atrial pacemaker block. It appears that a portion of the ventricle is also depolarized by the synchronous pacemaker resulting in ventricular fusion beats (Fig. 3, B2, beats 1, 2, 4, 5 and 7 through 12). Atrial pacemaker block was transient and during this period protection from Adams-Stokes seizure was prevented by a fixed rate pacemaker. The pacemaker automatically took over the control of ventricular stimulation after a 1.1 second of ventricular asystole.

Summary
A new electrocardiographic syndrome of second degree atrial pacemaker block has appeared following the implantation of a synchronous pacemaker. Unusual electrocardiographic features of electrical pacing and ventricular fusion beats were noted. This is the result of a delay of the atrial impulses reaching the atrial pickup electrode as the impulse may normally traverse the A-V junction. Supernormal ventricular excitation was demonstrated when a sinus beat fell at a critical period (0.48 seconds) following ventricular discharge. Transitory atrial pickup block has no clinical significance in this type of synchronous pacemaker, since the fixed rate pacemaker automatically takes over the impulse formation.

Resumé
Un nouveau syndrome électro-cardiographique de bloc atrial du second degré venant du pacemaker est apparu après l'implantation d'un pacemaker synchrone. On a remarqué le caractère électrocardiographique inhabituel d'impulsions électriques et de battements ventriculaires de fusion. Ceci résulte d'un retard des impulsions au-

*P-E (Interval of beginning of P wave to pacemaker electrical discharge).