Atrioventricular Pacemaker Lead Reversal

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During cardiac surgery temporary epicardial atrial and ventricular leads are placed in case cardiac pacing is required postoperatively. We present the first reported series of patients with reversal of atrioventricular electrodes in the temporary pacemaker without any consequent deleterious hemodynamic effect. We review the electrocardiographic findings and discuss the findings that lead to the discovery of atrioventricular lead reversal.

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Introduction

During cardiac surgery, atrial and ventricular epicardial leads are now routinely placed, in case temporary cardiac pacing is needed in the post-operative period. Often the epicardial leads are connected to the pulse generator at a time when pacing is not required hence the accuracy of atrial and ventricular lead connection is not tested. A variety of pacemaker complications have been reported.1–5 A secure and accurate mechanical fit between the connector pin and the pin cavity is required for the adequate transmission of cardiac signals and electric current to and from the pacemaker to the myocardium. Although lead reversal may seem to be a fairly common phenomenon there have been no reported cases. To the best of our knowledge, we present for the first time a series of post-cardiac surgery patients with reversed atrio-ventricular electrodes in the temporary pacemaker without any consequent deleterious hemodynamic effect.

Case Reports

The first case is a 76 year old woman with multiple coronary risk factors who presented with angina and was found to have severe multi-vessel coronary artery disease. She underwent coronary artery bypass grafting and atrial and ventricular epicardial leads were placed intraoperatively. An electrocardiogram (ECG) immediately following surgery showed a regular and repeating pattern (ECG 1). Each repeating pattern consists of a junctional escape beat that is followed 0.24 seconds later by a large pacemaker spike afterwhich another narrow QRS complex occurs 0.26 seconds later. This repeating sequence suggests that the initial QRS
complex was being sensed as atrial activity as the ventricular lead was connected to the atrial port of the pacemaker. Following a pre-programmed delay the pacemaker produces a ventricular pacing spike. However, since the ventricular pole of the pacemaker has the atrial lead attached, the pacemaker spike captures the atria and intrinsic atrioventricular conduction occurs. When lead reversal was corrected her native sinus-induced QRS complex appeared identical to the junctional escape complex.

The second case is a 56 year old woman who had previously undergone coronary artery bypass grafting and who was 5 years later found to have severe aortic insufficiency with left ventricular dysfunction. She underwent an aortic valve replacement with a bioprosthetic tissue valve and developed post-operative atrial fibrillation which was treated with amiodarone. Consequently, she became hypotensive and bradycardic and required temporary pacing through her epicardial wires. An electrocardiogram while she was paced showed a regular and repeating pattern (ECG 2). Following each accelerated junctional beat a pacer spike occurred with a fixed interval of 0.24 seconds from the preceding QRS complex. This repeating sequence and the interval of 0.24 seconds, which is the commonly chosen pacemaker atrioventricular interval, suggests that the ventricular port is connected to the atrial lead and the atrial port to the ventricular lead. The pacer spike within the T-wave either captures the atria and conducts with an AV delay of 0.42 seconds or does not pace the atria and is seemingly followed by an accelerated AV junctional beat. Lead reversal was identified and corrected.

The third case is a 77 year old man who presented with shortness of breath and orthopnea and was found to have a flail anterior mitral leaflet with severe mitral regurgitation and left ventricular dysfunction. Coronary angiography showed normal coronary arteries and he underwent mitral valve replacement with a bioprosthetic tissue valve. Post-operatively he required pacing via his epicardial wires. Electrocardiography while being paced showed a regular rhythm with both narrow and wide QRS complexes and with pacer spikes preceding and following each QRS complex, with a fixed interval of 0.2 seconds between two consecutive pacemaker spikes (ECG 3). The latter half of the electrocardiogram showed a repeating pattern of a pacemaker spike producing a wide QRS complex (ventricular capture) and 0.2 seconds after the first pacemaker spike a second pacemaker stimulus occurs within the QRS complex. From this finding it is apparent the atrial port of the temporary pacemaker is connected to the ventricular epicardial lead. It appears that the narrow QRS complexes are fusion beats, i.e. ven-
tricular activation from a supraventricular impulse and ventricular pacing from the temporary pacemaker. Lead reversal was identified and promptly corrected.

**Discussion**

Temporary cardiac pacemakers can play a vital role in the treatment of bradyarrhythmias and in
overdrive suppression of atrial and ventricular tachyarrhythmias in the post-cardiac surgery setting. However, benefit from these devices can be obtained only when used properly. Appropriate pacemaker sensing and pacing requires that the pacemaker leads be appropriately inserted into the pulse generator. Failure to do so may result in hemodynamic decompensation. Fortunately, none of our patients suffered any negative consequence of temporary lead reversal, perhaps due to prompt recognition and correction of their reversed lead connections.

Atrioventricular lead reversal in the temporary pacemaker in patients who are pacemaker dependent may result in atrioventricular dyssynchrony resulting in the loss of atrial kick and its contribution to cardiac output. Patients with preexisting left ventricular dysfunction and prolonged atrioventricular dyssynchrony from atrioventricular lead reversal may present with decompensated heart failure. In the temporary pacemaker, atrioventricular lead reversal can be easily corrected by inserting the leads into the correct pin cavities. However, atrioventricular lead reversal in patients with a permanent implanted pacemaker would require reopening of the pacer pocket and correction of atrioventricular lead reversal.

Clinicians taking care of patients with temporary and permanent atrioventricular pacing electrodes should be careful when plugging in the pacemaker leads into the pin cavity so as to assure accurate lead placement. Technical improvements like color coding or labeling of the leads and their respective pin cavities may serve to prevent the occurrence of these episodes. These patients should also have 12 lead electrocardiograms performed during pacing so as to confirm normal atrioventricular pacing sequence and stable atrioventricular capture.

References