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Overdrive Pacing Reversed Life-threatening Sustained Ventricular Tachyarrhythmia after Coronary Artery Bypass Graft

Po-Shun Hsu[1], Jia-Lin Chen[2], Guo-Jieng Hong[1], Yi-Ting Tsai[1], Chih-Yuan Lin[1], Chung-Yi Lee[1], and Chien-Sung Tsai[1*]

[1]*Division of Cardiovascular Surgery, Department of Surgery;*
[2]*Department of Anesthesiology, Tri-Service General Hospital, National Defense Medical Center, Taipei, Taiwan, Republic of China.*

A 60-year-old female with 3-vessel coronary artery disease underwent emergent coronary artery bypassing grafting (CABG). Six hours after finishing the CABG procedure, pulseless sustained ventricular tachyarrhythmia (VT) was noted. The arrhythmia occurred frequently and was resistant to defibrillation and conventional antiarrhythmic agents. Eventually, we tried to convert the rhythm using an overdrive pacemaker via pacing wires placed during the CABG procedure. Indeed, the overdrive pacemaker converted the life-threatening ventricular rhythm to a pacing rhythm. The patient was released from our section with a normal sinus rhythm and no recurrent ventricular tachyarrhythmia (VT) was noted for 1-year following. Overdrive pacing could be considered as a treatment for life-threatening sustained VT after CABG, which has rarely been reported. We report this case and review the literature.

Key words: sustained ventricular tachyarrhythmia, overdrive pacing, coronary artery bypass graft

INTRODUCTION

Malignant sustained VT post-cardiac surgery is a rare but very serious complication that has an incidence of 0.4% to 1.4% and a mortality rate of up to 50%.[1] Many risk factors may result in post-bypass sustained VT, including: electrolyte imbalance; metabolic abnormalities; hypoxia; hypovolemia; recent or perioperative myocardial infarction; existence of preoperative ventricular arrhythmia; and proarrhythmic side effects of inotropic agents.[2] Recent literature has reported several additional associated risk factors, including: female gender; left ventricle ejection fraction (LVEF) <35%; systemic hypertension or pulmonary hypertension; and long bypass pump time. In particular, the LVEF (<35%) plays an important role in the occurrence of sustained VT after bypass surgery.[3] Defibrillation and cardioversion are absolutely the best choice for the post-CABG sustained VT. In our case, the arrhythmia didn't respond to conventional medical therapy or defibrillation. Lower-energy overdrive pacing was tried to stop the sustained VT and it indeed converted the sustained VT to normal sinus rhythm.

CASE REPORT

A 60-year-old female was diagnosed with 3-vessel coronary artery disease (CAD) 6 months prior. She also had hypertensive cardiovascular disease and congestive heart failure (New York Heart Association Function class III), with an ejection fraction of about 30%. The patient had a percutaneous transluminal coronary angioplasty (PTCA) of the circumflex branch 4 months after being diagnosed as having the coronary artery syndrome. During the PTCA in this admission, CAD with 3-vessel disease was diagnosed, and balloon dilations of the left anterior descending branch (LAD) and the right coronary artery (RCA) were performed. After the PTCA, many episodes of short run VT with hemodynamic collapse developed. Profound residual ischemia was highly suspected and emergent CABG with vein grafts to the LAD, RCA, and the obtuse marginal branch was done. In addition, pacing wires were placed in the epicardium

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[*]Corresponding author: Chien-Sung Tsai, Division of Cardiovascular Surgery, Department of Surgery, Tri-Service General Hospital, National Defense Medical Center, No. 325, Sec. 2, Cheng-gong Rd, Taipei 114, Taiwan, Republic of China. Tel: +886-2-87927212; Fax: +886-2-87927376; E-mail: sung1500@mail.ndmctsgh.edu.tw

and subcutaneous tissue to prevent bradycardia after CABG. About 6 hours after CABG, pulseless VT was noted (Fig 1A), and cardiopulmonary resuscitation with defibrillation was performed. Many times of defibrillation were done but the sustained VT continued. Antiarrhythmic agents, such as amiodarone, lidocaine, and procainamide, were also tried to suppress the VT rhythm, but in vain. In the next two days, occasional pulseless short run VT was still present and we tried to use overdrive pacing with pacing rate of 110 per minute, output: 10 mA, and sensitivity: 1.5mV. The VT was successfully overdrived by a pacing rhythm at a rate of 110 per minute (Fig 1B). The next day, we tried to taper the pacemaker rate but failed; recurrent VT was noted when the pacing rate was tapered to 105 per minute (Fig 1C). Therefore, we maintained the rate at 110 per minute with the pacemaker. Two days later, when we adjusted the pacing rate to 60 per minute, the rhythm converted to a sinus rhythm with a rate of 70 to 85 per minute (Fig 1D). Finally, the ventricular rhythm was rarely seen on the telemetry. The pacemaker was removed on the 24th post-CABG day, and she was discharged with regular sinus rhythm. No recurrent VT was noted in the 1-year following.

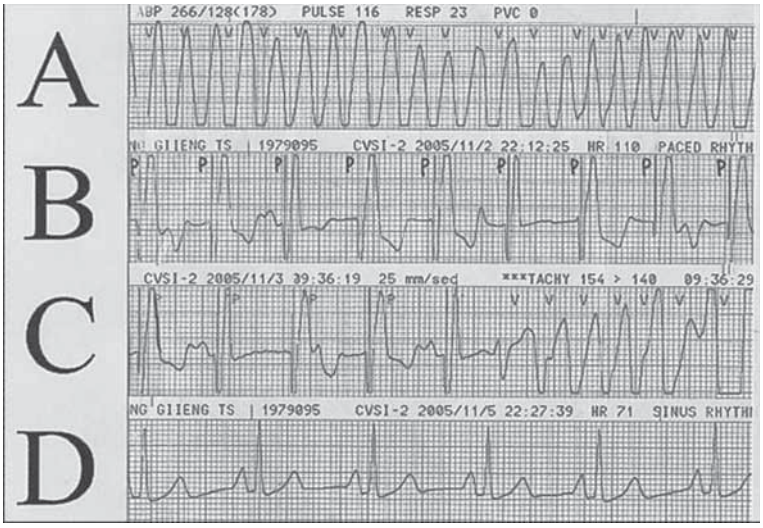

Fig. 1 (A). Pulseless VT was noted 6 hours after the coronary artery bypass graft. (B). Overdrive pacemaker converted the VT to a pacing rhythm (110/minute) two days later after the CABG procedure. (C). Recurrent VT was noted when the pacing rate was tapered to 105/minute. (D). Normal sinus rhythm (71/ minute) was noted after the pacing rate was successfully tapered to 60/minute.

DISCUSSION

The true mechanism of post-CABG VT has not yet been identified. Many methods of treating post-bypass VT have been suggested. Defibrillation and cardioversion have been thought to be the best therapy for sustained VT, when it is resistant to antiarrhythmic agents.[4] Most literature supports the use of an implantable defibrillator as the preferred treatment.[5] Some case reports have suggested that extracorporeal membrane oxygenation (ECMO) can provide temporary life support for circulation collapse.[6] Ohnishi suggested that intra-aortic balloon pumping, emergent percutaneous cardiopulmonary bypass, and emergent catheter ablation can be considered for patients who do not respond to conventional resuscitative measures.[7]

Some literature has proposed that ischemic reperfusion is the mechanism that triggers post-CABG VT because it reactivates the ischemic region. Jonathan reported that placement of a bypass graft across a noncollateralized total occlusion in a vessel supplying an infarct zone was strongly and independently associated with the development of VT.[8] Based on this hypothetic mechanism, some researchers have tried to devascularize the reperfusion region. Wu reported that in patients after CABG, ischemic preconditioning significantly reduced postoperative VT, the post-bypass mechanical ventilation time, and the need for inotropes.[9]

In our case, we tried conventional medical therapy with lidocaine, amiodarone, and procainamide, but the VT did not subside. Defibrillation was also done several times for the VT episodes, but it was ineffective. Thus, we tried persistent overdrive pacing for the sustained VT and then the rhythm converted to normal sinus rhythm after 2 days of overdrive pacing.

Cardiac pacing is often necessary after open heart surgery to maintain adequate hemodynamics in patients with rhythm disturbance. Temporary cardiac pacing is also used to eliminate perioperative bradycardia, to augment cardiac output, to suppress or to terminate various forms of arrhythmia.[10] A recent study published in Circulation, the Journal of the American Heart Association, indicated that mild pulses of electricity can interrupt rapid heart beat-ventricular tachycardia (VT)-as effective as the more powerful and painful shocks delivered by implantable cardioverter defibrillators (ICDs).[11] One could hypothesize that the overdrive pacemaker provided regular lower stable currents that could suppress and replace the ventricular rhythm. In contrast, defibrillation provides

higher currents that temporarily suppress VT, but the VT returns once the defibrillation current stops. Overdrive pacing is rarely used as a treatment for post-CABG sustained VT. Nevertheless, overdrive pacing is a well-known treatment for post-CABG atrial fibrillation[12], especially in patients who are prone to develop post-bypass atrial fibrillation. Therefore, we would suggest that overdrive pacing may serve as an emergent rescue treatment for post-CABG sustained VT if both conventional medical therapy and defibrillation have failed. Although an implantable cardioversion device has been considered to be the preferred treatment for post-bypass sustained VT, it may not be practical under emergent conditions. Besides, the shocks are always painful and would make the patient more anxious, which may increase the work loading of the heart. Furthermore, we would also suggest that patients who are at high risk of developing post-CABG sustained VT should have pacing wires placed, not only to prevent post-CABG bradycardia but to treat sustained VT that might not be responsive to conventional medical therapy or emergent defibrillation.

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