

Original Research Article

Temporary Pericardial Pacing Wire Removal after Cardiac Surgery: Is Not Always an Innocuous Procedure

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Abstract: The efficacy of temporary pericardial pace maker after cardiac operations has been widely proved. Complications related to temporary pericardial pacing wires (TPPWs) removal can be serious and even fatal. This paper is a report of an investigation. We report a series of clinical complications due to bleeding from right ventricular laceration or the graft with tamponade, some abscess developed in the lower sternotomy incision after several years. Removal of TPPWs is not innocuous and is associated with any complications. Careful nursing and management substantially reduces the risks of negative complications after the removal of TPPWs. Strategies to standardize wire removal may prevent complications and may minimize unnecessary wire retention.

Keywords: Cardiac surgery, Pacing wire removal, complication

INTRODUCTION

The pericardial pace maker are routinely used in some patients after cardiac surgery because they are at risk of developing arrhythmias in the early post-operative period [1, 2]. They can be an essential adjunct to facilitate weaning from cardiopulmonary bypass and may be life-saving means in the situation of heart block or developing arrhythmias in the early post-operative period [3].

Usually, temporary pericardial pacing wires (TPPWs) are removed close to the time of hospital discharge, often as a designated medical act by a nurse. In the majority of cases, this procedure is well-tolerated by the patient, however infrequently complications may occur such as late tamponade. Further, failure to remove a temporary wire completely has been associated with late complications such as infection and wire migration [4].

There is no clinical information to guide medical practitioners how to optimally remove temporary wires. We sought to assess the management required for the routine removal of TPPWs after cardiac surgery as well as factors related to complications due to their removal.

PATIENTS and METHODS

This descriptive, Correlational, cross-sectional study used review of medical records and a cardiac surgery database that has been active since April 2010. The institutional review board of the hospital approved the study. Preoperative, intraoperative and postoperative data of patients who received TPPW were collected. Decision to implant and use TPPW in operating room and intensive care unit was made by surgical teams.

Surgical Technique

Conventional median sternotomy was used for all patients. Cardiopulmonary bypass was carried out, maintaining a mean arterial pressure of 60 to 80 mmHg, except for in children and 4 patients with coronary heart disease that revascularized with off-pump technique. Midrate or moderate systemic hypothermia, antegrade or combined antegrade and continuous retrograde blood cardioplegia were used for myocardial protection. Ventricular wires were placed on anterior surface of right ventricle in 111 patients, only one patient received biventricular wires.

The patients were using double epicardial pacing electrode. The epicardial wires are tiny thin stainless steel cables, insulated along most of their length, which sticks out through the patient's skin. Inside, they tend to

be fixed to the epicardial surface with some restorable sutures. Appropriate placement of temporary wires for optimum function requires 2-cm electrode separation. The wires should be placed well away from thin walled areas of the heart, particularly the right atrial auricle. The wires should not cross any coronary vessels and grafts. Gentle traction for removal is recommended on the day prior to discharge, especially for patients on anti platelet or anticoagulant therapy.

RESULTS

Patient Data

A total of 822 patients were operated during study period and 219(26.5%) patients who received TPPWs were included in the study. Patient population aged from 8 months to 72 years, 149(68%) patients being males and 70(32%) being females. Surgical procedures included 16(7.2%) congenital heart surgery, 178(81.3%) isolated valve surgery, 3(1.4%) combined valve surgery and radiofrequency ablation, 22(10.1%) coronary artery bypass surgery (CABG). Preoperative and operative details for patients are summarized in Table 1.

In our patients, time of temporary pacemaker used was 1~20d. The patient whose wires were removed at 20 days had no intraoperative or postoperative conduction abnormalities, and there was no electrophysiological reason for the delay in removing the pacing wires.

There were two mortalities in early postoperative period. One patient with preoperative left ventricular dysfunction and required pacing died of multiorgan system failure. The other patient, who was died of sepsis following acute renal failure.

A 56-year-old male underwent double valve replacement was removed his TPPW at 7 days after operation. A brisk postoperative bleeding (200 ml/h)

prompted exploration 4 hours later and the bleeding was identified at the insertion site of one of the right ventricular pacer wires. The Bleeding site was resutured and the bleeding stopped. The other 58-year-old male with coronary heart disease underwent CABG. Before his discharge, the TPPW was retained. However, 2 hour later, he felt dizzy. His blood pressure decreased significantly. The patient was exploration and found a fresh clot was noted within the pericardium. Bleeding from a side branch of the right coronary saphenous vein bypass was noted in proximity to the previous right ventricular wire application to the epicardium. It appeared that a hemoclip on a side branch of the vein had been avulsed by the frayed end of a right atrial wire. The two patients both survived.

The complications were observed related with the use or removal of TPPW. Two patient after removal of pacing lead cardiac tamponade, emergency rescue operation was successful. The patients, 3 patients died of multiple organ failure, 1 case of malignant arrhythmia death. The remaining 215 cases were discharged.

FOLLOW-UP :

Outpatient evaluations consisted of routine examination and observation of incision. 10 months later, one CABG patient developed wound infection. In a ventricular septal defect repair patient developed wound infection two years later. In another with case was found an anterior mediastinal abscess cavity 4 years after his mitral valve replacement. Their chest computerized tomography (CT) revealed the presence of local abscess containing surgical material. The three patients were taken to the operating room for local debridement of their wounds respectively. The patients underwent surgical removal of the abscess. The surgery revealed the presence of local abscess containing the retained wires. The patient characteristics were shown in table 1.

Table-1: Patient characteristics

Patient	Patient characteristics	Outcomes	Key results
Patient 1	56y, male with rheumatic heart disease underwent mitral+aortic valve replacement,	Prompted exploration and the bleeding was identified at the insertion site of one of the right ventricular pacer wires.	Patient survived
Patient 2	58y, male with coronary heart disease underwent CABG.	Bleeding from a side branch of the right coronary saphenous vein bypass was noted in proximity to the previous right ventricular wire application to the epicardium.	
Patient 3	11y, male with CABG patient	The patients underwent surgical removal of the abscess. The surgery revealed the presence of local abscess containing the retained wires.	Incision healed
Patient 4	22y, male with ventricular septal defect repair		
Patient 5	38y, male with mitral valve replacement		

DISCUSSION

Temporary epicardial pacemakers were used as an essential adjunct to facilitate weaning from cardiopulmonary bypass and they may be life-saving means in the situation of developing arrhythmias, such as prolonged atrioventricular block and junctional tachycardia which are common after cardiopulmonary bypass, are the specific conditions known to benefit from temporary pacing [5]. For example, Up to 83% patient under-going valve surgery and up to 48% patients undergoing coronary artery bypass will develop dysrhythmias in the early postoperative period [6]. These arrhythmias can be haemodynamically significant and temporary pacemaker can help in optimizing cardiac function [7].

The intrathoracic wires should not be too tightly stretched, to prevent dislodgement. Once outside the skin, the wires should be knotted around a suture which holds them to the skin, another feature which prevents dislodgement. The leads which connect the pacing wires to the patient lead should be coiled; the coil gives ample room for error when the patient is repositioned. This way, even if they make sudden erratic movements, there will be plenty of accommodates, and the wires won't come out of the epicardium.

In ICU, the nurses should observe and record the parameters of the temporary pacemaker. The temporary pacemaker should be fixed in a secure and convenient place for observation, moving the patient to be careful to prevent the electrode disengaged. The nurses should Monitor heart rate and pacing rhythm, observe and record pacemaker working conditions. Plugging temporary pacemaker should be avoiding contact with any metal or liquids. The nurses must check that the pacing lead and pacemaker connection was solid, avoided wire discounting, broking, accidental releasing, or signs of infection. Replace the battery in working condition is prohibited.

The TPPWs are removed on or after postoperative day 3-5, or even longer, depending on the stability of the patient's heart rhythm. The use of TPPW is associated with low morbidity and mortality. However, after pacing wire removal patients are at risk of arrhythmias, hemorrhage and tamponade from atrial and ventricular lacerations, injury to SVG, retained wire, etc. The incidence of major complications following TPPW removal is 0.04%. The risk of complications is higher in redo cardiac surgery and anticoagulated patients. Patient's vital signs should be monitored following wire removal to allow prompt identification of potential complications. The chance of cardiac tamponade after TPWR was small but required cardiac reoperation, which led to higher rates of hospital complications, prolonged hospital length of

stay and higher in-hospital mortality. So, nurses measured all patients' vital signs frequently after TPPW removal in the hope of identifying cardiac tamponade early to minimize emergent events and facilitate early reoperation.

TPPWs should be removed during the day and not on the day of discharge to ensure that any emergent events can be dealt with more efficiently. In our institution, most of pacing wires are removed on the fourth day after operation with gentle transcutaneous retraction. Excessive force used at the time of TPPW removal can lead to haemorrhage, lacerations of the myocardium and damage to coronary artery bypass grafts. If resistance is encountered, the pacing wires should be cut flush with the skin surface with a gentle traction so that it can minimize the complications.

Removal of TPPWs at the time of discharge was uncomplicated in the majority of patients [8]. There was no significant difference in the amount of tension that physicians or nurses deemed was safe for temporary wire removal. We also sought to assess the tension required for the routine removal of TPPWs after cardiac surgery as well as factors related to resistance of removal. The majority of the TPPWs were removed with less than 20 ounces of tension. It shows that no patient factors were statistically associated with the need to apply greater than 20 ounces of tension [9].

Usually, hypotension, bleeding, and dyspnea are important markers of cardiac tamponade after TPPWs removal. Currently, measuring vital signs frequently during the first 4 hours after TPPWs removal is recommend. The nurses' observations should be emphasized, with emphasis on new or worsening bleeding and dyspnea in addition to hypotension. Further, it is necessary to record vital signs in the first 4 hours after TPPWs removal as often as recommended in the current procedural guidelines. Rather, nurses should measure vital signs frequently for the first 2 hours after TPPWs removal due to abrupt hypotension occurred early after removing of TPPWs. In addition, nurses should provide written and verbal communication about early warning sensations, signs, and symptoms of cardiac tamponade to patients immediately after TPPWs removal, and nurses should remind patients to communicate changes during all encounters for the first 24 hours after TPPW removal.

Although a major complication rate of 0.4% has been quoted for placement and removal of TPPWs [10], the risk of local infection may be increased when TPPWs are retained. One study reported that 13% of TPPWs clipped between 5 and 10 days postoperatively were colonized with bacterial pathogens [11]. The clinical significance of this finding is unclear; however, none of the patients with positive cultures developed

deep mediastinal infection. The threshold for clipping TPPW may be lowered by other factors, including thrombocytopenia or level of anticoagulation. While clipping TPPWs eliminates the short-term risk of bleeding related to removal of the TPPW, it leaves behind a foreign body in the mediastinum [12]. In our cases, this appears to be without significant short-term risk; however, we should pay attention the long-term effects of this practice.

In our cases, the retained TPPWs likely contributed to the late development of the local mediastinal abscess. Patients with acute infectious endocarditis may be at higher risk of late infectious complications when foreign bodies, including retained TPPWs. Although rare, a few other cases of mediastinal abscess in association with retained epicardial pacing wires have been reported. The epicardial pacing wire could be found inside an anterior mediastinal abscess cavity many years after heart operation [13]. The mainstay of treatment for mediastinal abscesses is effective drainage, removal of any wires and appropriate antibiotic coverage. In our cases, wound debridement in time was favoured via a small reoperative sternotomy. This approach facilitated access to the retained pacing wire.

After cardiac operations, careful management substantially reduces the risks of negative complications during or after the removal of temporary epicardial pacing wires. Although low complication rate of 0.4% has been quoted for placement and removal of temporary epicardial pacing wires [14], temporary pacing wires must be considered capable of providing a focus for infection or inciting a latent reaction of rejection by the body. If TPPWs are retained, this should be appropriately documented and the cardiac surgeon and nurses should pay attention to those possible complications postoperatively.

CONCLUSION

TPPWs removal can present with various and often vague signs and symptoms that may present decades postoperatively and may lead to significant morbidity and further surgery. We recommend that any TPPWs removal should be documented prior to their discharge and the surgeons and nurses should be mindful of retained TPPWs when patients present with any postoperative complication. The temporary pacing wires must be considered capable of providing a latent infection in the body.

CONFLICT OF INTERESTS

None declared.

AUTHOR'S CONTRIBUTION

Xiaofang Yang and Haiyong Wang wrote the paper. Fugui Ruan, QiongfangKe, Tianci Qian,

Donghua Pan and Jiangbin Sun supervised the composition of the paper. All authors read and approved the final paper.

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