Implantation of the left ventricular pacemaker lead after successful balloon angioplasty for coronary vein stenosis: a report of two cases

Koroner ven darlığına başarılı balon anjiyoplasti sonrası sol ventrikül elektrodu yerleştirilmesi: İki olgu sunumu

Ahmet Vural, M.D., Teoman Kilic, M.D., Ertan Ural, M.D., Dilek Kural, M.D.

Kocaeli University Faculty of Medicine, Department of Cardiology, Kocaeli

Stenosis in the coronary veins can cause failure of left ventricular pacemaker lead implantation, which is the cornerstone of cardiac resynchronization therapy. There are several case reports in which left ventricular pacing could be possible after successful elimination of coronary vein stenosis by stent implantation or cutting balloon angioplasty. We report two cases of left ventricular pacemaker lead implantation after successful balloon angioplasty for posterolateral and posterior vein stenoses, respectively.

Key words: Angioplasty, balloon; cardiomyopathy, dilated coronary angiography; coronary stenosis/therapy; electrodes implanted; heart failure; pacemaker, artificial.

Koroner ven darlıkları kardiyak resenkronizasyon tedavisinin temel aşamalarından biri olan sol ventrikül elektrodu yerleştirilmesi işlemini başarısız kılabilmektedir. Koroner ven darlık bölgesine stent uygulaması ve cutting balon anjiyoplasti işlemi sonrası sol ventrikül elektrodu takılan olgular bildirilmiştir. Bu yazıda, birinde posterolateral, diğerinde posterior ven darlığı nedeniyle başarılı balon anjiyoplasti işlemi uygulandıktan sonra sol ventrikül elektrodu takılan iki olgu sunuldu.

Anahtar sözcükler: Anjiyoplasti, balon; kardiyomiyopati, dilate;koroner anjiyografi; koroner darlık; elektrot yerleştirme; kalp yetersizliği; kalp pili.

Cardiac resynchronization therapy is the mode of therapy which significantly improves the clinical picture, increases long-term survival and decreases mortality rate.[1-4] However, 20-25% of the patients do not respond to therapy due to various reasons.[2,5]

Biventricular pacemaker (triple-chamber permanent pacemaker) is implanted by the transvenous approach owing to its ease-and safe-to-use features. Although pacemaker leads are implanted easily to the right atrium and right ventricle, it is sometimes impossible for left ventricular pacemaker lead implantation, due to anatomy of the coronary artery sinus.[6] Despite technological advancements, left ventricular pacemaker leads cannot be implanted transvenously by coronary sinus cannulation in approximately 8.4% of the patients and 1.8% undergo more than one intervention.[7] Displacement of the coronary sinus following dilatation of the right atrium and distortion in coronary sinus or presence of anatomical obstacles such as Thebesian and Vieussens valves may lead to failure of coronary sinus cannulation and left ventricular pacemaker lead implantation.[8,9] Although coronary sinus cannulation may be performed successfully, stimulation of diaphragm and pectoral muscle and lack of suitable coronary sinus branches or coronary venous stenoses may lead to failure of left ventricular pacemaker lead implantation. Pacemaker leads may be implanted by a small thoracotomy surgical technique in some of the patients in whom implantation cannot be performed transvenously.[10-12]

In this paper we report two cases of left ventricular pacemaker lead implantation after successful balloon angioplasty for coronary venous stenoses, respectively.

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Corresponding address: Teoman Kılıç. Umuttepe Yerleşkesi, Eski İstanbul Yolu 10 km, 41380, Umuttepe-Kocaeli, Turkey
Tel: +90 - 262 - 303 95 00 e-mail: kilicteoman@yahoo.com

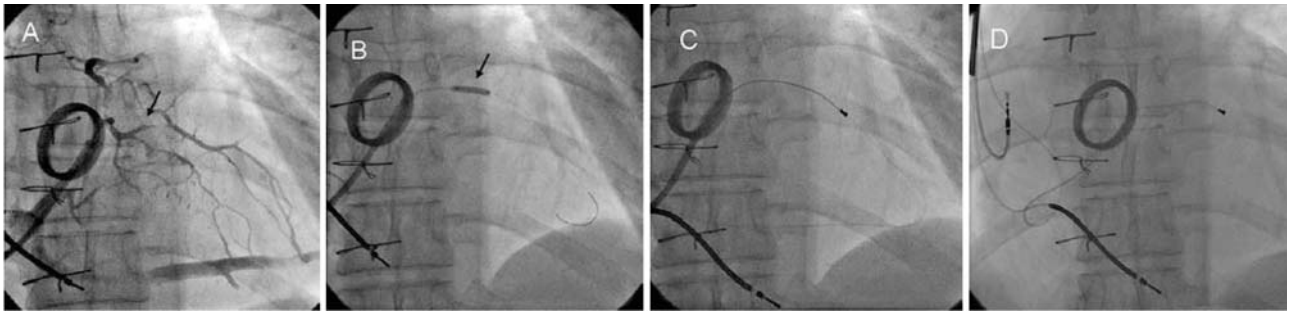

Figure 1. (A, B) Coronary sinus image showing subtotal stenosis in posterolateral vein and a rich interconnected commoncollateral network system. Balloon angioplasty was performed at the stenotic area. **(C, D)** View of the advanced left lead and three implanted leads.

CASE REPORT

Case I- A 40-year old male patient with a history of dilated cardiomyopathy, rheumatic valvular disease and mitral valve replacement surgery was hospitalized in our clinic with the diagnosis of heart failure. The functional capacity of the patient who underwent mechanical mitral valve implantation 10 years ago was in class III, with the most appropriate pharmacological treatment. Electrocardiography showed sinus rhythm, PR interval of 180 msn and wide QRS (130 msn) associated with left bundle branch block. Echocardiographic evaluation demonstrated the left ventricular enddiastolic diameter to be 95 mm, while left ventricular ejection fraction was found to be 12% in the patient detected with dilatation in all cardiac chambers and ventricular dyssynchrony. Holter examination showed nonsustained ventricular tachycardia and electrophysiological examination revealed ventricular tachycardia attacks which did not exceed 30 seconds but led to hypotension attacks and recover spontaneously. According to treatment guidelines for heart failure and cardiac resynchronization the patient was scheduled for cardiac resynchronization therapy and defibrillator implantation for primary prevention.[13,14]

A triple-chamber pacemaker was implanted by means of the left subclavian venous approach. Once a site for the pacemaker was prepared subcutaneously, subclavian venous puncture was performed from three different sites. Bipolar shock electrode and active bipolar electrode were implanted into the right ventricular apex and right atrium, respectively. Coronary sinus was viewed anatomically following coronary sinus cannulation. Side branches except ectasic middle cardiac vein were very thin and were interconnected by a common collateral network. An appropriate coronary sinus side branch could not be found for left ventricular pacemaker lead implantation (Figure 1a) except posterolateral vein. However, there was significant stenosis in the proximal segment of posterolateral vein and the left ventricular pacemaker lead could not be advanced even through the guide wire. Balloon angioplasty was scheduled to dilate the stenosis since there was no alternative except posterolateral vein. A 2.5 x 11 mm balloon catheter (Inva Balon) was inflated at 10 atmospheric pressures for 10 seconds using standard 0.014 guide wire and the venous stenosis was dilated. The balloon catheter was then retrieved and 78 cm unipolar electrode (Model 4193, Medtronic, Minneapolis, MN, USA) (Figure 1b,c) through the guide wire remaining in the vein was placed into posterolateral vein. Test results showed appropriate threshold and resistance values which did not stimulate the diaphragm and chest muscles. All of three pacemaker leads were connected to the InSync Sentry ICD Model 7299 (Medtronic) device and the procedure was terminated after closing the implanted permanent pacemaker site (Figure 1d).

Case 2- A-40-year old male patient was admitted in our clinic with the diagnosis of heart failure following a pre-diagnosis of dilated cardiomyopathy, heart failure and complete left bundle branch block. The functional capacity of the patient was in class III with the most appropriate pharmacological treatment. Electrocardiography demonstrated sinus rhythm and wide QRS (150 msn) associated with the left bundle branch block. Echocardiographic examination demonstrated dilatation in all chambers and ventricular dyssynchrony, while left ventricular ejection fraction was found to be 18%. Electrophysiological examination revealed sustained ventricular tachycardia attacks exceeding 30 seconds and disrupting hemodynamics. The patient was scheduled for cardiac resynchronization therapy and defibrillator implantation for primary prevention, according to treatment guidelines for heart failure and cardiac resynchronization.

Coronary sinus cannulation was performed and coronary sinus was viewed anatomically following placement of bipolar shock electrode into the right ventricu-

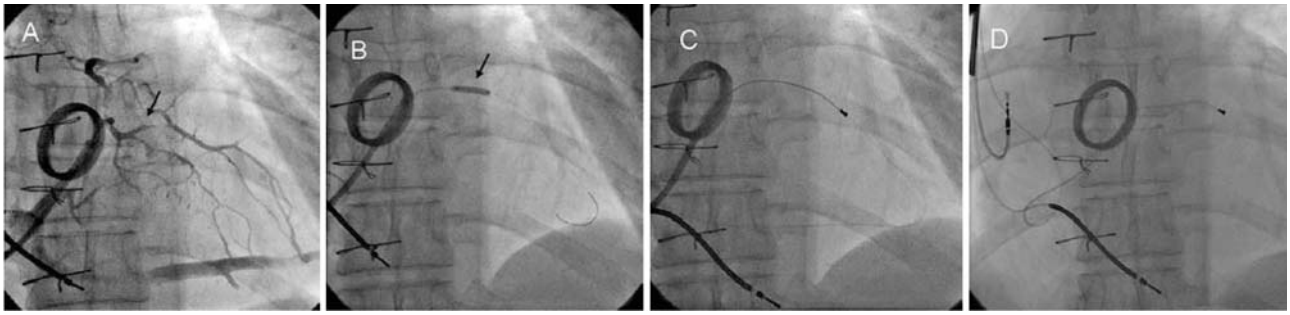

Figure 2. (A, B) Image of stenosis in the coronary sinus posterior vein and of inflated balloon. **(C, D)** Image of the advanced left lead and three implanted leads following balloon angioplasty.

lar apex by means of the left subclavian venous approach. Following anatomical evaluation in terms of the left ventricular pacemaker lead, two appropriate coronary vein branches including posterior and lateral were detected (Figure 2a). Due to high threshold value for *pacing* (>5 V) and low sensitivity value (4 mV) in the lateral vein, left ventricular pacemaker lead was scheduled to be implanted into the posterior vein. However, the pacemaker lead could not be advanced through due to the stenosis in the middle of the posterior vein (Figure 2a). A 2 x 22 mm balloon catheter was inflated at 10 atmospheric pressures for 15 seconds using a 0.014 guide wire and the stenosis was dilated (Figure 2b). The balloon catheter was then retrieved and the 78 cm unipolar electrode (Model 4193, Medtronic, Minneapolis, MN, USA) over the guide wire remaining in the vein was placed into posterolateral vein (Figure 2c,d). Test results showed appropriate threshold and resistance values which did not stimulate the diaphragm and chest muscles. All of three pacemaker leads were connected to the InSync Sentry ICD Model 7299 (Medtronic) device and the procedure was terminated after closing the implanted permanent pacemaker site.

DISCUSSION

Despite technological advancements, the left ventricular pacemaker lead cannot be implanted transvenously in 8.4% of the patients.[7] The most important factors leading to failure of the procedure are inability to place the cannula into coronary sinus, inability to reach the target side branch, low threshold safety of *pacing*, and stimulation of extracardiac muscles such as the diaphragm. Others include inability to fix the left ventricular pacemaker lead and to position distal lead properly.[7] On the other hand, one of the rare reasons is the inability to penetrate the targeted, coronary venous stenosis.[15-17] In our cases the left ventricular pacemaker leads were implanted after dilating stenosis in the coronary vein by balloon angioplasty.

The incidence of coronary sinus stenosis is approximately 10% and is mostly asymptomatic.[9] On the other hand, experimental animal studies have demonstrated that thrombus or fibrotic stenosis may develop in coronary veins following DC shock from radiofrequency or laser energy applications.[18,19] It has been also reported that coronary sinus stenosis may rarely develop in humans following ablation of accessory pathways.[20]

Coronary vein stenoses during implantation of triple-chamber cardiac pacemaker may be an obstacle to left ventricular pacemaker lead implantation. Various techniques have been used in such cases. Epicardial pacemaker leads have been implanted in the majority of the patients by the small thoracotomy surgical technique.[10-12] Apart from the thoracotomy technique, Van Gelder et al.[15] first performed angioplasty and stent and implanted the left ventricular pacemaker lead in a 79-year-old patient. In another patient the left ventricular pacemaker lead was implanted by dilating the resistant stenosis in the coronary sinus lateral vein via *cutting* balloon angioplasty.[16] Kaptan et al.[17] also implanted the left ventricular pacemaker lead after dilating coronary sinus vein stenosis by stent in a 57-year-old patient.

Coronary sinus stenoses were dilated by only balloon angioplasty in both patients and the left ventricular pacemaker leads were able to be implanted following angioplasty. Dilating venous stenosis by inflation at 10 atmospheric pressures once, suggested that stenosis was not resistant. It may be suggested that mitral valve replacement procedure which was performed on one of the patients 10 years ago may be responsible for the stenosis in the posterior coronary vein. Absence of a history of any cardiac intervention in other patient suggests an isolated coronary vein stenosis.

In conclusion, coronary vein stenosis is one of the rare reasons associated with failure of left ventricular pacemaker lead implantation. In such cases, balloon angioplasty or stent placement may facilitate implantation of the left ventricular pacemaker lead.

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