CASE REPORTS

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Balloon angioplasty of cardiac vein in a patient treated by cardiac resynchronization therapy

Balon angioplastika srčane vene kod bolesnika lečenog primenom kardioresinhronizacione terapije

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Abstract

Introduction. Cardiac resynchronization therapy (CRT) reduces mortality and hospitalization in patients with symptomatic heart failure and left bundle branch block (LBBB) on optimal drug therapy. Among all, the reasons for "non-response" to CRT pacemaker could be the failure to achieve optimal left ventricular (LV) lead position due to severe curve or stenosis/occlusion of the target vein. **Case report.** We presented a 79-old-male patient, New York Heart Association (NYHA) class III, with atrial fibrillation, chronic coronary syndrome (CCS), and prior myocardial infarction. The patient underwent coronary artery bypass surgery and mechanical prosthetic aortic valve implantation. He was indicated for CRT. The patient's venogram revealed ostial/proximal severe curve and stenosis of the posterolateral vein, the only vein of coronary sinus that led to anatomically optimal LV segment for stimulation. After the balloon angioplasty of the curved and stenotic portion of the target vein with compliant balloon 4.0 × 30 mm, a satisfactory and stable position of quadripolar LV lead was achieved. **Conclusion.** Compliant balloon angioplasty could be a safe and efficient way to override severe coronary vein stenosis in some CRT cases.

Key words:
angioplasty, balloon; cardiac resynchronization therapy; coronary sinus; heart failure.

Apstrakt

Uvod. Kardioresinhronizaciona terapija (CRT) smanjuje smrtnost i broj hospitalizacija kod bolesnika sa simptomatskom srčanom insuficijencijom i blokom leve grane (LBBB) koji su na optimalnoj terapiji lekovima. Jedan od razloga za „nereagovanje" (*non-response*) posle ugradnje CRT pejsmekera može biti neuspeh u postizanju optimalnog položaja elektrode koja stimuliše levu komoru zbog izražene krivine ili stenoze/okluzije ciljne vene**. Prikaz bolesnika**. Prikazan je muškarac, starosti 79 godina, *New York Heart Association* (NYHA) klase III, sa atrijalnom fibrilacijom, hroničnim koronarnim sindromom (CSS) i preležanim infarktom miokarda koji je hirurški revaskularizovan sa implantacijom veštačke mehaničke aortne valvule. Bolesniku je indikovana ugradnja CRT pejsmejkera a venogramom mu je detektovana ostijalno/proksimalna teška krivina i stenoza posterolateralne vene koronarnog sinusa, anatomski jedine vene za optimalnu stimulaciju leve komore. Posle balon-angioplastike zakrivljenog i stenotičnog dela ciljne vene sa komplijantnim balonom 4.0 × 30 mm, postignuta je zadovoljavajuća i stabilna pozicija kvadriplolarne elektrode za stimulaciju leve komore. **Zaključak**. U nekim slučajevima CRT, komplijantna balon angioplastika bi mogla biti siguran i efikasan način za prevazilaženje teške stenoze vene koronarnog sinusa.

Ključne reči:
angioplastika, balonska; srce, terapija, resinhronizaciona; koronarni sinus; srce, insuficijencija.

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Introduction

Cardiac resynchronization therapy (CRT) is a Class I indication for treatment of patients with symptomatic systolic heart failure (HFrEF) and QRS > 150 ms and left bundle branch block (LBBB) QRS morphology, on optimal drug therapy [1].

One of the main reasons for "non-response" on CRT is suboptimal lead placement due to impassable target vein because of vein anatomy, i.e. severe curve or/and thrombosis/stenosis/occlusion, which occurs in 1–4% of the cases [2]. One of the non-routine options is to use percutaneous transluminal coronary angioplasty (PTCA) balloon.

Case report

We presented a case of a 79-year-old male patient, New York Heart Association (NYHA) class III, with a history of hypertension, chronic coronary syndrome (CCS), prior myocardial infarction. The patient underwent coronary artery bypass surgery together with implantation of a mechanical prosthetic aortic valve six years ago.

The electrocardiogram (ECG) showed permanent atrial fibrillation (AF) and complete LBBB, with a QRS duration of 180 ms and ECG signs of the antero-apical scar. Echocardiography revealed reduced left ventricular (LV) ejection fraction (LVEF) 30%, dilated LV end-diastolic diameter (LVEDD) 61 mm, LV end-systolic diameter (LVESD) 45 mm with mechanical dyssynchrony, and normal function of the mechanical prosthetic aortic valve. Since the patient had no history of ventricular tachycardia or ventricular fibrillation and on ambulatory 24-hours HOLTER monitoring only isolated ventricular premature beats (VPBs) were recorded, a CRT pacemaker was intended to be implanted.

Right ventricular lead (Tendril™ STS, St. Jude Medical, 58 cm) was implanted via a cephalic vein and placed on the mid interventricular septum with satisfactory electrical parameters. On coronary sinus (CS) balloon-assisted venography (introducing sheath: Acuity™ Pro, Boston Scientific, 9F, 54 cm, plus Balloon catheter, model 6747, Boston Scientific), posterolateral branch was identified with a good distal diameter reaching the posterolateral LV segment of the latest activation. Unfortunately, the proximal tortuosity and sharp curve (Figure 1) made the vein unpassable with quadripolar (QUARTET™ 1458Q-86, St. Jude Medical), or also with bipolar lead (QUICKFLEX™ 1258T-86, St. Jude Medical). The vein was made passable only with coronary wire 0.014 Fr (ASAHI SION, 180 cm). Subselecting introducing sheath (Attain Select II™ 90^0, Medtronic) with two different curves also failed to achieve the passage of the lead. Finally, we solved the problem with the compliant percutaneous transluminal angioplasty (PTCA) balloon (Sprinter Legend™ Medtronic) 4.0 × 30 mm, which was introduced and placed into the proximal part of the posterolateral vein with gradual expansion up to 12 atmospheres (Figure 2).

During the inflation of the PTCA balloon, vein stenosis (probably due to local thrombus) was confirmed, and after the dilatation, the quadripolar LV lead (QUARTET™ 1458Q-86, St. Jude Medical) easily reached the desired destination (Figure 3). The electrical parameters for LV lead on the anatomically optimal position were acceptable (P4/M3 threshold 0.625V/ 0.4 ms, without phrenic nerve stimulation).

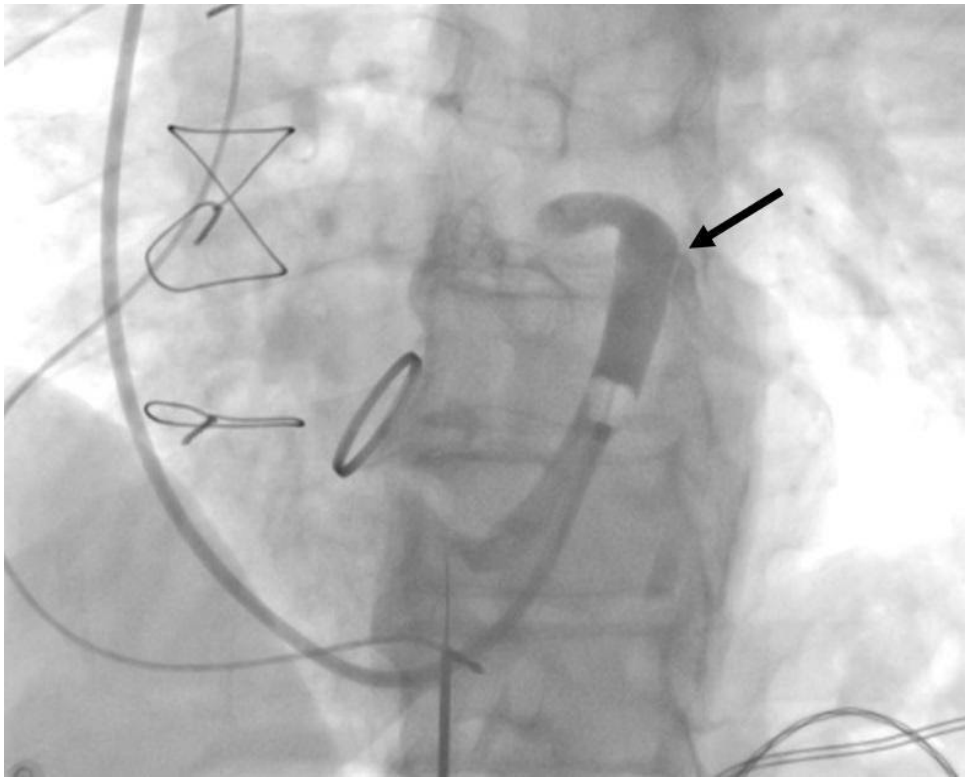

Fig. 1 – Venogram of the coronary sinus. Note the stenosis of the proximal segment of the posterolateral vein.

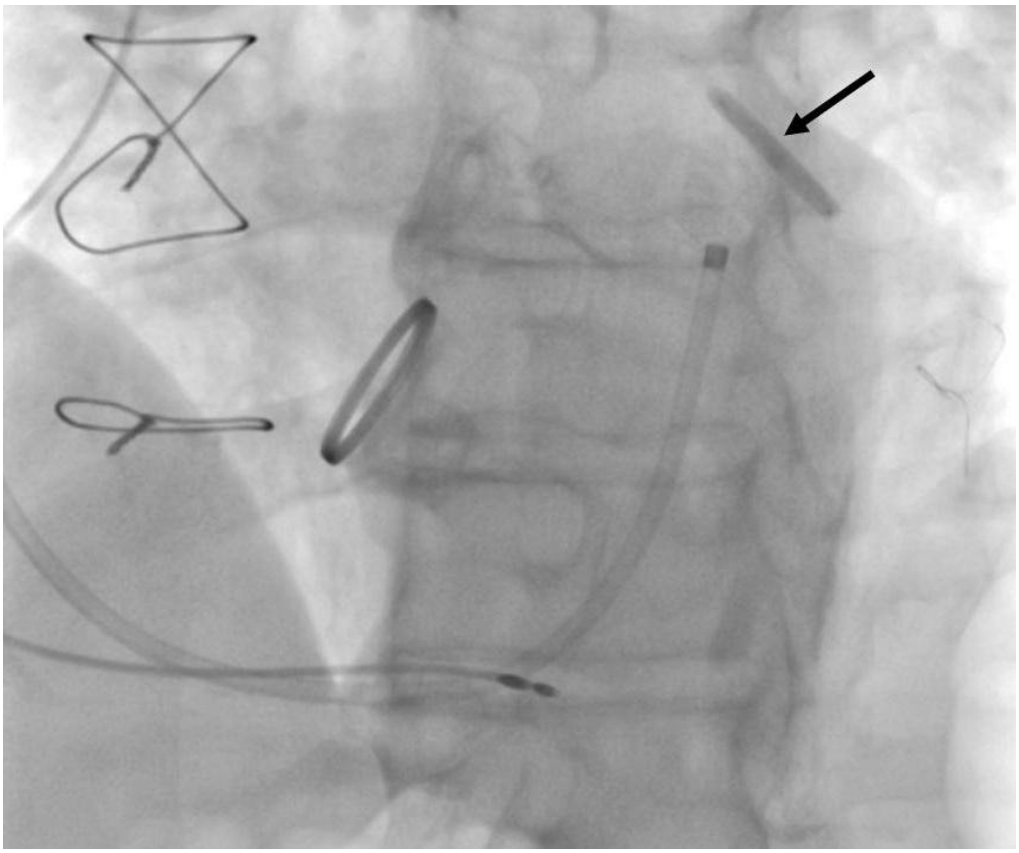

Fig. 2 – Venous angioplasty into the ostial and proximal part of posterolateral vein with compliant percutaneous transluminal coronary angioplasty balloon (Sprinter Legend™ Medtronic) 4.0 × 30 mm.

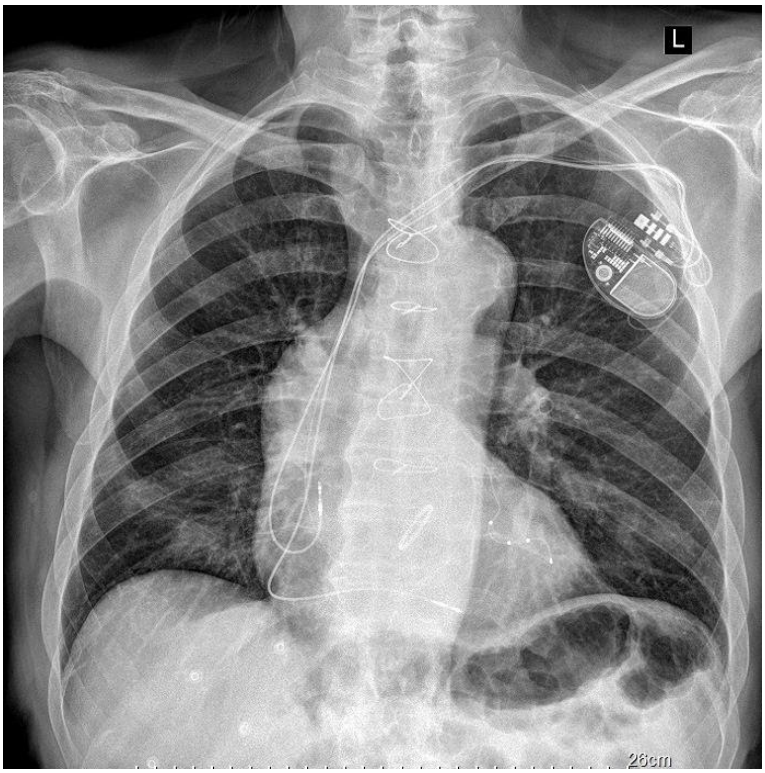

Fig. 3 – Successful implantation of quadripolar left ventricular electrode (QUARTET™ 1458Q-86, St. Jude Medical) after balloon dilatation of proximal segment of posterolateral vein.

Finally, the atrial lead (Tendril™ STS, St. Jude Medical, 52 cm) was implanted since the realistic chance of sinus rhythm in the follow-up period was expected due to a left atrial diameter of less than 50 mm, and a pulse generator (Quadra Allure MP™ St. Jude Medical) was placed in standard subclavicular subcutaneous pocket.

The patient was discharged from the hospital the next day without complication and with QRS narrowed for 40 ms, with normal biventricular capture (according to the lead V1/2). After four months of follow-up, the patient was referred as a clinical "responder" (LVEF improved up to 45%), with evident signs of reverse remodeling, having one NYHA class less and better tolerance of effort.

Discussion

Although CRT is clearly indicated [3–5] in patients with symptomatic HFrEF and optimal drug treatment, having complete LBBB with a QRS duration > 150 ms, in sinus rhythm (Class IA) or atrial fibrillation (Class IIA), randomized controlled trials [6, 7] reported 7.5–10% of unsuccessful implantation due to failure of pacing the LV lead on optimal and stable position.

We presented a case of a 79-year old male patient with permanent atrial fibrillation, a mechanical prosthetic aortic valve with an indication for CRT pacemaker, with the proximal stenosis of the posterolateral coronary vein, which aggravated optimal LV lead positioning. After venous angioplasty with a compliant PTCA balloon, optimal and stable position of quadripolar LV lead was achieved.

Multiple studies have reported the utility of applying interventional principles and equipment in coronary venous circulation to accomplish optimal biventricular stimulation [8, 9]. Luedorff et al. [10] showed on retrospective analysis in a single-center with 705 CRT cases that in 3.5% of the cases, venous angioplasty (balloon 3.0 mm in size usually) was needed and successfully performed. Moreover, the collateral veins could be also dilated in case of occlusion of big coronary vein branches, using small diameter guidewires and balloons [11] to retrogradely approach the target zone of the latest activation of LV, but which is a risky, delicate, and prolonged procedure.

Some authors propose placing the stent on the stenotic portion of the vein (after the dilatation), but this could lead to post-procedural vein occlusion in a short follow-up period with further deterioration of LV ventricle function, which would diminish the positive effect of CRT. Such a case was described in a case report by Jachec´ et al. [12], making these options obscure and potentially dangerous.

On the other hand, some implanters perform stent implantation in the veins parallel to the LV lead, but for other reasons than stenosis [13] (to prevent lead dislodgement). In that case, the potential huge technical and clinical problem would arise in case an extraction was needed. Therefore, one should carefully analyze cost-benefit before the decision.

Finally, since the importance of reaching the optimal LV segment for LV stimulation was well established and recently again emphasized (in 69% of lateral or posterolateral segments) [14], the present case report, which is an example of a non-routine approach and has not been published up to now in domestic journals, showed a relatively easy and safe way to solve the problem of unpassable target vein by using only simple PTCA balloon. In our opinion, a compliant balloon is better than a non-compliant or semi-compliant balloon primarily because of safety issues with polyolefin copolymer material.

Conclusion

In the case of vein stenosis, which precludes placement of LV lead, balloon angioplasty is a relatively easy and safe approach to facilitate the CRT procedure.

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