Left Main Coronary Stent Positioning Using Rapid Transcoronary Pacing

Crochan J. O'Sullivan, MB, BCh and Bernhard Meier, MD

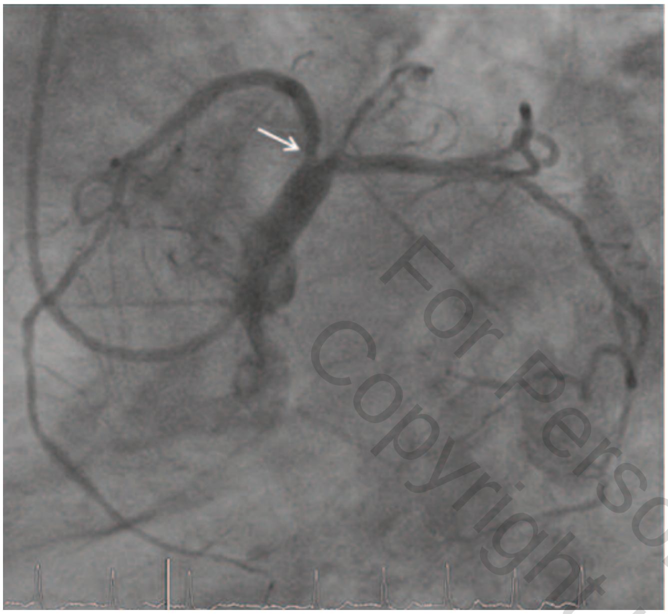

Figure 1. *Distal left main stem and ostial left anterior descending artery (LAD) bifurcation stenosis (arrow).*

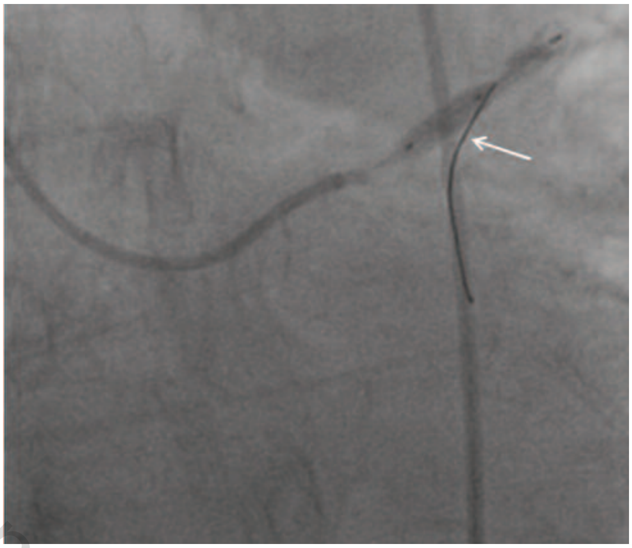

Figure 2. *Rapid transcoronary pacing via the coronary guidewire during stent deployment into the distal left main stem and left anterior descending (LAD) artery to achieve stent immobilization during device deployment. Note the position of the guidewire tip in the septal branch of the LAD (arrow).*

ABSTRACT: Temporary transcoronary unipolar pacing is a validated simple, effective, and safe alternative to temporary transvenous pacing of the right ventricle for the treatment of relevant bradyarrhythmias complicating percutaneous coronary intervention. We describe the use of rapid transcoronary pacing to aid precise placement of a stent in the left main coronary artery bifurcation.

J INVASIVE CARDIOL 2013;25(1):E4-E7

Key words: cardiac pacing, left main intervention, bifurcation

The correct positioning of a stent during percutaneous coronary intervention (PCI) can be thwarted by the pulsatile movement of the stent caused by blood flow and by vigorous contraction and relaxation of the cardiac ventricles. Immobilizing the balloon during deployment is essential for precise placement. Misplacement of an intracoronary stent can have adverse consequences or call for additional measures. Transcoronary unipolar pacing using a coronary guidewire has been an established alternative to conventional transvenous right ventricular pacing for almost 30 years.[1] It has found applicability in a range of cardiac interventional procedures.[2-12] In the current report, we describe the use of temporary transcoronary unipolar pacing as a means to achieve stent immobilization during deployment for precise placement in a left main (LM) stent bifurcation.

From the Swiss Cardiovascular Center Bern, Bern University Hospital, Bern, Switzerland.

Disclosures: The authors have completed and returned the ICMJE Form for Disclosure of Potential Conflicts of Interest. The authors report no conflicts of interest regarding the content herein.

Manuscript submitted April 18, 2012, provisional acceptance given July 3, 2012, final version accepted July 20, 2012.

Address for correspondence: Bernhard Meier, MD, Professor and Chairman of Cardiology, Cardiovascular Department, Bern University Hospital, 3010 Bern, Switzerland. Email: bernhard.meier@insel.ch

Case report. *A 78-year-old female with a medical history of 2-vessel coronary artery disease, paroxysmal atrial fibrillation, transient ischemic attack, hypertension, and dyslipidemia was referred for diagnostic coronary angiography because of increasing shortness of breath on exertion (New York Heart Association Class II-III shortness of breath). She had a history of two stents in the mid and distal left anterior descending (LAD) coronary artery following an anterior transmural myocardial infarction in 2003 and 2 overlapping stents in the proximal and mid right coronary artery (RCA)*

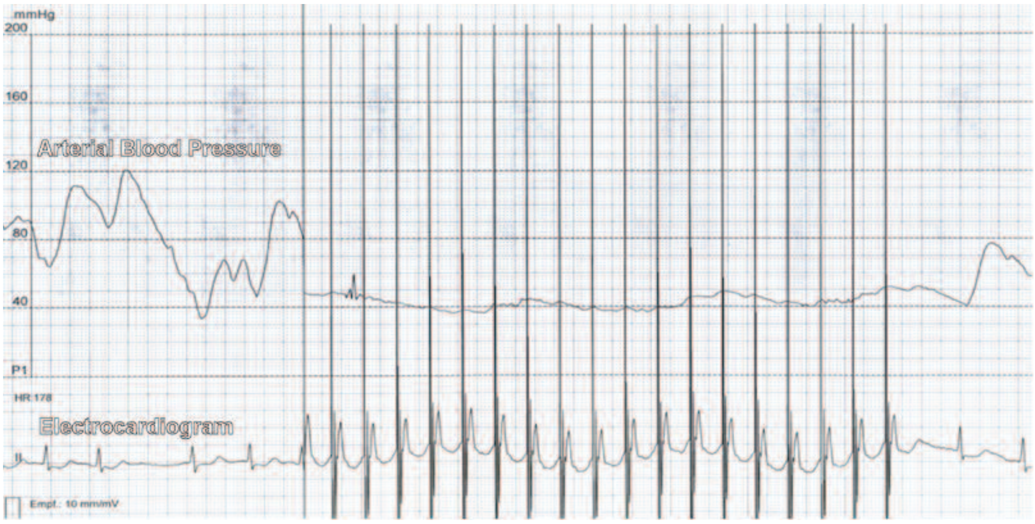

Figure 3. *Electrocardiogram and blood pressure tracing before, during, and after rapid pacing at 180 beats per minute. Mean arterial blood pressure reduced to 40 mm Hg during rapid pacing.*

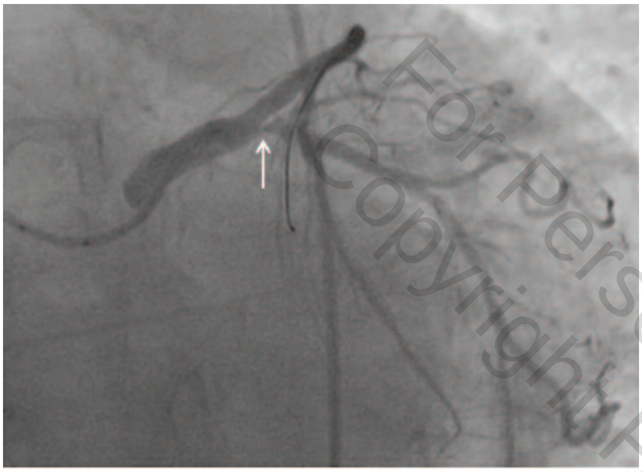

Figure 4. *Following stenting compromise of the ostial left circumflex coronary artery due to carinal plaque shift (arrow) with good result of the ostial left anterior descending coronary artery.*

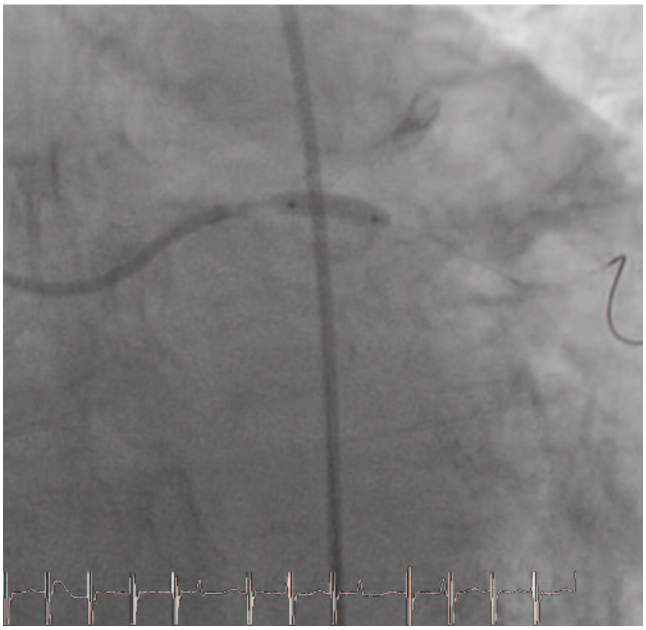

Figure 5. *Coronary stent (9 mm in length) deployment to the ostial left circumflex coronary artery under rapid transcoronary pacing via the coronary guidewire.*

in 2004. The overlapping RCA stents were shown to have an in-stent restenosis at the junction, which was treated with an additional stent in 2010 and again with balloon angioplasty alone a few months later.

The current coronary angiogram revealed again a significant in-stent restenosis at this site as well as a significant de novo ostial LAD stenosis involving part of the distal LM stem (Figure 1). The left circumflex (LCX) coronary artery, including the ostial segment, was free of significant disease. The mid and distal LAD stents were widely patent and the left ventricular systolic function was normal.

The RCA in-stent restenosis was treated via the right femoral artery approach using a 5 Fr Launcher Amplatz Left 2 guiding catheter (Medtronic, Inc) without a femoral sheath, over an 0.035″ J-tipped guidewire (Cordis Corporation) to engage the ostium of the RCA. A 0.014″ Magnum coronary guidewire (Biotronik AG) was used to cross the lesion, after which a 3.0 x 20 mm Maverick balloon (Boston Scientific) was used. An excellent angiographic result was achieved with no evidence of dissection.

The ostium of the LM stem was engaged using the same 5 Fr guiding catheter and guidewire. The tip of the wire was positioned into a septal branch of the LAD. The distal LM and ostial LAD were predilated using the same balloon at 24 bar. An Orsiro 3.0 x 9 mm stent (Biotronik AG) was placed in the lesion. The external end of the Magnum guidewire was connected to the cathode (negative pole) of a single-chamber Medtronic 5348 temporary pacemaker (Medtronic, Inc) with an alligator clamp, whereas the anode (positive pole) was connected to a large surface skin electrode at the left thigh of the patient. Pacing was instituted at 180 beats per minute, with output set at maximum (20 mA) and sensitivity turned off. The awake patient felt no discomfort. During rapid pacing, the stent was deployed using 14 bar for an inflation duration of 10 seconds (Figure 2). The mean arterial pressure was decreased to 40 mm Hg and the pulse wave to around 10 mm Hg (Figure 3). Rapid pacing was stopped with balloon deflation. Angiography revealed a good result in the distal LM stem and ostial LAD, but the ostial LCX was now compromised owing to the carinal plaque shift (Figure 4). The Magnum guidewire was therefore repositioned across the ostial LCX into the first obtuse marginal

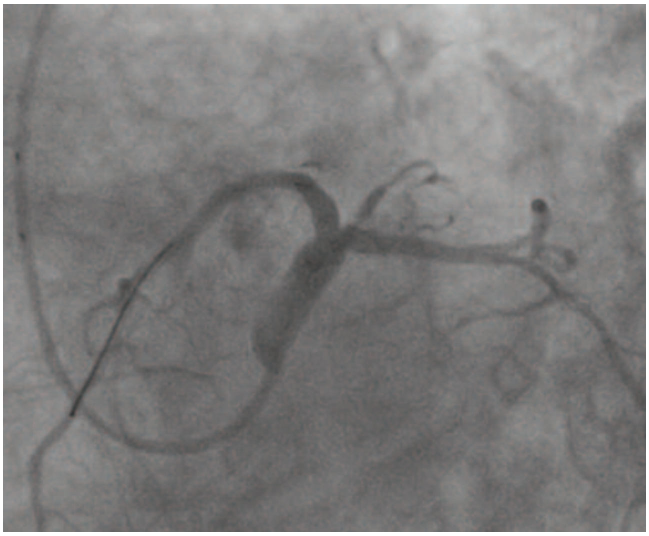

Figure 6. *Good final angiographic result.*

branch of the LCX and the 3.0 x 9 mm stent balloon was used to fenestrate the side branch (ostial LCX) with 20 bars. Because the result was suboptimal, a second Orsiro 3.0 x 9 mm stent was positioned with its proximal portion located at the junction of the LM stem with the ostial LCX. The external portion of the Magnum guidewire was again connected to the temporary pacemaker and rapid pacing was instituted at 180 beats per minute to optimally position the stent at 14 bar (Figure 5). An excellent angiographic result was achieved in the LCX, but there was slight impingement of the ostial LAD (not shown). Therefore, the LAD was rewired and the ostial LAD was postdilated using the 3.0 x 9 mm stent balloon. An excellent angiographic result was achieved (Figure 6).

Discussion. Transcoronary unipolar pacing, first performed in humans in 1984,[1] was initially conceived of as a simple alternative method to treating bradyarrhythmias occurring during the course of coronary balloon angioplasty. This was complemented later by left ventricular pacing.[2] Since then, numerous other applications for transcoronary and left ventricular pacing have evolved, including the treatment of bradyarrhythmias occurring in the context of rheolytic thrombectomy and rotablation,[7,8] the termination of ventricular tachycardia during coronary angioplasty using transcoronary overdrive pacing,[9] the use of left ventricular guidewire pacing as an alternative to transvenous temporary right ventricular pacing during aortic balloon valvuloplasty,[10] and transcatheter aortic valve implantation.[11]

In the present report we describe the use of transcoronary pacing in facilitating and optimizing stent positioning during bifurcational stenting. The short length of the main lesion invited a short stent. Rapid pacing reduced the pulsatile movement of the heart and the thrust of the coronary blood flow. This facilitated optimal positioning of the short (9 mm) stent. This technique was again helpful when it became clear that the side branch would also require a short stent owing to the carinal shift.

Transcoronary pacing involves a number of straightforward steps.[1-12] The tip of the guidewire should be advanced in the coronary artery as distal as possible into a side branch supplying muscle rather than epicardium. Outside the body, the proximal end of the guidewire should be connected to the cathode of any commercial external pulse generator, eg, using an alligator clip. The anode (positive pole) of the pulse generator can be connected either to a large skin electrode or to a steel monofilament suture, other needles, or a clamp attached to the anesthetized groin. At our institution, we have found attaching the anode to a large skin electrode (surface area of about 100 cm^2) on the left leg or abdomen to be adequate. The guidewire should be insulated as much as possible all the way up to at least the coronary orifice. In practice, the guiding catheter takes care of this. Within the coronary artery, advancement of the balloon catheter (Monorail or over-the-wire balloon) to the region of the guidewire tip will provide additional insulation if needed. The pacing output on the external pulse generator should first be set at maximum and only reduced once pacing is achieved and has to be maintained for a while. The output can be gradually decreased to determine the pacing threshold. Once the pacing threshold has been achieved, the output can be set at 2 or 3 times the threshold to provide a safety margin and the pulse generator can be set in demand mode or turned off or disconnected to be re-used when required. The pulse width is usually set at 2.5 ms (default) and sensitivity is turned off. Most coronary guidewires are suitable for transcoronary pacing.[8] Notable exceptions, however, include the Choice PT with ICE hydrophilic coating, Forte Moderate Support with silicone coating and Roto Floppy coronary guidewires (all manufactured by Boston Scientific), which have been shown to have high electrical resistance and are therefore not suitable for transcoronary pacing.[8]

A number of techniques have been described to stabilize the stent during aorto-ostial or bifurcation stenting procedures. These include the Szabo technique,[13,14] rapid pacing via transvenous catheter stimulation of the right ventricle[15,16] and induction of asystole through adenosine administration,[12] among others. The Szabo technique requires 2 guidewires, therefore adding cost. In addition, there have been reports of excessive resistance when attempting to remove the tail anchoring wire while using the Szabo technique, which may lead to telescoping of the guide into the stented vessel. This is a risk for vessel dissection and wire fracture.[14] Furthermore, the insertion of the tail anchor wire under the last stent cell can potentially damage the stent balloon and distort the architecture of the stent.[13,14] Transvenous right ventricular pacing requires additional catheters and is associated with numerous potentially serious complications in 1%-20% of cases,[3] including right ventricular perforation with associated tamponade,[3,17] femoral arteriovenous fistula formation,[3] deep vein thrombosis and pulmonary embolism[3] and bleeding at the femoral access site by inadvertent arterial laceration. The duration of asystole induced by adenosine is short and unpredictable and must be used with caution in patients with asthma. Transcoronary pacing is associated with none of these complications. Described side effects include coronary spasm, diaphragmatic stimulation (treated by changing the wire position) and a stinging sensation at the site of the anode (prevented by using a larger electrode or the anesthetized groin for the anode contact).[3]

Lasa et al were the first to describe the use of transcoronary pacing to achieve stent immobilization during coronary angioplasty in 27 consecutive patients including 1 patient with LM stem disease.[12] They found transcoronary pacing via the guidewire to be an effective and safe method for achieving stent immobilization during PCI in cases with excessive pulsatile motion. Our case report complements the case series by Lasa et al by describing in detail the steps involved in a more simple approach.

Conclusion. Transcoronary unipolar pacing is a no-cost, validated, and simple method that can be easily applied in the catheterization laboratory to a range of cardiac interventional procedures as outlined above. It can be considered as a means to achieve stent immobilization to optimize stent deployment during complex coronary bifurcation or ostial interventions.

References

1. Meier B. Coronary pacing for bradycardia during balloon angioplasty. N Engl J Med. 1984;311(12):800.
2. Meier B, Rutishauser W. Coronary pacing during percutaneous transluminal coronary angioplasty. Circulation. 1985;71(3):557-561.
3. de la Serna F, Meier B, Pande AK, et al. Coronary and left ventricular pacing as standby in invasive cardiology. Cathet Cardiovasc Diagn. 1992;25(4):285-289.
4. Meier B. Pacing in the left heart — often forgotten because rarely needed. Catheter Cardiovasc Diagn. 1997;42(1):33.
5. Meier B. Emergency pacing during cardiac catheterization: it is all there already. Catheter Cardiovasc Interv. 2004;61(4):501-502.
6. Meier B. Coronary or left ventricular pacing, the easy and obvious way out of asystole during cardiac catheterization. J Invasive Cardiol. 2011;23(3):115.
7. Mixon TA, Dehmer GJ, Santos RA, Gantt DS, Lawrence ME, Watson LE. Guidewire pacing safely and effectively treats bradyarrhythmias induced by rheolytic thrombectomy and precludes the need for transvenous pacing: the Scott & White experience. J Invasive Cardiol. 2008;20(8 Suppl A):5A-8A.
8. Mixon TA, Cross DS, Lawrence ME, Gantt DS, Dehmern GJ. Temporary coronary guidewire pacing during percutaneous coronary intervention. Catheter Cardiovasc Interv. 2004;61(4):494-500.
9. Goode G, Bennett D. Successful coronary pace-termination of ventricular tachycardia during coronary angioplasty. Catheter Cardiovasc Diagn. 1997;42(1):31-32.
10. Navarini S, Pfammatter JP, Meier B. Left ventricular guidewire pacing to simplify aortic balloon valvuloplasty. Catheter Cardiovasc Interv. 2009;73(3):426-427.
11. Guérios EE, Wenaweser P, Meier B. Left ventricular guidewire pacing for transcatheter aortic valve implantation. Catheter Cardiovasc Interv. 2012 May 14 [Epub ahead of print]. doi: 10.1002/ccd.24474.
12. Lasa G, Larman M, Gaviria K, Sanmartin JC, Sàdaba M, Rumoroso RJ. Coronary stent immobilization during angioplasty by transcoronary ventricular pacing via a guidewire. Rev Esp Cardiol. 2009;62(3):288-292.
13. Kern MJ, Ouellette D, Frianeza T. A new technique to anchor stents for exact placement in ostial stenoses: the stent tail wire or Szabo technique. Catheter Cardiovasc Interv. 2006;68(6):901-906.
14. Applegate RJ, Davis JM, Leonard JC. Treatment of ostial lesions using the Szabo technique: a case series. Catheter Cardiovasc Interv. 2008;72(6):823-828.
15. O'Brien DG, Smith WH, Henderson RA. Stabilisation of coronary stents using rapid right ventricular pacing. Eurointervention. 2007;3(2):235-238.
16. Okamura A, Ito H, Iwakura K, et al. Rapid ventricular pacing can reduce heart motion and facilitate stent deployment to the optimal position during coronary artery stenting: initial experience. Eurointervention. 2007;3(2):239-242.
17. Nashed G, French B, Gallagher D, et al. Right ventricular perforation with cardiac tamponade associated with use of a temporary pacing wire and abciximab during coronary angioplasty. Catheter Cardiovasc Interv. 1999;48(4):388-389.