Temporary transcoronary pacing by coated guidewires

A safe and reliable method during percutaneous coronary intervention

**Summary** Relevant bradycardias during percutaneous coronary intervention (PCI) are a rare event, but they require immediate therapy by temporary pacing. However, transvenous pacing is associated with frequent and severe complications. Therefore, we wanted to evaluate the safety and reliability of transcoronary pacing by means of a PCI guidewire. Coronary pacing was applied to 70 consecutive patients undergoing PCI. Pacing was performed before and after PCI in a unipolar setting using standard guidewires as a cathode and a skin electrode as an anode. Both were connected to an external pacemaker. Coronary pacing (maximum output at 10 V, impulse duration 2.5 ms) was effective in 60 of 70 patients (85.7%). Successful pacing was achieved in the LAD and diagonal branches in 90% (27 of 30 Pts.), in the LCX and marginal branches 84.2% (16 of 19 Pts.) and in the RCA in 81% (17 of 21 Pts.). Pacing thresholds were comparable in all vessels within a range of 1–10 V averaging 6.6 ± 2.3 V before and 6.6 ± 2.2 V after PCI. The impedance ranged from 190–544 Ω with mean pacing impedance for coronary pacing of 424 Ω before and 416 Ω after PCI, respectively. Significant bradycardias during PCI occurred in 7 cases (10%). In three cases (4.3%) temporary coronary pacing became necessary at a maximum pacing duration of 3 min. There were no severe side effects. Coronary spasm occurred in 3 cases (4.3%) after pacing and was promptly reversible after intracoronary application of nitroglycerine. It is concluded that coronary pacing is a safe and feasible method for the treatment of bradycardias during PCI. It avoids additional venous puncture under hemodynamically unstable conditions and subsequent transvenous pacing, which is accompanied by potentially severe complications and additional costs.

**Key words** Percutaneous intervention – bradycardia – temporary transcoronary pacing

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**Introduction** Relevant bradycardias during percutaneous coronary intervention (PCI) are a rare event in about 1–2% of all patients undergoing PCI [6]. According to the ALLK registry for Germany [22], there are about 220,000 PCI procedures/year resulting in about 2200–4400 bradycardias/year during coronary interventions to be treated quickly and efficiently.

None of the currently available Guidelines for PCI procedures recommends how to deal with the problem of bradycardias during PCI. Furthermore, there
are no reliable data on the risk of relevant bradycardias originating from different clinical situations. Thus, the need for temporary pacing remains poorly predictable. Therefore, it depends on the decision of the interventional cardiologist to indicate prophylactic transvenous temporary pacing devices during PCI procedures. If a right ventricular lead for temporary pacing is installed prophylactically, this will increase procedure duration and costs, and, most importantly, it will increase the risk of severe complications like cardiac perforation with subsequent tamponade [2], induction of ventricular arrhythmias [9, 14] up to ventricular fibrillation [6, 12], deep vein thrombosis with pulmonary embolism, and local vascular complications with arteriovenous fistula and bleeding complications [24]. The overall risk of some of these complications varies between 1% and 20% [21]. Furthermore, if glycoprotein IIb/IIIa receptor inhibitors are used, the risk of severe bleeding complications is increased [3, 16, 23].

To avoid additional venous puncture and intracardiac lead placement, transcoronary pacing was introduced in 1984 as a new method to handle unexpected bradycardias during PCI. Despite the promising data in experimental and clinical settings published by Meier et al. [4, 5, 18], this method has not yet gained general acceptance. More recently, results from a small study with 26 patients were published [20]. These results underline the problem of the high resistance of some guidewires especially when using the “over-the-wire” technique.

The purpose of this study was to re-evaluate the feasibility and safety of transcoronary pacing for stand-by during coronary interventions in the era of coated guidewires and exceeding use of coronary stents.

### Materials and methods

Coronary pacing was performed in 70 consecutive patients undergoing PCI after written informed consent was obtained. The study was conducted according to the regulations of the local ethics committee.

All patients underwent standardized interventional procedure with 70 I.U./kg body weight i.v. unfractionated heparin (Fa. Braun, Melsungen, Germany) for anticoagulation. Iopamidol 370 (Solutrast, Fa. Altana, Konstanz, Germany) at body temperature was used as contrast medium for coronary angiography in all cases. For the treatment of coronary vasospasms 0.1–0.2 mg nitroglycerine was injected into the coronary vessel.

![Pacing technique](Image)

For coronary pacing, the tip of the coronary guidewire was advanced into an intramyocardial branch distal to the target lesion, either of the main vessel itself, or into a small side branch. According to our standardized protocol, only guidewires from Guidant (Guidant Corp, St. Paul; USA) were used. All provided guidewires (floppy, middle-weight or heavy-weight guidewires) could be used, depending on the morphology of the target vessel and the corresponding need for support. Outside the body, the uncoated stiff end of the guidewire was connected to the cathode of an external pulse generator (model 3105, Guidant Corp., St. Paul; USA) with a maximum output of 10 V at a maximum pulse width of 2.5 ms. A sterile alligator clamp (the same as used for measurement during implantation of permanent pacemaker electrodes) allowed easy and fast connection of the pulse generator to the guidewire. The guiding catheter (6-F-guiding catheters, Fa. Cordis, USA) in the aorta provided insulation for the guidewire.

The anode of the pulse generator was connected to a skin electrode in the left hip region with a surface area about 100 cm².

After the guidewire was placed appropriately, the target lesion for PCI was measured after intracoronary injection of 0.1–0.2 mg nitroglycerine. The time required for measuring the diameter was used for the investigation of transcoronary pacing. After measurement of the R-wave, transcoronary pacing was performed at a pacing rate of about 20 beats per minute faster than the spontaneous sinus rate. Pacing was started at maximum output (10 V at 2.5 ms impulse duration) with subsequent reduction of output voltage until the pacing threshold was reached. Pacing was continued above the pacing threshold for several seconds for measuring the pacing impedance.

If an effective pacing could not be achieved at maximum output, we attempted to push the guidewire slightly deeper into the selected branch. If pacing was furthermore still ineffective, another side branch distal to the target lesion was selected. If pacing was not effective after the guidewire was repositioned three times, the vessel was considered not suitable for transcoronary pacing and the manipulation was stopped to avoid vessel damage or perforation. Depending on the peri-interventional risk of AV-conduction disturbances (especially in PCI of the RCA) transvenous pacing was established before PCI was performed. The position of the tip of the wire was documented by a short cine loop. In some cases the tip of the wire had to be removed from the wedge position to improve back up for balloon and/or stent positioning. After PCI was completed, the