



The Interventional Cardiac Catheterization

HANDBOOK

second edition



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BASIC CORONARY BALLOON ANGIOPLASTY AND STENTING

Morton J. Kern

INTRODUCTION

On September 16, 1977, Andreas Grüentzig performed the first human percutaneous transluminal coronary angioplasty (PTCA) in Zurich, Switzerland. Until then, coronary artery bypass surgery was the only alternative to medicine for the treatment of coronary artery disease. Over the last 26 years, new developments have resulted in a dramatic growth of percutaneous coronary intervention (PCI) as one of the most successful methods of coronary revascularization. In 2002 approximately 750,000 patients underwent PCI in the USA alone. PCI is the treatment of choice for discrete single- and double-vessel coronary lesions in patients with good left ventricular function and plays an important role in complex revascularization in patients with multivessel coronary artery disease and depressed left ventricular function. Today there are many techniques to open a narrowed artery, not only of the coronary arteries but also of the peripheral and great arteries of the body. The use of various techniques, which include balloons, stents, cutters, lasers, grinders, suckers, filters and other tools, are collectively called PCI. Percutaneous transluminal coronary angioplasty (PTCA) will be used to describe information and techniques related to use of the balloon inflation technique alone that was first employed by Grüentzig.

This chapter will present the basic method and mechanisms of balloon angioplasty and stenting as an introduction to the practice of interventional cardiology. The various techniques of

percutaneous coronary revascularization can be placed into niche applications for specific devices (Table 1-1).

OVERVIEW OF THE BASIC PCI METHODS

Percutaneous coronary intervention was derived from the basic procedures used for diagnostic cardiac coronary angiography. PCI begins with vascular access and uses the same techniques for the insertion of an arterial sheath through the arm (radial artery) or leg as Seldinger's method (needle and guidewire). Specialized larger-lumen "guiding" catheters engage the coronary artery in the same manner as those used for diagnostic coronary angiography with relatively minor differences.

Figure 1-1 shows how to perform PCI. A guiding catheter is first seated in the coronary ostium. A thin, steerable guidewire is introduced into the coronary artery and positioned across the stenosis into the distal aspect of the artery. An angioplasty catheter, which is considerably smaller than the guiding

Table 1-1

Niche Applications of PCI Devices

Lesion Type	Balloon/ Stent	Rotoblator	DCA	TEC	Special Device
Type A	+++	++	–	–	–
Complex	++	++	+	–	–
Ostial	++	++	–	–	–
Diffuse	+	+++	–	–	–
Total occlusion	++	+	–	–	–
Calcified bifurcation	±	++	+	–	–
SVG Focal	+++	±	+	±	–
SVG Diffuse	+	±	–	++	–
SVG Thrombotic	±	–	–	++	Angio Jet
Complication dissection	+++	–	±	–	–
Acute Occlusion	++	–	–	–	–
Thrombosis	+	–	–	+	Angio Jet
Perforation	±	–	–	–	Covered stent, perfusion balloon

+++ highly applicable; ++ somewhat helpful; + applicable; ± marginal; – not applicable.
DCA, directional coronary atherectomy; TEC, transluminal extraction catheter.

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Fig. 1-1 How angioplasty and stenting works. **A**, The artery is filled with atherosclerotic material, compromising the lumen. A cross-section of the artery is shown on the right side. **B**, A guidewire is positioned past the stenoses through the lumen. **C**, A balloon catheter is advanced over the guidewire. **D**, The balloon is inflated. **E**, The balloon is deflated and withdrawn. **F**, The balloon catheter is exchanged for a stent (on a balloon). **G**, The stent is expanded. **H**, The expanded stent remains in place after the deflated balloon is withdrawn. (Reproduced with permission from 'Your PTCA, our Guide to Percutaneous Transluminal Coronary Angioplasty', American Heart Association, 2001.)

catheter, is inserted through the guiding catheter and is positioned (in the artery) across the stenotic area by tracking it over the guidewire. Once correctly placed within the area to be treated, the balloon on the PCI catheter is inflated several times for periods ranging from 10 seconds to several minutes. The

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