Management of Complications

Peter P. Monteleone, MD, MS[a], Robert W. Yeh, MD, MSc, MBA[b,*]

KEYWORDS

• Complications • Vasovagal • Coronary dissection • Coronary perforation • Stent thrombosis • No reflow • Stent loss • Embolization

KEY POINTS

- As the complexity of percutaneous coronary intervention (PCI) cases has grown, so too has the opportunity for procedural complications.
- The estimated risk associated with diagnostic coronary angiography of death, myocardial infarction (MI), or stroke in patients who are stable at the time of presentation to a catheterization laboratory is less than 0.1% for each.
- Vascular complications, allergic complications, renal injury, and radiation injury are all complications to be remembered during performance of cardiac catheterization procedures.
- Meticulous and focused technique, applied consistently, is mandatory to prevent the intracoronary complications of PCI.
- Operators must be constantly vigilant for intracoronary complications and prepared to initiate treatment of them when they occur immediately and expertly.

INTRODUCTION

Over the past 4 decades, PCI has made incredible progress in the management of obstructive coronary artery disease. From the first percutaneous balloon angioplasty by Gruntzig in 1977, through the first scaffolding coronary stent placed by Puel and Sigwart in 1986 to prevent vessel closure, through the commercialization of drug-eluting stent (DES) technologies in 2002 to slow restenosis, the rapid growth of technology has progressively improved the ability to combat the complications of PCI.[1] The use of dual antiplatelet therapy, anticoagulation strategies, improved guiding catheters, atherectomy devices, novel balloons, improved stent materials, embolic protection devices, percutaneous hemodynamic support devices, and untold other technologies has enhanced interventionalists' ability to successfully open obstructive coronary lesions while minimizing the incidence of periprocedural complications.[2]

PERCUTANEOUS CORONARY INTERVENTION AND FOUNDATIONAL ELEMENTS OF INFORMED CONSENT

The many distinct complications of PCI run the gamut from the general (eg, death, stroke, and periprocedural MI) to the exceedingly specific (eg, balloon rupture and stent embolization). To discuss the specific incidence and characteristics of every possible complication that could occur during preprocedural consent is time prohibitive. More importantly, providing such an abundance of information likely would cloud a preprocedure patient's ability to understand the fundamental elements of the catheterization procedure and the major points of the associated procedural risk. Operators thus develop

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[a] Division of Cardiology, Department of Medicine, Massachusetts General Hospital, Harvard Medical School, 55 Fruit Street, Boston, MA 02114, USA; [b] Division of Cardiology, Smith Center for Outcomes Research in Cardiology, Beth Israel Deaconess Medical Center, Harvard Medical School, 185 Pilgrim Road, Baker 4, Boston, MA 02215, USA
* Corresponding author.
E-mail address: ryeh@bidmc.harvard.edu

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their own consent process, with unique discussion points and demonstrative techniques by which to ensure that their patients are well informed about the processes and the risks of PCI.[3] Regardless of interoperator consent variability, however, there are certain fundamental risks and statistics that ideally should be included in any informed consent process prior to performance of coronary angiography and intervention.

General Risks of Diagnostic Coronary Angiography

Diagnostic coronary angiography carries its own general risks, and, in that many coronary procedures are performed as angiography with the possibility of performing ad hoc PCI, it is important to prespecify to patients the potential risks of both coronary angiography and PCI.

Death secondary to coronary angiography is rare. A registry of 200,000 patients reported that the procedural mortality of diagnostic coronary angiography had fallen to 0.1%.[4] Advanced age, advanced heart failure, severe left main disease, valvular heart disease, and chronic kidney disease have been identified as risk factors for procedural mortality.[4,5] The risk of periprocedural MI is less than 0.1%.[4,6] The risk of stroke is also approximately 0.1%.[7]

Although every patient, and thus every case, is different, a statistic that is frequently cited during the informed consent process is that the risks associated with diagnostic coronary angiography of death, MI, or stroke in patients who are stable at the time of presentation to a catheterization laboratory are less than 0.1% for each.[8,9]

General Risks of Percutaneous Coronary Intervention

The risk of short-term mortality immediately due to PCI is widely variable secondary to underlying patient risk factors as well as the degree of PCI complexity. The American College of Cardiology National Cardiovascular Data Registry (NCDR), which included more than 100,000 PCIs performed between 1998 and 2000, with stent placement in 77%, reported a risk of death secondary to PCI of 1.4%, ranging within individual participating hospitals from a low of 0% to a high of 4%.[10] A 2013 analysis of the Cleveland Clinic's institutional PCI registry of 4078 PCI patients reported a 2% risk of death within 30 days, with 42% of these deaths deemed secondary to PCI-related complications.[11]

The risk of periprocedural MI is even more difficult to report because every measurement of periprocedural MI incidence has changed with the improving technology that has both reduced the risk of complications and simultaneously allowed operators to tackle more complex lesions. Perhaps even more importantly, the measured frequency of periprocedural MI has changed with changing definitions of periprocedural MI itself, as well as with the increasing sensitivity of biochemical markers of MI.[12] This effect of the changing definition of postprocedural MI becomes clear when up to 43% of patients who go into a PCI with a normal troponin level have some elevation of troponin at the completion of the case.[13] The 2011 American College of Cardiology/American Heart Association guidelines for PCI describe the 2007 universal definition of MI as occurring when cardiac biomarkers post-PCI climb to above the 99th percentile upper reference limit of normal and thus indicate myocardial necrosis. These guidelines also report, however, that the increase of biomarkers greater than 3 times the 99th percentile upper reference limit defines PCI-related MI.[2] According to this definition, approximately 15% of patients undergoing PCI experience a periprocedural MI.[14] In an attempt to define a group at risk for a clinically negative outcome and to develop a definition of periprocedural MI applicable to patients with elevated baseline troponin levels, the 2012 Third Universal Definition of Myocardial Infarction was formulated by a joint European Society of Cardiology/American College of Cardiology Foundation/American Heart Association/World Health Federation task force. This definition somewhat arbitrarily defines MI associated with PCI as elevation of troponin values greater than 5 times the 99th percentile upper reference limit in patients with normal baseline values or a rise of troponin values greater than 20% if the baseline values are elevated and are stable or falling. Patients must also experience symptoms suggestive of myocardial ischemia, new ischemic electrocardiographic changes, new left bundle branch block, angiographic loss of patency of a major coronary artery or a side branch, persistent diminished flow or embolization, or imaging demonstration of new loss of viable myocardium or new regional wall motion abnormality. The incidence of periprocedural PCI meeting this definition is currently poorly delineated.[15]

An NCDR report describes a 0.4% risk of conversion to emergency coronary artery bypass surgery.[16] The incidence of PCI-related stroke, defined as development of a central neurologic deficit persisting greater than 72 hours with its onset starting anytime from the time of PCI until