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Primary Percutaneous Coronary Intervention for ST–Elevation Myocardial Infarction and Door-to-Balloon Time: A Catheterization Laboratory Perspective

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1. Introduction

Rapid reperfusion improves mortality in patients with acute ST- elevation myocardial infarction (STEMI). Moreover, achieving reperfusion by primary percutaneous coronary intervention (PCI) instead of fibrinolytic therapy is preferred because patients have less strokes, less nonfatal reinfarctions, and a lower mortality rate (Keeley et al., 2003). However, because achieving perfusion with primary PCI sometimes involves transporting patients from the location where the diagnosis was made to a catheterization laboratory, and once in the catheterization laboratory numerous technical and clinical problems must be successfully managed, there is a significant time delay. In some studies, this time delay has been associated with an increased mortality (Boersma, 2006; Nallamothu and Bates, 2003). Furthermore, the advantages of primary PCI over thrombolytic therapy may be negated if the time to reperfusion with primary PCI exceeds that of fibrinolytic therapy by one hour or more (Nallamothu and Bates, 2003). In absolute terms, when patients are selected for the primary PCI strategy, every minute of delay to reperfusion affects the one-year mortality. In one study, the one-year mortality was increased by 7.5% for every 30 minute delay (De Luca et al., 2004). With these factors in mind, the American Heart Association/American College of Cardiology (AHA/ACC) guidelines for STEMI recommend that the interval between arrival at the hospital and treatment of the coronary lesion with a balloon inflation (door-to-balloon time) should be 90 minutes or less (Antman et al., 2004). Conjointly, in the United States the Centers for Medicare and Medicaid Services (CMS) and the Joint Commission on Accreditation of Healthcare Organizations have included this goal as one of their core quality measures. Subsequently, institutions responsible for quality improvement in patients with STEMI were created to focus on factors that increase door-to-balloon times (Singh and Harrington, 2007). Most of the barriers that affect the time interval from patient presentation to the arrival of the patient in the catheterization laboratory have been identified and significant improvements have been made (Bradley et al., 2006; Kraft et al., 2007). Less attention, however, has been directed toward reducing delays after the patient enters the catheterization lab. This chapter will focus on methods clinicians have used to decrease the time between establishment of arterial access and successful coronary reperfusion in patients with STEMI.

2. Electrocardiogram (EKG) - directed PCI in patients with STEMI

In patients with STEMI, an EKG is an essential roadmap if the culprit vessel is visualized and then treated first before performing any other diagnostics. In a retrospective study, Lachance and colleagues used the EKG to determine the culprit vessel in patients undergoing primary PCI for STEMI. In one group, they imaged and then immediately percutaneously treated the culprit vessel before performing a complete coronary and left ventricular evaluation. In another group, they performed complete coronary catheterization and then PCI. Acute myocardial infarction by EKG was defined as chest pain or the equivalent symptoms at rest greater than 30 minutes, with either ST-segment elevation in greater than two contiguous leads (greater than 2 mm in the precordial lead, greater than 1 mm in the limb lead), ST-segment depression greater than 1 mm in the precordial leads, or new or presumed new left bundle branch block (LBBB). In the group where the culprit vessel was treated first, the actual culprit vessel was the presumed culprit vessel by EKG most of the time. Specifically, the EKG correctly diagnosed the culprit vessel in 83 of these 87 patients (95%). In this study, however, patients who had previous coronary artery bypass surgery (CABG) and those with thrombolysis in myocardial infarction (TIMI) 2 to 3 flow in the culprit vessel were excluded from the analysis (LaChance et al., 2008). Similarly, in the retrospective study by Applegate and colleagues, an EKG in the emergency room determined the presumed culprit vessel in the culprit PCI group. The presumed culprit vessel was the actual culprit vessel in 49 of the 50 patients. In one patient, a right coronary guide was chosen but the culprit vessel was a distal dominant left circumflex coronary artery. Left main or severe three-vessel coronary artery disease was found in only 2% of the patients in the culprit vessel group (Applegate et al., 2008).

3. Arterial access

In the catheterization laboratory, several critical but time-consuming steps are performed to help make important decisions not only about revascularization, but also about overall patient management. The first of these involves the location of arterial access. The most common access routes include the femoral, the brachial and the radial artery. In patients undergoing PCI for STEMI, various potent antiplatelet and anticoagulant therapies are required. As a result, bleeding at vascular access sites, particularly the femoral artery, is an important and common cause of morbidity and mortality (Hetherington et al., 2009). Comparatively, the radial artery in this setting, has been associated with minimal or no bleeding complications. Despite this, the femoral artery has been the access site of choice in the United States. Reasons for this include the learning curve associated with performing cardiac catheterizations via the radial artery, and difficulty achieving radial access in certain patients despite having considerable experience. With good reason, operators have been concerned that these difficulties may increase door to balloon times. Several studies have evaluated this concern. Cantor and colleagues in a small multicenter study randomized 50 patients with acute myocardial infarction requiring either primary or rescue PCI to radial or femoral access. Operators in this study had significant experience with the transradial approach. They reported their times from local anesthesia to first balloon inflation at 32 (25th percentile 26, 75th percentile 38) minutes for radial access and 26 minutes (25th percentile 22, 75th percentile 33) for femoral access (P=0.04). Reperfusion success rates were high and comparable with either approach (Cantor et al., 2005). In another randomized

study, however, not only were the success rates for perfusion high and similar in both groups, procedure time was less in the transradial group compared to the transfemoral group (44 minutes ± 18, versus 51 minutes ± 21) (Saito et al., 2003). Non-randomized studies investigating these approaches in patients with STEMI, where the location of access is left to the discretion of the interventionalists, have reported lower or similar access to reperfusion times with the transradial approach compared to the femoral approach (Hetherington et al., 2009; Larrazet et al., 2003; Pancholy et al., 2010; Weaver et al., 2010).

These data suggest that the transradial approach may be preferable to the transfemoral approach in patients being treated for STEMI. Furthermore, in patients where femoral access is extremely difficult to obtain, the radial artery provides an attractive alternative. As attractive as the radial approach may seem, there are important points to highlight. There is a significant learning curve associated with radial access. In studies where low failure rates via the radial artery approach were reported, most of the operators already performed more than 1000 radial cardiac catheterizations (Agostoni et al., 2004). In addition, in the non-randomized studies where the choice of access was left to the discretion of the operator, patients with coronary artery bypass grafts of unknown anatomy were more likely to have been performed via the femoral approach. Also, access site crossover is higher when the radial artery access is used. That is, if the initial approach by the radial artery is unsuccessful the procedure has to be performed via the femoral approach. Consistently, a crossover rate of 7% has been observed in most of the studies investigating these approaches. Lastly, the radial approach is often limited by the size of the sheath (not more than 6 French). Placing a 7 or 8 French sheath, which can help provide more support during the procedure, is associated with a higher risk of radial arterial spasm, and thus a lower procedural success rate (Agostoni et al., 2004; Weaver et al., 2010). Despite these obstacles, it seems that a catheterization laboratory team dedicated to the radial approach can achieve comparative door to balloon times with the benefit of decreased morbidity and mortality related to major bleeding in patients with STEMI.

There are little data comparing brachial arteriotomy with other locations of vascular access in patients undergoing PCI for STEMI. In general the brachial approach, like the radial artery approach, is used in patients with severe peripheral vascular disease, or where there is an increased risk of bleeding (due to anticoagulation or recent thrombolytic therapy). Another advantage of this approach, as opposed to the radial artery is the ability to use 7 French or greater catheter sizes. Complications with the brachial artery, however, include median nerve injury from compression by a hematoma, which can potentially lead to irreversible nerve damage. Thus in our laboratory, the radial artery is preferred over the brachial artery for vascular access in selected patients with STEMI.

4. Culprit vessel PCI versus traditional catheterization and PCI for STEMI: Door to balloon times

Comprehensive coronary angiography can identify STEMI patients who may benefit from an urgent surgical approach. Left ventriculography can quantify left ventricular function, left ventricular end-diastolic pressure; exclude mechanical complications including mitral regurgitation, pseudoaneurysms or a ventricular septal defect. This strategy also allows identification of left main and severe three-vessel coronary artery disease upfront. Performing EKG-directed directed PCI, however, after achieving arterial access and prior to routine coronary angiography with or without left ventriculography has been shown to

decrease door to balloon times in two small studies (Applegate et al., 2008; LaChance et al., 2008).

In the first study, Applegate and colleagues reviewed 135 consecutive patients who underwent primary PCI for STEMI from July 2005 to June 2007. During the study period, five patients who underwent primary PCI for STEMI were excluded because of incomplete door-to-balloon time data. No other patients were excluded from this analysis. Eighty-five STEMI patients who underwent complete coronary angiography followed by culprit lesion PCI served as the control group. The study group consisted of 50 STEMI patients who first underwent culprit PCI followed by complete coronary angiography. The strategy for achieving reperfusion was at the discretion of the interventionalist performing the procedure. During the study period, six interventionalists performed primary PCI for STEMI. Concern about performing PCI prior to the availability of information from complete coronary angiography, prior coronary artery bypass graft surgery (CABG) and indicators of cardiogenic shock on admission were factors in determining the decision to perform culprit versus traditional PCI by some interventionalists (Applegate et al., 2008).

In the traditional PCI group, vascular access was obtained using the femoral approach. Complete coronary angiography was then performed followed by left ventriculography at the discretion of the interventional cardiologist. Identification of the culprit lesion was based on composite assessment of the ECG, coronary angiogram, and left ventriculogram if available. The choice of equipment for PCI was left to the discretion of the attending physician performing the procedure, including guide catheter shape and size (6 or 7 French). In the culprit PCI group, the location of the presumed infarct lesion was based only on the initial ECG obtained in the emergency department. In these patients, after vascular access was obtained, a guide catheter was advanced and PCI was performed immediately, prior to complete coronary angiography or left ventriculography. Following PCI, coronary angiography was completed, with left ventriculography performed at the discretion of the interventionalist.

The baseline clinical characteristics of the culprit and traditional groups were similar although patients were younger in the culprit vessel group (56 ± 10 years versus 60 ± 13 years) versus the traditional group, $p=0.029$ (Table 1). The target vessel was more often the right coronary artery (70% versus 49%, $p=0.020$) in the culprit versus the traditional group. Procedural characteristics were similar, although fewer drug-eluting stents were used in the culprit vessel group (60%) compared to the traditional group (76%, $p=0.043$). Door-to-balloon times were shorter in the culprit vessel group (66 ± 20 minutes) than in the traditional group (79 ± 28 minutes, $p=0.003$). This was achieved primarily because of a shorter vascular access-to-balloon time in the culprit group (11 ± 8 minutes) than in the traditional group (18 ± 8 minutes, $p<0.001$). Door-to-vascular access times were similar for the two groups: 55 ± 18 minutes in the culprit group, versus 61 ± 24 minutes in the traditional group; $p=0.10$. Ninety- two percent of the culprit group patients achieved a door-to-balloon time <90 minutes, compared to 76% in the traditional group; $p=0.023$. In 62% of the traditional PCI group, left ventriculography was performed after the PCI. Door-to-balloon times were still significantly lower in the culprit vessel PCI group (17 ± 9 minutes) than in this subgroup of traditional PCI patients (22 ± 7 minutes; $p<0.001$).

Thirty-day outcomes are shown in Table 2. Planned revascularization procedures after the index PCI were performed in two culprit vessel patients, and in 1 traditional patient; $p=0.28$.

Characteristic	Traditional PCI {n = 85}	Culprit Vessel PCI {n = 50}	p Value
Male gender, n {%}	70 {82}	39 {78}	0.536
Age, years	60 ± 13	56 ± 10	0.029
Heart failure class III or IV, n {%}	5 {6}	1 {2}	0.412
Current smoker, n {%}	48 {56}	27 {54}	0.780
Diabetes mellitus, n {%}	18 {21}	10 {20}	0.871
Hypertension, n {%}	56 {66}	31 {62}	0.649
Hypercholesterolemia, n {%}	47 {55}	35 {70}	0.091
Vascular disease, n {%}	9 {11}	3 {6}	0.366
History of renal failure, n {%}	3 {4}	1 {2}	0.613
Previous PCI, n {%}	20 {24}	17 {34}	0.188
Previous CABG, n {%}	5 {6}	3 {6}	0.978
Left ventricular ejection fraction, {%}	45 ± 10	45 ± 9	0.921
Vessels disease, n	1.7 ± 0.8	1.6 ± 0.8	0.512
Severe 3-vessel or LMCA disease, n {%}	7 {8}	1{2}	0.138
Cardiogenic shock, n {%}	6 {7}	2 {4}	0.467
IABP inserted, n {%}	6 {7}	2 {4}	0.467
CABG = coronary artery bypass surgery, IABP = intra-aortic balloon pump; LMCA = left main coronary artery disease; PCI = percutaneous coronary intervention			

Table 1. Baseline clinical characteristics by percutaneous coronary intervention method.

Outcome	Traditional PCI {n = 85}	Culprit Vessel PCI {n = 50}	p Value
Planned revascularization, n {%}	1 {1.2}	2 {4.0}	0.283
Death, n {%}	1 {1.4}	1 {2.0}	0.702
Nonfatal MI, n {%}	0 {0}	0 {0}	---
Nonfatal MI or death, n {%}	1 {1.4}	1 {2.0}	0.702
Stent thrombosis, n {%}	0 {0}	0 {0}	---
Target vessel revascularization, n {%}	0 {0}	0 {0}	---
Any major adverse cardiac event, n {%}	1 {1.4}	1 {2.0}	0.702
MI = myocardial infarction; PCI = percutaneous coronary intervention			

Table 2. Major adverse cardiac events out to 1 month by percutaneous coronary intervention method.

There were no stent thromboses or recurrent nonfatal MIs in either group after 30 days of follow up. One patient in each group died during the initial hospitalization (*p*=0.70), and none thereafter.

In this study, door-to-balloon times were reduced when culprit vessel PCI was performed before complete coronary angiography and left ventriculography. The benefit was due to a decrease in the vascular access-to-balloon time of 7 minutes. Importantly, this benefit was achieved when efforts to reduce door-to-balloon times under 90 minutes had already been implemented, with an average door-to- balloon time of 79 minutes in the traditional PCI group. Significant left main or three-vessel coronary artery disease, cardiogenic shock or mechanical complications of MI were infrequently observed and were similar in each group. Specifically, severe three vessel or left main coronary artery disease was seen in 8% of the traditional PCI patients and in 2% of the culprit vessel PCI patients (p=0.138). Cardiogenic shock was seen in 7% of the traditional PCI patients and 4% of the culprit vessel PCI patients (p=0.467). In this study, no mechanical complications were diagnosed by ventriculography. In-hospital and thirty-day outcomes were similar between the two groups.

A similar study performed by Lachance and colleagues compared the door-to-balloon times in a group of STEMI patients assigned to EKG-guided culprit vessel PCI (group 1) and another group assigned to traditional PCI (group 2) retrospectively (Lachance et al., 2008). Two hundred and seventy-nine patients were included in the analysis. These consecutive patients underwent primary PCI at Laval Hospital, Quebec, Canada between May 2006 and August 2007. Eighty-seven patients were in the first group and 192 patients were in the second group. The type of procedural strategy was left to the discretion of the interventionalists. The baseline characteristics, including clinical, procedural and lesion type, were similar between the two groups. Median catheterization lab door-to-balloon times were 21 minutes in group 1 and 25.5 minutes in group 2 (P<0.0001). The median door-to-balloon time was 80 minutes for patients in group 1 and 90 minutes for patients in group 2 (p=0.01). Compared to group 2, more patients in group 1 received reperfusion in less than 90 minutes (63% versus 49%; p=0.04). Three STEMI patients in this cohort were referred for coronary artery bypass surgery. One patient, who had an anterior MI, was in group 2. This patient had a diagnostic right coronary angiogram performed, which revealed moderate stenosis. The left coronary angiogram then revealed severe stenosis of the left main artery and occlusion of the left anterior descending artery. The patient was then referred for urgent coronary artery bypass grafting. The second patient was in group 1 and presented with ST-elevations in the inferior leads. An angiogram of the right coronary artery was performed with a guiding catheter and no significant stenosis was seen. Coronary angiography of the left coronary artery revealed a severe stenosis of the left main. This patient underwent coronary artery bypass grafting two days after coronary angiography. The third patient presented in cardiogenic shock and an echocardiogram was performed before coronary angiography. This revealed a ventricular septal defect and mitral regurgitation. The patient was then referred for urgent cardiac surgery. In the study by Lachance, no mechanical complications were diagnosed by ventriculography. After one year of clinical follow-up, there was no difference between groups in rates of death, reinfarctions, or need for repeat PCI. Because these are small retrospective studies, however, further studies are needed not only to determine if the culprit vessel PCI strategy for STEMI consistently lowers door-to-balloon times, but also, if it improves clinical outcomes.

Observational studies such as ours and that of Lachance may be subject to selection bias. Randomized clinical trials would provide the fairest evaluation of culprit vessel versus traditional PCI for STEMI. The decision to perform culprit versus traditional PCI could have been influenced by important patient and procedural factors that relate to the outcomes of the study, such as age, prior PCI or CABG, and infarct location. While we cannot exclude this possibility, culprit and traditional patient groups had similar baseline clinical and lesion characteristics in both these studies. Moreover, among the interventionalists performing culprit PCI for STEMI, no patient or procedural factors seemed to influence strongly the decision to perform culprit PCI. While there remains a concern that discovery of important clinical information after first performing culprit PCI would surface, in both these studies, this was observed infrequently. These concerns need to be evaluated in larger groups of patients before accepting this strategy as standard clinical practice. Also, the study groups were small and studies in larger groups of patients will need to be performed to determine if the strategy evaluated in this study is both feasible and beneficial in broader clinical practice. Hopefully, longer-term follow-up of cohorts will provide valuable information concerning the relative benefit of culprit vessel versus traditional PCI for STEMI.

5. Culprit vessel PCI versus traditional catheterization and PCI for STEMI: Is there a potential for harm?

Efforts to reduce door-to-balloon times have focused on reducing the time spent prior to getting the patient in the cardiac catheterization laboratory (Bradley et al., 2006; Eagle et al., 2002; Kraft et al., 2007; Kurz et al., 2007). However, there have been few efforts aimed at further reducing door-to-balloon times within the cardiac catheterization laboratory itself (Bradley et al., 2006; Burzotta et al., 2008). Traditionally, patients undergoing urgent percutaneous revascularization initially undergo complete coronary angiography, with or without left ventriculography. This strategy allows identification of life-threatening disease that may require urgent surgery. In the United States, this traditional approach to the patient requiring emergency revascularization, including STEMI patients has been utilized in most laboratories. However, several factors have evolved in the contemporary care of patients with coronary artery disease that are relevant to this approach. First, the actual number of cases undergoing emergency revascularization procedures requiring CABG has dramatically fallen in the past decade (Seshadri et al., 2002; Yang et al., 2005). For example, Yang and colleagues reported a significant decrease in the incidence of emergency CABG from 2.9% to 0.7% to 0.3% across three groups (the "pre-stent" era, 1979 to 1994; the "initial stent era," 1995 to 1999; and the "current stent era," 2000 to 2003 in 23,087 patients undergoing PCI at the Mayo Clinic from 1979 to 2003. This trend was observed despite higher risk features in the more recent patient cohorts. Second, mobilization of the operating room, even under the best of circumstances, generally exceeds a satisfactory time to achieve reperfusion in STEMI patients. Finally, there has been a growing acceptance of hybrid revascularization procedures utilizing both PCI and CABG, either at the same time, or as part of a planned revascularization strategy (Friedrich and Bonatti, 2007). Thus, the identification of left main or three-vessel coronary disease itself is not a contraindication to performing PCI of a culprit vessel in a STEMI patient with a staged CABG as deemed necessary.

6. Traditional catheterization and PCI versus culprit vessel PCI versus a hybrid approach for STEMI

The benefits of performing primary PCI for STEMI, and the need for PCI centers to achieve door-to-balloon times less than 90 minutes, has led to the strategy of performing culprit vessel PCI, even in the setting of left main or significant multivessel disease. Once the decision to perform culprit vessel PCI has been made, the next choice is the stent type, that is, bare metal stent versus drug-eluting stent. The merits of bare metal and drug-eluting stent implantation in STEMI have been the subject of several studies and meta-analyses (De et al., 2009;Hao et al., 2010;Vink et al., 2011;Spaulding et al., 2011). Overall, it appears that drug-eluting stents are as safe as bare metal stents, and reduce rates of target vessel revascularization. Nonetheless, the choice of drug-eluting stents mandates longer term dual antiplatelet therapy than bare metal stents, which is problematic in the patient who may require additional surgical revascularization. While the likelihood of finding significant left main or multivessel disease in STEMI patients is low (Applegate et al., 2008; Lachance et al., 2008), there remains strong concerns that incomplete visualization of the coronary anatomy prior to PCI in STEMI leads to less than optimal decision-making. Traditional complete coronary angiography with multiple orthogonal views followed by left ventriculography is ideal but is time consuming in a situation that demands rapid decisions and treatments. Many operators have adopted a hybrid approach, which allows evaluation of the left main coronary artery with one or two angiograms, and completing a left ventriculogram after the PCI.

We also advocate a hybrid approach as follows (Figure 1) : if the suspected infarct is located in the anterior or lateral left ventricular wall, the first catheter we choose is a left coronary artery guide with the purpose of proceeding with immediate revascularization using a bare metal or drug-eluting stent. The choice of stent in this situation is dependent on both clinical and procedural factors. Our default stent type is a drug-eluting stent unless we are uncertain about compliance with dual-antiplatelet therapy, or we believe that left main or surgical disease is present and will require CABG. In this setting, we believe that an angiogram of the right coronary artery before PCI will not change management. If the suspected infarct-related vessel is the right coronary artery, we perform one or two diagnostic cine angiograms of the left coronary artery to exclude significant left main disease and then perform PCI of the right coronary artery lesion. This identifies left main or three-vessel disease prior to PCI and prevents us from placing drug-eluting stents in patients that will likely need CABG surgery. For STEMI patients with hemodynamic instability, in order to exclude mechanical complications, we also advocate cardiac auscultation, quick look echocardiography and/or left ventriculography before stent implantation.

7. Case presentations

Two cases will be presented to highlight the culprit PCI approach. The first case was a 48-year-old man, with no previous cardiac history, who was admitted with an acute antero-lateral myocardial infarction. The patient was eating dinner at a restaurant when he developed progressive chest pain radiating to the jaw and left arm. He also became diaphoretic. He presented to an outside emergency department and was then transferred to our facility. On physical examination, his vital signs were stable and he had no heart
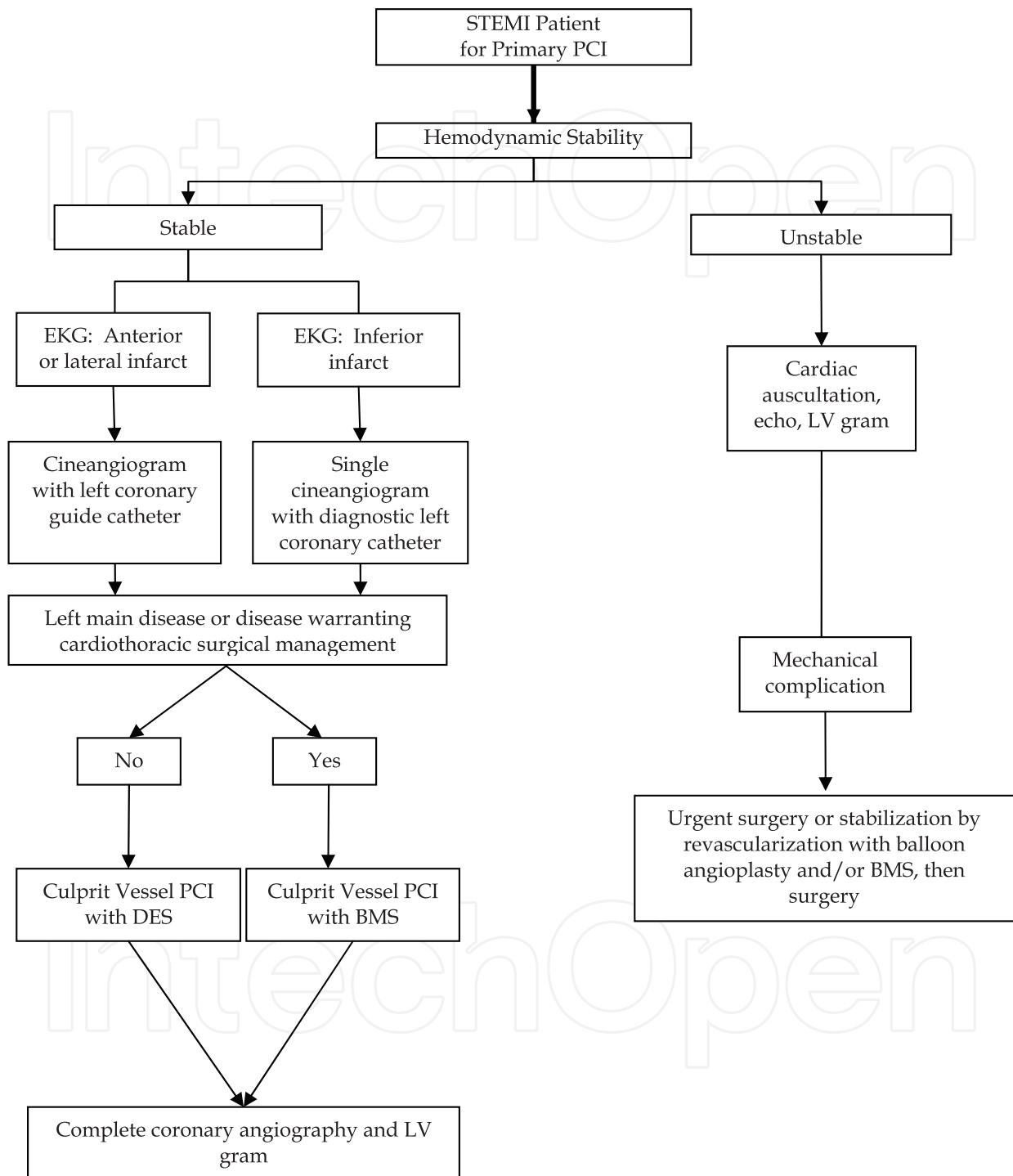
Fig. 1. Algorithm of Hybrid Approach to Primary PCI for STEMI
BMS = bare metal stent, DES = drug-eluting stent, LV gram = left ventriculogram,
echo = echocardiogram

murmur. There were no signs of heart failure. His electrocardiogram demonstrated sinus rhythm with a normal axis and normal intervals. ST elevations and pathological Q waves were present in the anterolateral leads (Figure 2). Laboratory data was not yet available on presentation. Coronary angiography was performed first with a 6 French EBU 3.5 guide catheter (Medtronic Inc., Minneapolis, Minnesota) via the right femoral artery. Complete occlusion of the proximal left anterior descending artery was demonstrated without evidence of collaterals (Figure 3). Percutaneous coronary intervention was then performed with a 2.5 x 12 mm Voyager RX balloon (Abbott Vascular, Chicago, Illinois), followed by a Fetch aspiration thrombectomy catheter (MEDRAD Inc., Warrendale, Pennsylvania). A 3.0 x 18 mm Xience V RX (Abbott Vascular, Chicago, Illinois), drug-eluting stent was then implanted successfully. A 3.5 x 16 mm Voyager NC RX balloon (Abbott Vascular, Chicago, Illinois) was then used to post-dilate the stent. Coronary angiography was then completed. Non-obstructive coronary disease was seen in the right coronary artery. The left ventriculogram demonstrated severe anterolateral hypokinesis and apical dyskinesis. The ejection fraction was 40%. The patient was discharged three days later, free of symptoms.
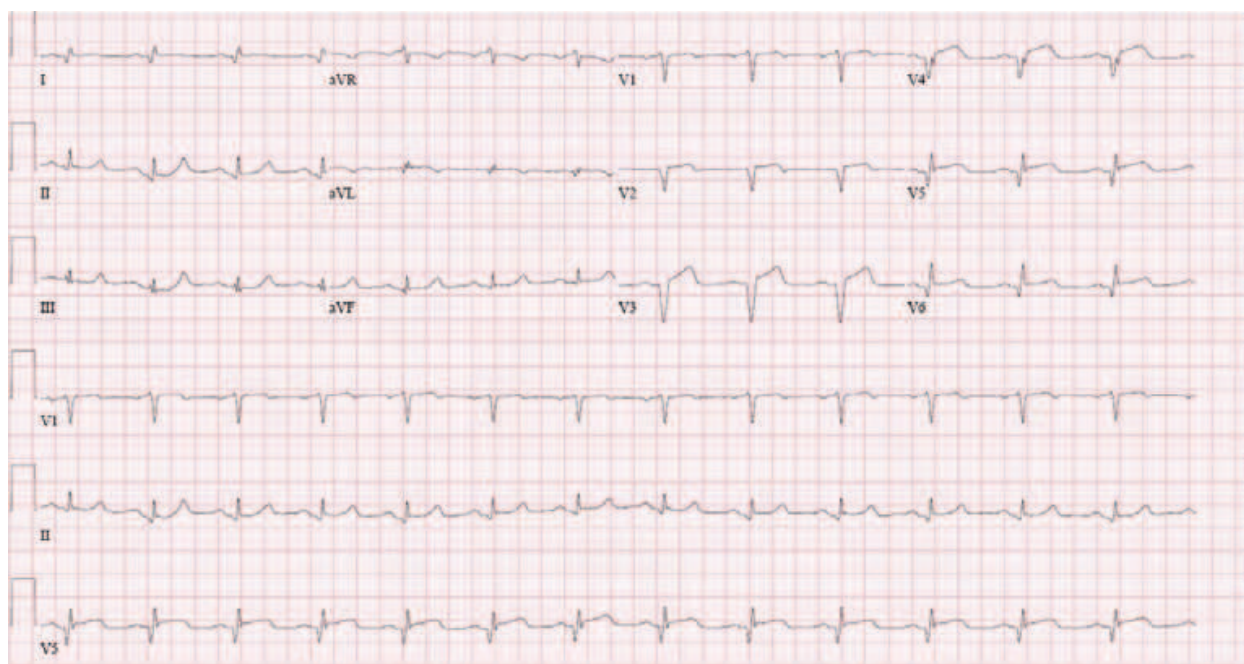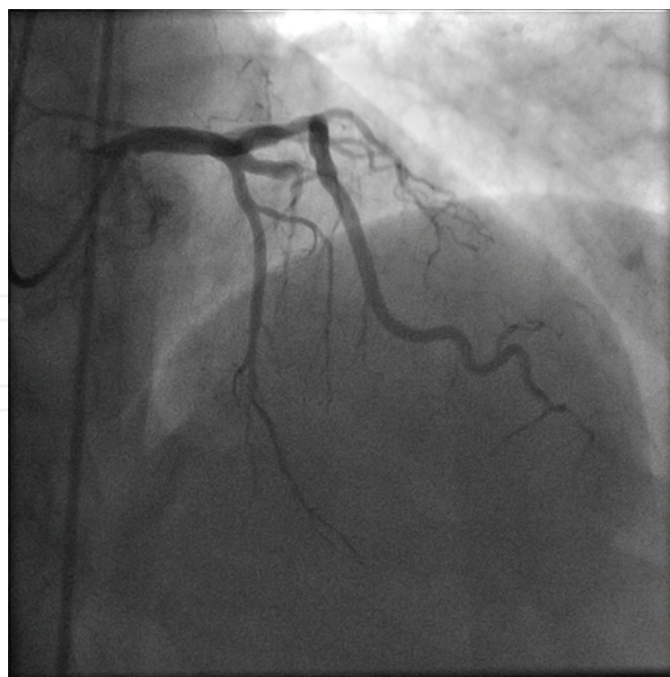

Fig. 2. Case 1, Electrocardiogram

Fig. 3. Case 1, Left Coronary Angiogram

The second case was a 57 year old man with an unknown past medical history who presented with chest pain via the emergency medical services to the emergency room. He was diagnosed with an STEMI in the ambulance. In the emergency room, he developed ventricular fibrillation, requiring cardio-pulmonary resuscitation, multiple cadio - defibrillations, and maximum doses of amiodarone and lidocaine. He was intubated. He eventually developed a stable ventricular tachycardia and was taken to the cardiac catheterization lab. Heart sounds were difficult to appreciate because of the ventilator. His initial EKG in the emergency room demonstrated sinus tachycardia at 123 beats per minute, a left anterior fascicular block, and ST elevations with pathological Q waves in the inferior leads (Figure 4). In the cardiac catheterization lab, the patient required intermittent cardiopulmonary resuscitation, while a 6 French 3.5 ART guide catheter (Boston Scientific/Scimed, Natick, MA) was used to engage the right coronary artery. The right coronary angiogram was the first image acquired. 100% occlusion of the proximal right coronary artery was demonstrated and a 2.5 x 12 mm Voyager RX balloon was used to dilate the coronary artery (Figure 5). After five low-pressure inflations, a VeriFLEX monorail 2.75 x 28 mm bare metal stent (BMS) (Boston Scientific/Scimed, Natick, MA) was implanted successfully across the lesion. The right coronary artery was, at least, co-dominant. Angiography on the left coronary artery was then performed with a diagnostic catheter. This demonstrated a stenosis of 50% in the left main coronary artery and a stenosis of 75% in the left anterior descending artery (Figure 6). The left ventriculogram demonstrated akinesis of the inferior wall and severe hypokinesis of the anterolateral wall. The ejection fraction was 35%. An intra-aortic balloon pump was then placed. The patient did very well, post-procedure. He was extubated two days after admission and was discharged four days after admission. The patient did not undergo CABG surgery during that hospitalization, because he demanded to leave the hospital. Three months after his initial admission the patient underwent CABG. Clopidogrel was discontinued four days prior to the surgery. He
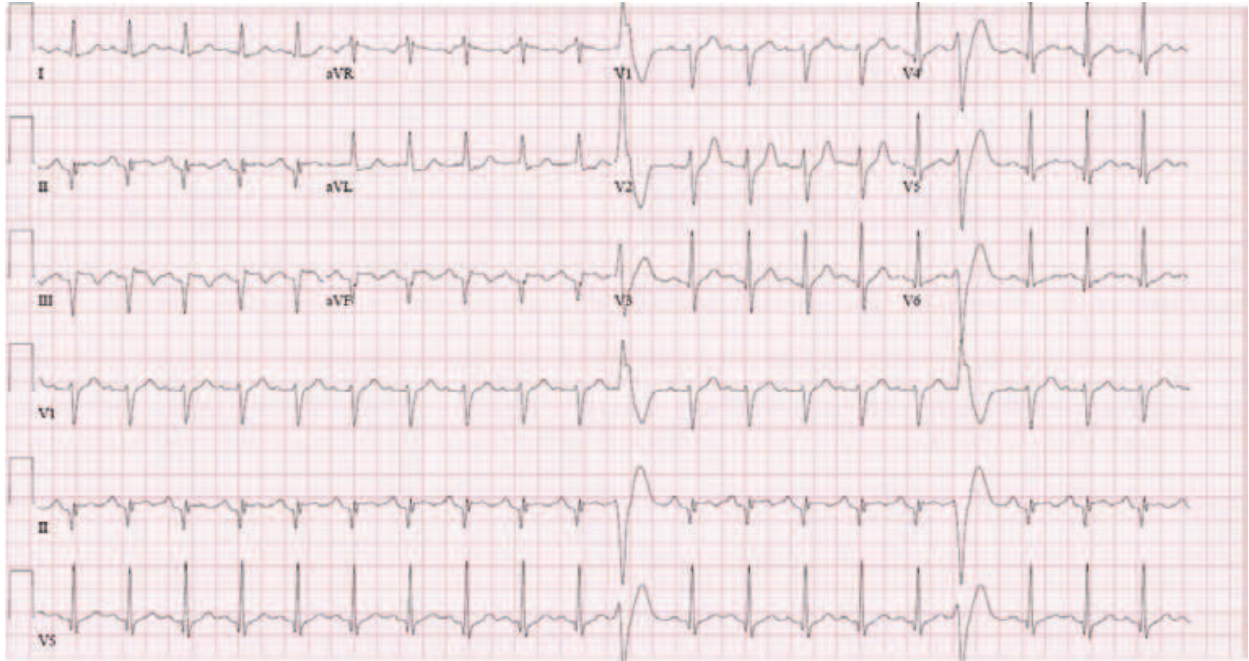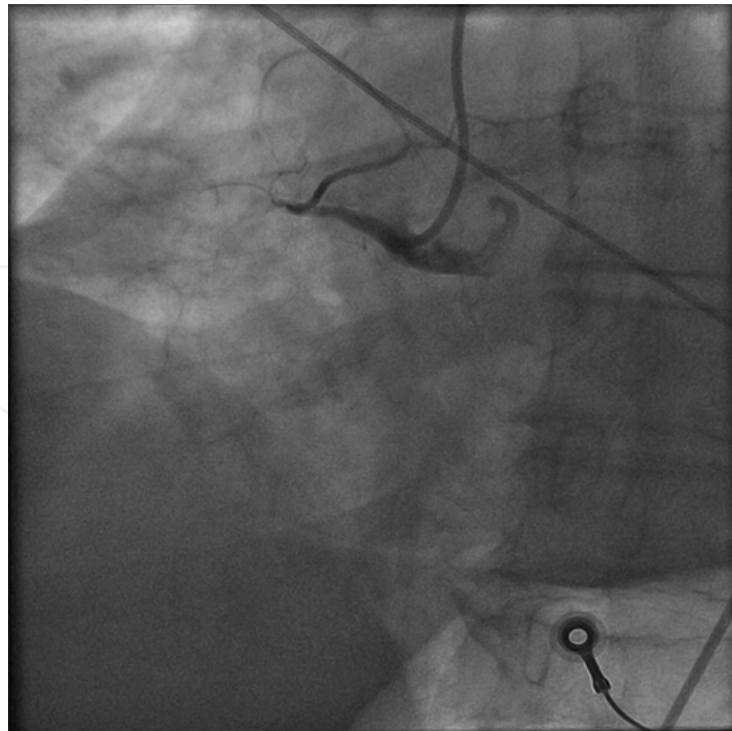
Fig. 4. Case 2, Electrocardiogram

Fig. 5. Case 2, Right Coronary Angiogram

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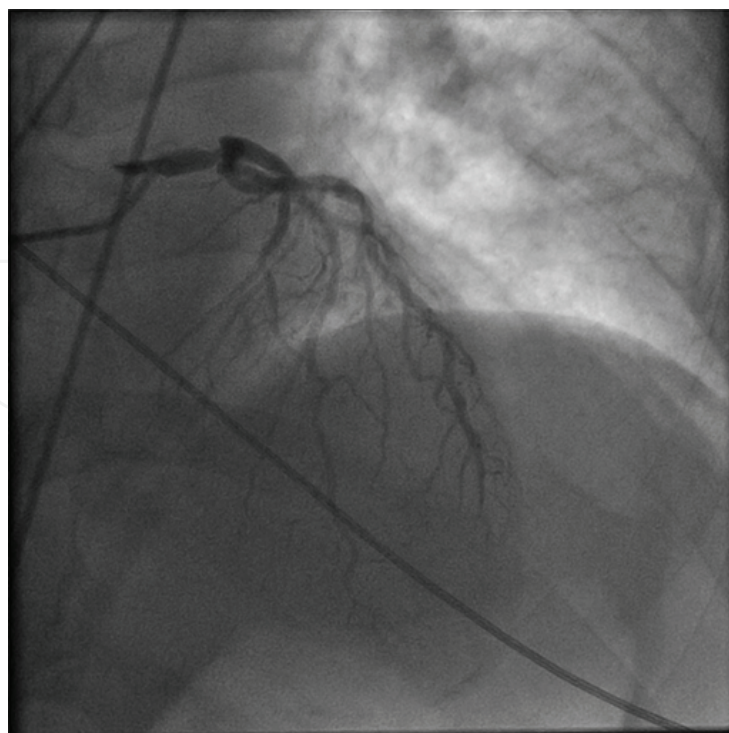
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Fig. 6. Case 2, Left Coronary Angiogram

underwent a three vessel bypass with a free skeletonized right internal mammary artery to the first obtuse marginal as a Y graft from the left internal mammary artery, a saphenous vein graft to the posterior descending artery from the aorta, and a skeletonized left internal mammary artery to the left anterior descending as an arterial graft. The patient had no perioperative or postoperative complications.

8. Conclusion

Prior to primary PCI, comprehensive coronary angiography, including left ventricular imaging can provide valuable information for the care of a patient with a STEMI. This approach is time consuming, however, and increased time to reperfusion has been associated with worse outcomes. In the two studies presented, a culprit vessel PCI approach may decrease door-to- balloon times without compromising patient safety. Randomized studies are needed, however, to determine if the incremental decrease in door-to-balloon times using this approach provides clinical benefit. We recommend a hybrid approach, combining certain aspects of comprehensive coronary angiography and the culprit vessel PCI approach. Compared to the femoral approach, the radial arteriotomy is an attractive alternative for vascular access even in the setting of primary PCI for STEMI. Operators experienced with the radial approach report lower or similar access to reperfusion times with the transradial approach compared to the femoral approach.

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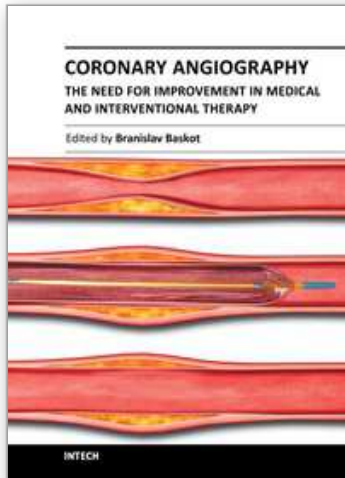
Coronary Angiography - The Need for Improvement in Medical and Interventional Therapy

Edited by Prof. Baskot Branislav

In this book we examined a periprocedural complication of coronary angiography, and coronary intervention. That includes related to cardiac catheterization and diagnostic coronary angiography, and those that occur as a consequence of the specific equipment. However, improvements in devices, the use of stents, and aggressive antiplatelet therapy have significantly reduced the incident of major periprocedural complications. This book giving knowledge and experiences many of interventional cardiologists from all over the world, and provide possibility to recognize new approach in this domain. Book gives lecture on how we image and how we decide on what to treat, how to treat it, and then results of that treatment. They offer many answers to what we have today and what we will have tomorrow.

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