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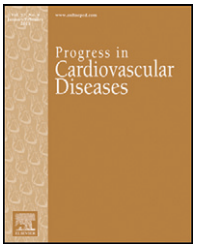

Current State of Radial Artery Catheterization in ST-Elevation Myocardial Infarction

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ABSTRACT

A well-established body of evidence demonstrating the advantages of a transradial approach for coronary angiography and intervention has led to worldwide adoption of this technique. In some countries, radial access has replaced femoral access as the dominant access site for percutaneous coronary intervention (PCI). More recently, numerous randomized controlled trials have compared transradial and transfemoral access in patients with ST elevation myocardial infarction (STEMI) and have shown that transradial access is associated with lower mortality and less major bleeding. This review examines the advantages of transradial primary PCI for STEMI patients, addresses concerns in adopting this approach for primary PCI, and reviews recommendations on how to start a transradial primary PCI program.

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Over the past two decades, radial access for coronary angiography and intervention has become increasingly popular worldwide.[1] In many countries, radial access has replaced femoral access as the dominant access site for percutaneous coronary intervention (PCI).[1] Adoption of radial access as the preferred access site is due to numerous observational and randomized controlled trials (RCTs) demonstrating advantages over femoral access including patient comfort, earlier ambulation, and patient safety including less major bleeding and fewer vascular complications with no difference in PCI success.[2,3] In the context of ST-segment elevation myocardial infarction (STEMI), transradial primary PCI may reduce mortality compared with traditional femoral access. However, the emphasis on rapid reperfusion [i.e. door-to-balloon time (D2BT)] has led to a lag in the adoption of a radial approach for primary PCI despite the mortality benefit because of the potentially longer procedure times associated with radial access. In this review, we will examine the current evidence comparing radial and femoral access for angiography and PCI with particular interest in the clinical outcomes of radial access in STEMI patients. We will also review published recommendations for starting transradial primary PCI programs.

Bleeding and vascular complications after PCI

Optimal PCI controls both ischemic and bleeding risks. Antithrombotic and antiplatelet drugs are a mainstay of decreasing ischemic events by reducing the rate of stent thrombosis and reinfarction.[4] Bleeding and vascular complications are the most common PCI related complications

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Abbreviations and Acronyms

D2BT = door-to balloon time

MI = myocardial infarction

NSTEMI = non ST-segment elevation myocardial infarction

PCI = percutaneous coronary intervention

RCT = randomized controlled trials

STEMI = ST-segment elevation myocardial infarction

occurring in up to 10% of PCI cases. Both are associated with an increased risk for short- and long-term adverse outcomes including recurrent MI, stent thrombosis, and death.[5,6] Potential mechanisms underlying this association include cessation of dual antiplatelet therapy resulting in activation of platelets and the coagulation cascade as well as receiving blood transfusions, which may impair tissue oxygenation and increase inflammatory mediators.[7] Importantly, there is a relationship between the acuity of the patient's presentation and the incidence and site of bleeding.[8] Patients undergoing PCI for stable angina have very low rates of bleeding with the majority of bleeding events occurring at the vascular access site. On the other hand, patients with NSTEMI have higher rates of bleeding but the majority is unrelated to the vascular access site (gastrointestinal bleeding is more common); patients with STEMI undergoing primary PCI have the highest rates of bleeding with nearly half of the bleeding events occurring at the vascular access site.[9] This important distinction is the central principle that underlies vascular access choice as a strategy to improve outcomes in patients with STEMI – the higher bleeding risk leads to greater benefit of bleeding avoidance strategies like a transradial approach.

Indeed, the most effective strategy to reduce PCI-related bleeding is radial access. The radial artery is easily compressible due to its small caliber and superficial location allowing for easier control of bleeding compared to the femoral artery. A systematic review of observational and RCT studies comparing radial with femoral access involving over 760,000 patients demonstrated a 78% reduction in bleeding with a transradial approach.[10] There was also a strong association with a reduction in mortality, which was driven not only by the observational studies but also RCTs of patients undergoing primary PCI for STEMI.

Radial access in primary PCI

Since the incidence of peri-procedural bleeding is highest among patients with STEMI, the degree of benefit from a bleeding avoidance strategy focused on vascular access should be greater in this population than for patients with NSTEMI or stable angina. A meta-analysis of 12 randomized trials (n = 5055) comparing radial and femoral access for primary PCI in STEMI demonstrated that mortality was significantly reduced with a transradial approach (2.7% versus 4.7%, OR 0.55, 95% CI 0.31–0.85).[11] Furthermore, a significant outcome benefit for transradial access was demonstrated in the three largest RCT trials on this topic: RIVAL, RIFLE-STEACS, and MATRIX.[3,12,13] Although RIVAL showed no difference between radial and femoral access in the primary endpoint of death, myocardial infarction (MI), stroke, or major bleeding, a pre-specified subgroup analysis of patients with STEMI demonstrated lower 30-day death, MI or stroke (p = 0.011) and death (p = 0.001). In a dedicated trial comparing radial and femoral access in 1001 patients with STEMI undergoing primary PCI, the RIFLE-STEACS trial showed that radial access not only significantly reduced the 30-day rate of net adverse clinical events defined as a composite of cardiac death, stroke, MI, target lesion revascularization, or bleeding, but also the 30-day mortality compared with femoral access.[12,14] These data are further corroborated by the recent MATRIX trial that randomized over 8000 patients with acute coronary syndrome, including both non ST-segment elevation MI (NSTEMI) and STEMI, to either radial or femoral access. Radial access significantly reduced 30-day net adverse clinical events, defined as major adverse cardiac events or major bleeding, and reduced 30-day mortality, without heterogeneity of the effect by MI type.[13]

Adoption of a transradial approach in primary PCI

Despite these advantages over the traditional transfemoral approach, the adoption of radial access for primary PCI lags behind that for non-MI indications.[15] There are likely several reasons for the reluctance of operators to perform transradial primary PCI even among those who may already utilize radial access for elective PCI cases (Table 1). These include concerns over D2BT, which may be prolonged with radial access, and femoral access crossover. Since a principal emphasis in the management of STEMI is the rapid reestablishment of flow in the occluded epicardial artery measured by D2BT, one concern over adopting a radial approach for primary PCI is that procedural delays and failures requiring crossover to a femoral approach could increase D2BT. Radial access delays may be due to a longer time to gain access in a smaller caliber artery and more difficulty in seating the guide catheter due to arterial tortuosity in the arm and chest.

Table 1 – Advantages and disadvantages of a transradial approach for primary PCI.

Advantages
• Lower mortality in MI patients undergoing PCI
• Lower incidence of major bleeding
• Fewer vascular complications
• Potential for more aggressive anti-thrombotic and anti-platelet therapy
• Shorter length of stay
Disadvantages
• Procedural metrics and outcomes [a] are dependent on transradial case volume
• Potential for femoral crossover
• Lack of standardized transradial training programs
• Inability to use same entry site to insert hemodynamic support systems like intra-aortic balloon pump
• Catheter size is limited by radial artery caliber

[a] Includes radiation exposure, procedure time, D2BT, procedure success rate.