Economic Opportunities of Transradial Angiography and Intervention

How a transradial program can lower costs and decrease complications.

BY ADHIR SHROFF, MD, MPH

During the past 20 years, percutaneous coronary intervention (PCI) has grown from a niche procedure to a common diagnostic and therapeutic modality that is performed more than 1.1 million times a year in the United States.[1] Due to the clinical benefit and improved side effect profile, patients with increasingly complicated anatomy are being treated with more sophisticated percutaneous therapies. The economic impact of providing this level of care is significant. In the United States alone, the total direct and indirect cost of cardiovascular disease and stroke was estimated to be $286 billion (15% of all health expenditures).[1] Mean hospital charges for a PCI procedure in 2008 were $56,015.[1] Given the current economic climate, all sectors of the economy are in search of mechanisms to decrease their expenses—health care is no different.

TRANSRADIAL ANGIOGRAPHY AND INTERVENTION

Performing cardiac catheterization via the radial artery has been possible for more than 20 years[2] and has been widely adopted in many regions of the world.[3] However, transradial (TR) procedures accounted for only approximately 1% of all cardiac catheterization procedures in the United States as recently as 2007.[4] This disparity is related to multiple factors, including a lack of familiarity with the approach, a concern for increased procedure duration, and a concern for limiting one's therapeutic options.

There has been an explosion of interest in the TR approach to angiography and intervention as an alternative to the traditional transfemoral (TF) approach. Supporters of the TR technique cite improved patient comfort and fewer complications as the primary benefits of this approach. Patients also strongly prefer the radial approach.[5] Although it may not be readily apparent, the primary clinical benefits of the TR approach have important economic ramifications as well. This article briefly reviews the clinical data emphasizing financial outcomes and the monetary impact of decreases in complications, staff workload, and length of stay.

DECREASED BLEEDING AND VASCULAR COMPLICATIONS

The primary clinical benefit of the TR approach is a decrease in bleeding and vascular complications among patients undergoing PCI. Bleeding and vascular complications after TF PCI procedures range between 3% and 5%.[6] Complication rates with TR PCI in the published literature are much lower (0.7%–1.5%).[4,6] Despite a recent trial that demonstrated similar rates of bleeding between access strategies,[5] there is a wealth of clinical data that have shown improved rates of these complications with radial access. When patients who are at the highest risk for bleeding were studied, those with acute coronary syndromes, women, and the elderly all demonstrated fewer bleeding events with radial access.[4]

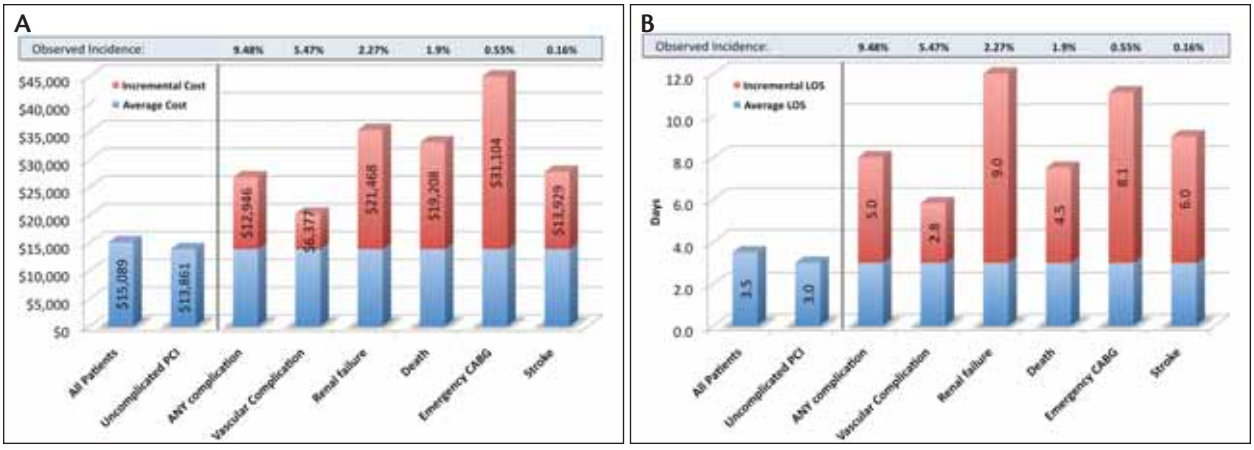

Figure 1. Incremental cost of post-PCI complications among Medicare beneficiaries who underwent PCI in 2002 (A). Incremental length of stay related to post-PCI complications among Medicare beneficiaries who underwent PCI in 2002 (B). Adapted from Kugelmass A et al. Am J Cardiol (2006;97:322-327).[7]

Although the relationship between post-PCI bleeding and increased short- and long-term mortality is described in the literature,[8] the economic consequences are not as well documented. In an economic analysis of patients with bleeding events during their admission for an acute coronary syndrome, the investigators noted a stepwise increase in costs as bleeding severity increased. This was primarily driven by increases in length of stay.[9] In a separate analysis of all Medicare patients who underwent an inpatient PCI in 2002, Kugelmass et al reached a similar conclusion.[7] Although vascular complications were not the most costly complications after PCI, they were the most common post-PCI complication among the study population. The overall rate of any complication was 9.5%; vascular events comprised more than half of the events (5.5%) (Figure 1). Even after adjusting for patient and clinical factors, an adverse vascular event increased cost by $4,830 and increased length of stay by 2.1 days.[7]

The cost savings associated with a decrease in post-PCI bleeding and vascular complications accounts for the most dramatic economic benefit of the TR approach. Based on the figures previously described, reducing adverse vascular events by a single percent would lead to more than $53 million in savings, primarily due to 23,000 fewer days of hospitalization.

DECREASED STAFF WORKLOAD

Once a physician becomes familiar with the TR approach and adopts the technique for a significant proportion of his/her practice, the impact on staff workload will become readily apparent. The technical and nursing staff will become the most ardent supporters of the technique. In addition to appreciating the benefits to the patient, the favorable impact on their work responsibilities will certainly be noted. Gone will be the days of prolonged manual compressions, treating vagal reactions, lengthy recovery times, bedpans, and managing a patient's back pain. Access sites can be managed safely and reliably with compressive hemostasis bands. After TR PCI, patients are able to sit up, eat, and ambulate immediately.

In an Italian study, the investigators measured nursing workload in the catheterization lab and on the wards for approximately 260 patients undergoing cardiac catheterization by either access route. The nursing staff recorded the actual time spent caring for each patient before the procedure and then after the procedure until the time of discharge. The nursing staff caring for TR patients required less than half as much time to provide care than for patients using the TF route (86 minutes vs 174 minutes; $P < .001$), respectively. They observed a similar decrease in workload for ward nurses who cared for patients after leaving the catheterization lab.[10] In a similar trial, a group of German investigators observed a time-savings with radial access of nearly 18 and 47 minutes for diagnostic and interventional procedures, respectively. Based on their caseload, they estimated an annual savings of nearly 1,400 hours of nursing effort. With current nursing salaries in the United States being nearly $45 per hour, a medical center that performs approximately 2,000 diagnostic and 1,000 PCI procedures could realize nearly $60,000 a year in savings.[11]

IMPROVED PATIENT FLOW AND DECREASED LENGTH OF STAY

Following outpatient catheterization procedures, length of stay is primarily determined by the time to

achieve hemostasis and a prespecified observation time to ensure that no access site complications have occurred. Managing a patient's pain and allowing for sedating medications to wear off are also determinants of when a patient is able to be released from the medical center. TR patients require less time to achieve hemostasis than TF patients and, because of the relatively superficial location, monitoring for access site bleeding is straightforward. Although some variability may exist between centers, TR access cases are observed for 2 hours compared to 4 to 6 hours for TF access cases. Patients notice less pain and difficulty with ambulation after TR procedures, which greatly facilitates the postprocedure discharge process.[12] Due to the decrease in complications and the reliability of the access site closure, patients are able to transition from the catheterization area to the recovery area and can be discharged a few hours after diagnostic catheterization.

As clinicians and medical centers develop experience with TR procedures, many have noted that certain low-risk PCI patients can be discharged safely on the same day as their intervention. In an elective PCI population, most complica-

COMMENTARY

By Ramon Quesada, MD, FACP, FACC, FSCAI

The author of this article used current literature and the economic analysis available from 2004 Medicare data. The focus of the transradial (TR) approach over the past 10 years has been largely confined to clinical outcomes (ie, reduced bleeding) and somewhat to addressing the learning curve for those who are trying to transition to its use. As TR use increases, it is helpful to consider not just the clinical benefits but also the overall economic impact of this less-traumatic approach.

Although the National Cardiovascular Data Registry CathPCI Registry does not aggregate economic data, it does provide a more recent snapshot, which perhaps gives a different perspective on the use of TR access (TRA) and its adoption by centers across the country. According to the CathPCI registry, in 2008, only 1.6% of all reported percutaneous coronary intervention procedures (500,000-plus) were done using TRA. In 2010, the percentage increased to 5.3% (600,000-plus), with a corresponding drop in the use of the transfemoral approach. At our institution, use of TRA has doubled from the annual mean of 11.6% for percutaneous coronary intervention (2010) to 19.3% for the first quarter of 2011.

I first started using the TR approach in 1997, and for more than 13 years, I remained the "lone ranger" in our cath lab. During that time, I completed more than 5,000 cases and moved from diagnostic to more challenging interventions such as ST-segment elevation myocardial infarction, chronic total occlusions, and complex lesions. I am currently able to use TRA in more than 80% of my cases. It is just in the last year that the other experienced interventionists in our cath lab have started to adopt TRA.

This is certainly a promising sign, not just at our center but nationwide; in fact, a recent change in the CathPCI dataset now specifically looks at bleeding complications but no longer tracks femoral pseudoaneurysm, specifically by treatment modalities (ie, fibrin injection, surgery). However, extrapolating financial benefits based on each approach is difficult; the author chooses to use Medicare data, but in our case, that only accounts for 50% of the patients—a stable number for the past 4 years. Certainly, TRA is the access of choice for the Medicare population. The elderly tend to have more vascular complications with the use of transfemoral access; in my experience, I have been able to treat octogenarians with tortuous and diffuse atherosclerotic vascular disease and complex anatomy through the radial artery with minimal, if any, vascular complications. It is in these types of patients that TRA really affects cost reduction.

The author addresses the easy acceptance by the cath lab staff. I would not be quite as enthusiastic about expecting an immediate approval by experienced staff who are used to working via the transfemoral approach. For the new operator, case startup time can be increased because of the considerable learning curve and may impact turnaround times. Thus, the use of TRA for an ST-segment elevation myocardial infarction may not be ideal for a new operator, because it would affect door-to-balloon time. The staff actually has increased work, because they must assess and prep both the radial and femoral access sites. However, once both the operator and the team become proficient, it is more enthusiastically accepted because everyone knows their role and the resultant postprocedure advantages.

Thus, it seems that as the use of TRA becomes more widely accepted, the economic advantages are certainly going to be described. There are multiple opportunities for future economic research on this topic, and it is encouraging that the percentage of TRAs is increasing, and that adoption of the technique is notching up each quarter.

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tions occur within a few hours of the procedure or after several days.[13] Overnight admissions are a remnant of a femoral artery–based approach, allowing for pain management and observation for access site complications. In many health care systems, including some in the United States, clinicians are safely discharging uncomplicated PCI patients on the same day of their intervention.[14-17] Although the standard of care in the United States continues to suggest overnight observation, TR PCI is likely to alter our practices similar to other societies. In a Canadian study, investigators observed a savings of $1,141 per patient at 30 days with same-day discharge.[18] The primary source for the difference in cost was related to length of stay (Figure 2).

In the United States, there are a few barriers to wide-scale adoption of same-day discharge after PCI. Patients and their families may be hesitant to go home soon after an invasive cardiac procedure. Overnight observation continues to be the standard of care, and there may be medicolegal ramifications of discharging patients on the same day as their PCI. Finally, medical centers continue to be reimbursed at a higher rate by some payors for observation time and for inpatient admissions. According to one estimate, approximately 250,000 elective PCI procedures would be suitable for same-day discharge. This would lead to a decrease in charges to payors of nearly $600 million but would lead to a decrease in revenue by $1.8 billion to medical centers.[19]

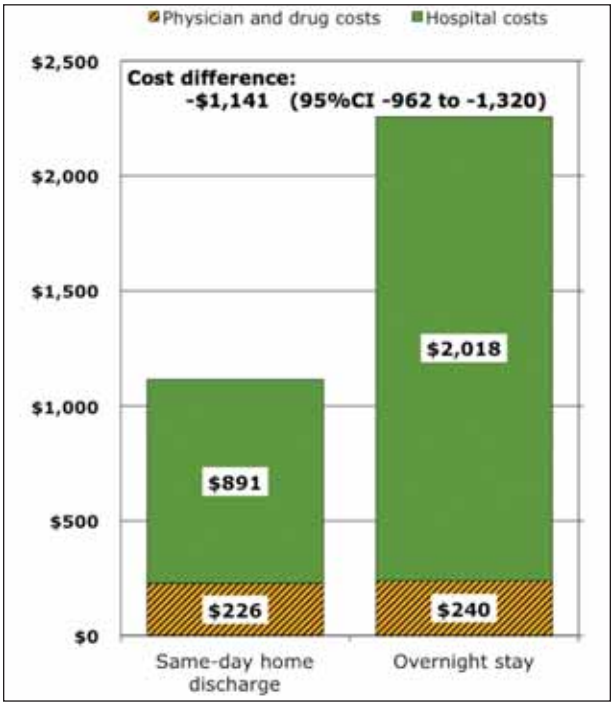

Figure 2. Cumulative health care costs within 30 days after PCI. Reprinted with permission from Rinfret et al. JACC Cardiovasc Interv (2010;3:1011-1019).[18]

TR VERSUS TF ACCESS: PROCEDURAL COSTS

In a prospective study, patients undergoing diagnostic cardiac catheterization were divided into a radial group, a femoral with manual compression group, and a femoral with a closure device group. The investigators measured equipment costs, including closure devices, medication, and staff utilization for recovery. Total costs were lowest in the radial group ($369.50 ± 74.6) compared to the femoral group without a closure device ($446.90 ± 60.2) and the femoral group with a closure device ($553.40 ± 81) (both $P < .001$).[20] In a comparison of patients undergoing elective and urgent PCI, TR PCI was associated with lower in-hospital costs than the TF approach due to costs associated with treating access site complications and differences in closure device costs.[21]

OUR EXPERIENCE

At the University of Illinois–Chicago and Jesse Brown Veterans Affairs (VA) Medical Centers, > 80% of procedures are performed using the radial approach. Although both institutions are public hospitals, their underlying financial models are very different. The federal government operates and funds the VA health care system. Most patients are not billed for the care that they receive. The VA administration welcomes any opportunity to provide quality health care at less cost. The University Hospital primarily serves an indigent, inner-city population. A government insurance program covers > 70% of patients. At this hospital, most private payors reimburse us for observing a patient who underwent an outpatient procedure, whereas government payors do not. Some expressed a concern as to the impact of not receiving the incremental 15 hours of observation charges between an 8- and 23-hour observation. This would have to be balanced by the opportunity cost of keeping the bed occupied during these 15 hours. After a relatively straightforward analysis, it was determined that foregoing the observation charges would only minimally affect the overall revenue generated from these PCI procedures. As our hospital is running near capacity on most days, keeping a bed available for another patient admission was the priority. Same-day PCI discharge programs have been in place for nearly a year at both institutions.

CONCLUSION

TR access improves patient comfort and recovery time while decreasing bleeding and vascular complications. These factors play an important role on the financial aspects of caring for patients undergoing PCI. Minimizing adverse vascular events provides the most direct opportunity to decrease health care expenditures associated with PCI. Decreasing staff workload and ultimately improving staffing

ratios for caring for PCI patients will lead to modest, but real, cost savings. Finally, improved patient flow through the medical center both for diagnostic and interventional procedures will result in shorter lengths of stay and lower costs. However, to realize the full economic potential of same-day discharge for PCI, financial and legal reforms must occur. Overall, the TR approach offers similar clinical efficacy to TF access, with fewer complications and lower costs. ■

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