Economic Analysis in Peripheral Artery Disease

Understanding the cost-effectiveness of new devices and treatment strategies.

BY ADAM C. SALISBURY, MD, MSc, AND DAVID J. COHEN, MD, MSc

Over 8 million individuals in the United States have lower extremity peripheral artery disease (PAD), with combined annual costs exceeding $21 billion.[1-3] Endovascular intervention has become the dominant mode of revascularization for symptomatic lower extremity PAD.[4] In response to high rates of restenosis with balloon angioplasty alone, new devices have been designed to reduce restenosis. However, in an era of limited health care resources, understanding which therapies should be broadly adopted requires an understanding of not only their clinical effectiveness, but also the costs associated with the use of these devices compared to standard care. Although treatments for PAD have traditionally been approved with little to no high-quality data regarding either clinical or economic outcomes, we believe that in the future, rigorous, comparative studies will be increasingly used to establish the value for such therapies. This article reviews the basic concepts of economic evaluation of medical technology with a focus on their application to lower extremity revascularization procedures.

EVALUATING THE ECONOMICS OF MEDICAL TECHNOLOGY

Several study designs may be used to describe the economics of new devices or care strategies. For each approach, it is critical to capture the cost of the procedures themselves, as well as the downstream consequences of their use—both the benefits (eg, avoidance of repeat procedures and complications) and the drawbacks (eg, potential for increased complications and higher costs). A cost-minimization study describes only the relative costs of different strategies. Although straightforward to design and interpret, this type of study is only useful for making treatment decisions if the strategies being compared yield similar clinical outcomes. Because clinical equivalence is often not established for device comparisons, cost-minimization studies can be challenging to interpret. A more robust design is the cost-effectiveness study, which evaluates treatment strategies in terms of both their costs and clinical benefits. Because a more effective device for revascularization of lower extremity PAD directly impacts patients' symptoms and functional capacity (rather than mortality), differences between interventions generally reflect their ability to yield sustained freedom from recurrent symptoms (eg, claudication) or prevent lifestyle-limiting complications (eg, amputation or nonhealing wounds).

In Figure 1, the origin of the graph represents the standard of care; the new treatment's effectiveness is plotted to the left of the origin if less effective and to the right of the origin if more effective than the existing standard of care. Similarly, a more expensive therapy would be plotted above the origin, and a less expensive intervention would be plotted below the origin. This creates four quadrants: quadrant 1, which is plotted in the lower right and represents a "dominant" strategy that is both more effective and less expensive than existing care; quadrant 2, which is plotted in the upper right and represents a more effective but more expensive alternative to current care; quadrant 3, which is located in the upper left or "dominated" quadrant and contains those therapies that are both less effective and more expensive than standard of care; and quadrant 4, which is plotted in the lower left quadrant and represents therapies that

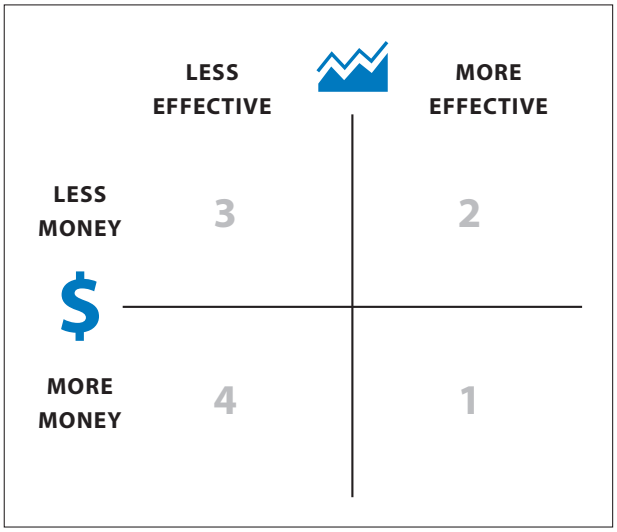

Figure 1. Cost-effectiveness is often described in terms of the cost-effectiveness plane.

are less effective but also less expensive than the reference treatment. Of note, the majority of new technologies tend to fall in the upper right quadrant, which are more expensive but also more effective than the existing alternatives.

Once the incremental cost and benefits of a new therapy compared with standard therapy have been established, the next step is to calculate the incremental cost-effectiveness ratio (ICER). This ratio is simply the difference in costs between the new therapy and standard of care divided by the difference in effectiveness. For this calculation, costs are measured in the currency of the country of interest. Effectiveness may be measured in a variety of units, but it is most commonly expressed in terms of quality-adjusted life-years (QALYs). To determine whether the new therapy is cost-effective, the ICER is compared with benchmarks that are appropriate for the decision maker. Although there are no explicit thresholds for cost-effectiveness in the United States health care system, a current American Heart Association/American College of Cardiology consensus document suggests that therapies that cost < $50,000 per QALY gained represent a high economic value, while therapies that cost between $50,000 and $150,000 per QALY gained represent an intermediate value, and therapies with ICERs > $150,000 per QALY gained represent a poor value in the context of the United States health care system.[5]

Another important concept when evaluating the cost-effectiveness of new therapies is that it may vary considerably based on the analytic perspective. Health care systems include a broad collection of stakeholders, each with different incentives and views on optimal policy for a particular approach to providing care. For example, the patient's goal is to maximize personal health, and assuming the patient has health insurance (and bears minimal out-of-pocket expense), patients would prefer the most effective intervention, regardless of cost. In contrast, the hospital's perspective is to maximize its contribution margin (ie, revenue minus variable cost) for each episode of care. Accordingly, a more expensive intervention with similar reimbursement as standard of care would be viewed less favorably from the hospital's perspective. Finally, a societal perspective focuses on maximizing benefits for the population within the constraints of available resources. Given the focus on the potential benefits, risks, and costs for all parties involved, the societal perspective is the recommended approach for the most cost-effective analyses. Nonetheless, it is important to recognize that therapies that may be viewed as cost-effective from one analytic perspective may be viewed differently from an alternate perspective.

The results of economic analyses are also strongly influenced by the time horizon of the study. PAD is a progressive, lifelong condition. Because an intervention may influence the clinical and economic outcomes of PAD over a patient's lifetime, the ideal time horizon for these studies is lifelong. Of course, the clinical studies that inform most economic analyses (especially clinical trials) follow patients for much shorter durations. A key element in interpreting results of an economic analysis is assessing whether the time horizon was adequate to capture the relevant costs and benefits of the intervention. In situations where the follow-up period was not adequate, modeling approaches may be used to estimate future costs and outcomes to extend the insights of the original trial. However, analyses limited to shorter time horizons may be acceptable in situations where the benefits of the therapy are time-limited (eg, treatments that reduce restenosis but do not affect longer-term outcomes such as survival, amputation, or claudication).

APPLYING ECONOMIC ANALYSIS TO PAD TREATMENT

A review of the recent literature on drug-coated balloons (DCBs) for the treatment of claudication among patients with obstructive femoral and popliteal PAD highlights several of these analytic challenges. The importance of understanding analytic perspective in interpreting study results is one example. In an economic analysis conducted along with the IN.PACT SFA trial that compared the In.Pact Admiral DCB (Medtronic) versus the standard percutaneous transluminal angio-

plasty (PTA) for patients with femoropopliteal PAD, the DCB was highly likely to be cost-effective from a societal perspective.[6] In fact, in our base case analysis, we found that treatment with the DCB was associated with a reduction of $576 per patient in 2-year PAD-related costs along with a 0.01-year gain in QALYs. Although there was some uncertainty in these findings, our analyses suggest that for patients similar to those enrolled in the trial, DCB therapy is likely to be cost-effective at a societal threshold of $50,000 per QALY gained and may be an economically dominant strategy.[6]

The results may differ when the analysis is performed from other perspectives. Pietzsch et al used a decision-analytic model to evaluate the 2-year costs of treatment for superficial femoral artery disease using a wide range of approaches, including standard balloon angioplasty, DCBs, bare-metal stents, and drug-eluting stents (DESs).[7] Similar to the IN.PACT SFA Health Economic study, they found that from a payer perspective (eg, Medicare), total 2-year costs were lower with DCB treatment compared with standard PTA. However, when the same data were reanalyzed from a hospital's perspective, margins (average reimbursement minus device costs) were greatest with standard balloon PTA.

Although trial-based economic analyses provide the most rigorous assessment of costs, clinical outcomes, and quality of life, these studies have important limitations. Most notably, because clinical trials generally consider only two potential treatments, the resulting economic analyses only provide insight into the cost-effectiveness of those specific therapies—even though many other approaches might be considered in clinical practice. For example, the economic analysis of the IN.PACT SFA trial focused only on the comparison of DCB with standard balloon angioplasty. In contrast, modeling studies, such as the one conducted by Pietzsch et al, allowed the investigators to compare a new intervention such as DCB with a range of alternative strategies. Although such analyses are subject to the limitations of the source data used to inform the model, they can still provide important insights into the relative costs and effectiveness of competing therapies in the absence of economic data from multiarm clinical trials.

Although economic studies of PAD are becoming more common, additional studies are needed to provide insight into several unanswered questions surrounding PAD care. For example, few operators currently pursue an up-front strategy of standard balloon PTA alone. Accordingly, high-quality economic data are needed to further inform comparisons of devices such as DCBs, DESs, and bare-metal stents (both traditional self-expanding and woven nitinol stents) and to consider the economics of these approaches with and without the use of atherectomy devices. Longer time horizons are also needed to gain maximum insight from these studies. Extended follow-up duration addresses the key concern of the durability of both cost savings and prevention of repeat revascularization with new techniques.

Another question requiring rigorous evaluation is the comparison of PTA versus bypass surgery in patients with complex femoral and popliteal disease. Previous studies have suggested lower long-term costs after treatment with PTA versus surgical bypass in patients with less complex disease,[8,9] but in current practice, the endovascular approach is increasingly used to treat long lesions, heavy calcification, and other challenging lesion subsets that were not included in these earlier studies. Finally, few data are available to compare the costs and long-term effectiveness of alternative strategies, including medical therapy, PTA, and surgery for management of patients with critical limb ischemia (CLI). To address this clinical dilemma, the National Institutes of Health–funded BEST CLI study plans to randomize 2,100 patients with CLI to treatment with surgical versus endovascular revascularization and includes plans for a formal, prospective health economic assessment.[10] This and other studies will be needed to better define what strategies are best adopted to manage this costly and clinically challenging manifestation of PAD.

CONCLUSION

An aging population and increasing societal focus on the efficient allocation of limited health care resources predict an increased focus on understanding the economic outcomes and cost-effectiveness of treatment strategies for highly prevalent and costly conditions, such as PAD. The challenge for the vascular interventional community is not only to design future trials to answer important clinical and economic questions, but also to use these data to inform clinical practice and ensure that reimbursement is tailored to support the use of the most clinically effective and cost-effective strategies. Accordingly, we anticipate that economic analyses will become an increasingly critical component of PAD-related research in order to better understand the role of new devices in the practice of vascular intervention and identify the optimal approaches to care. ■

1. Belch JJ, Topol EJ, Agnelli G, et al. Critical issues in peripheral arterial disease detection and management: a call to action. Arch Intern Med. 2003;163:884-892.

2. Hirsch AT, Haskal ZJ, Hertzer NR, et al. ACC/AHA 2005 practice guidelines for the management of patients with peripheral arterial disease (lower extremity, renal, mesenteric, and abdominal aortic): a collaborative report from the American Association for Vascular Surgery/Society for Vascular Surgery, Society for Cardiovascular Angiography

and Interventions, Society for Vascular Medicine and Biology, Society of Interventional Radiology, and the ACC/AHA Task Force on Practice Guidelines (Writing Committee to Develop Guidelines for the Management of Patients With Peripheral Arterial Disease): endorsed by the American Association of Cardiovascular and Pulmonary Rehabilitation; National Heart, Lung, and Blood Institute; Society for Vascular Nursing; TransAtlantic Inter-Society Consensus; and Vascular Disease Foundation. Circulation. 2006;113:e463-e654.

3. Mahoney EM, Wang K, Cohen DJ, et al. One-year costs in patients with a history of or at risk for atherothrombosis in the United States. Circ Cardiovasc Qual Outcomes. 2008;1:38-45.

4. Norgren L, Hiatt WR, Dormandy JA, et al. Inter-society consensus for the management of peripheral arterial disease (TASC II). J Vasc Surg. 2007;45(suppl S):S5-S67.

5. Anderson JL, Heidenreich PA, Barnett PG, et al. ACC/AHA statement on cost/value methodology in clinical practice guidelines and performance measures: a report of the American College of Cardiology/American Heart Association Task Force on Performance Measures and Task Force on Practice Guidelines. J Am Coll Cardiol. 2014;63:2304-2322.

6. Salisbury AC, Li H, Vilain KR, et al. Economic outcomes of endovascular femoropopliteal intervention using drug-coated balloons versus standard PTA: results from the IN.PACT SFA II trial. JACC Cardiovasc Interv. 2016. In press.

7. Pietzsch JB, Geisler BP, Garner AM, et al. Economic analysis of endovascular interventions for femoropopliteal arterial disease: a systematic review and budget impact model for the United States and Germany. Catheter Cardiovasc Interv. 2014;84:546-554.

8. Hunink MG, Wong JB, Donaldson MC, et al. Revascularization for femoropopliteal disease. A decision and cost-effectiveness analysis. JAMA.1995;274:165-171.

9. Adam DJ, Beard JD, Cleveland T, et al. Bypass versus angioplasty in severe ischaemia of the leg (BASIL): multicentre, randomised controlled trial. Lancet. 2005;366:1925-1934.

10. Farber A, Rosenfield K, Menard M. The BEST-CLI trial: a multidisciplinary effort to assess which therapy is best for patients with critical limb ischemia. Tech Vasc Interv Radiol. 2014;17:221-224.

Adam C. Salisbury, MD, MSc
Interventional Cardiology
Saint Luke's Mid-America Heart Institute
Assistant Professor of Medicine
University of Missouri-Kansas City
Kansas City, Missouri
Disclosures: Honoraria or speakers' fees from Medtronic; research grant support from Boston Scientific.

David J. Cohen, MD, MSc
Director of Cardiovascular Research
Saint Luke's Mid-America Heart Institute
University of Missouri-Kansas City
Kansas City, Missouri
dcohen@saint-lukes.org
Disclosures: Research grant support from Abbott Vascular, Boston Scientific, and Medtronic; consulting services to Abbott Vascular, Cardinal Health, and Medtronic.