Cost per day of patency: Understanding the impact of patency and reintervention in a sustainable model of healthcare

Michael C. Stoner, MD, Dorian J. deFreitas, MD, Mark M. Manwaring, MD, Jacqueline J. Carter, MD, Frank M. Parker, DO, and **C. Steven Powell, MD,** *Greenville, NC*

Background: **Healthcare resource utilization is an understudied aspect of vascular surgery. Initial cost of a given procedure is not an accurate reflection of resource utilization because it does not account for procedural durability and efficacy. Herein we describe an amortized cost model that accounts for procedural costs, durability, and re-intervention costs.**
Methods: **A cost model was developed using patency data endpoints and total hospital costs (direct and indirect) associated with an inital revascularization and subsequent re-interventions. This model was applied to a retrospective database of femoropopliteal reconstructions. One hundred and eighty-three open cases were compared with 198 endovascular cases; and the endpoints of initial cost, amortized cost at 12 months, and assisted patency were examined.**
Results: **The open and endovascular cases were not statistically different with respect to indication, patient co-morbid profiles, or post-procedural pharmacotherapy. Primary assisted patency was better in the open revascularization group at 12 months (78% versus 66%, $P < .01$). There was a statistically significant higher initial cost for open reconstruction when compared with endovascular ($12,389 ± $408 versus $6,739 ± $206, $P < .001$). However, at 12 months post-procedure, the initial cost benefit was lost for endovascular patients ($229 ± $106 versus $185 ± $124, $P = .71$). There was, however, a trend for endovascular cost savings in claudicants, though this did not reach significance ($259 ± $189 versus $86 ± $52, $P = .31$). For patients with critical limb ischemia, renal dysfunction, and end stage renal disease, the trend favored open surgery.**
Conclusions: **An amortized cost model provides insight into the healthcare resource utilization associated with a particular revascularization and assistive procedures. The initial cost savings of endovascular therapies are not sustained over time. Cost-savings trends were noted, however, longer follow-up is required to see if these will reach statistical significance. (J Vasc Surg 2008;48:1489-96.)**

Payment for the treatment of peripheral arterial disease (PAD) results in a significant cost to the healthcare system. In 2007, the United States (US) federal government spent 151 billion dollars in direct and indirect costs for the treatment of the eight to 12 million Americans with PAD. It is anticipated that this figure will continue to grow as baby boomers age and as hospitals and doctors expand their vascular practice in order to realize a population of patients as a new source of revenue.[1]

In the overall picture of healthcare spending, more than 500 billion US dollars are earmarked for Medicare and Medicaid payments this year, and this figure is expected to increase by 31% over the next five years. If costs continue to grow as projected, the United States federal government will spend approximately 20% of its gross domestic product on healthcare by 2050.[2]

In facing this looming crisis in healthcare reimbursement, responsible providers will need to know the true clinical benefit and cost efficacy of the treatment(s) that they provide. Vascular providers have available an ever-increasing array of new and potentially expensive modalities to treat PAD. Decreased healthcare resource utilization and lower procedural cost is often cited as rationale for technology adoption. Many of these new modalities compete with traditional open surgical procedures, and have not been fully evaluated for either clinical efficacy or cost effectiveness. Furthermore, the contemporary discussion about the cost of treatment modalities has frequently only taken into account the initial cost of the treatment rendered, which is flawed and myopic. There must be accounting for procedural success, procedural durability, and patient longevity, all of which are important factors in determining clinical and cost efficacy.

With this in mind, we reviewed our contemporary experience with open and endovascular therapy in the treatment of femoropopliteal occlusive disease. The primary aim of this study was to develop a simple cost efficacy framework that can be used to study the economic impact of any vascular reconstruction, taking into account the varying initial cost, patency and reintervention. The secondary aim was to utilize this new model to determine if the initial cost savings of endovascular therapy is sustained over time.

METHODS

Cost model. An amortized cost model was developed to examine the cost efficacy characteristics of a given revascularization procedure. To determine cost at any time, we

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Reprint requests: Michael C. Stoner, MD, Assistant Professor, East Carolina University, Brody School of Medicine, Department of Cardiovascular Sciences, Greenville, NC 27858-4354 (e-mail: stonerm@ecu.edu).
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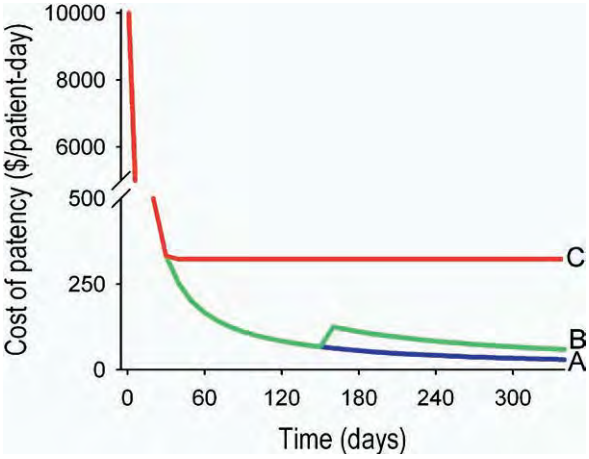

Fig 1. Hypothetical cost efficacy curves for the following revascularization scenarios: **A** (blue) – Successful initial revascularization without failure of patency or reintervention, **B** (green) – Re-intervention to maintain patency, **C** (red) – Failure of patency without reintrevention.

calculated the summation of all costs accrued over time to maintain patency. This takes into account the initial cost and the cost of all subsequent interventions. This is then divided by time in days to give the cost per day of patency. When an intervention failed patency, the cost per day of patency remains static throughout the remaining time period of the study.

Cost per day of patency is expressed at any given time interval (t) as follows:

$$\text{Cost}(t) = \lim_{t \to pa} \frac{\sum_{i=0}^{t} \text{Cost}(i)}{t} \qquad (1)$$

Where pa = maximum number of days of assisted patency and $Cost(i)$ = total hospital costs (direct and indirect) at time interval i days from index procedure ($t = 0$). With this cost model, the cost per day of patency was assessed at any given time interval from the index procedure. Hypothetical situations are illustrated in the cost efficacy curves of Fig 1. The figure depicts a series of patients undergoing revascularization. Patient A undergoes a successful revascularization, without the need for subsequent reintervention throughout the follow-up time period. Patient B requires a secondary procedure to maintain patency (primary assisted or secondary), and subsequently maintains patency. Finally, Patient C fails patency and an assistive procedure is not undertaken. Of note, total hospital costs were accounted for at each time point. If a patient suffered a complication or adverse event from a given procedure, the financial burden of that event was included in the model (costs and indirect costs associated with treatment of that complication). Cross-over to the other mode of therapy was considered a failure to maintain patency.

For the purpose of this study, total cost (direct and indirect cost) for the particular encounter was used to calculate the amortized cost. This cost data was obtained from hospital billing records. If a patient was admitted to the hospital for a non-lower extremity problem, only those costs associated with the appropriate diagnosis-related group (DRG) were used. Costs associated with adverse outcomes after a particular revascularization were also included for the total encounter cost calculation. Cost data was available for all patient encounters in this study. If the patient underwent a major amputation ipsilateral to the index revascularization, this was included in the cost analysis. Cost of postoperative rehabilitation, nursing home, or lost days of work was not included in this analysis.

Patient selection and data collection. In order to examine the use of the aforementioned model, a cohort of patients undergoing lower extremity revascularization was examined. The study was approved by the University and Medical Center Institutional Review Board of East Carolina University. From July 2003 to July 2006, all patients who had undergone open or endovascular treatments of femoropopliteal arterial circulation were identified in a retrospective computerized database. Patients were identified using the hospitals billing database using appropriate Common Procedural Terminolgy (CPT) codes. The decision to use open bypass or endovascular revascularization was based on clinical evaluation, anatomical factors, and the attending surgeon's preference.

Preoperative, procedural, and outcome variables were collected from the computerized patient care records. Basic demographic data were recorded, omitting patient identifying information. The indication for revascularization was classified by the criteria of Rutherford et al., and critical limb ischemia (CLI) was defined as Rutherford category > 3.[3]

Patient comorbidities were defined as:

- Diabetes mellitus: medical treatment of diabetes;
- Hypertension: medical treatement of hypertension;
- Hyperlipidemia: medical treatment of dyslipidemia or total cholesterol > 200 mg/dl;
- Tobacco use: recorded as both lifetime tobacco use and current use;
- Coronary disease: medical therapy for coronary vascular disease or prior coronary revascularizaton;
- Renal insufficiency: serum creatinine >1.5 mg/dl
- End stage renal disease: renal failure requiring chronic renal replacement therapy.

Perioperative medical management was noted with respect to the following agents: Aspirin, Clopidogrel (Plavix, Sanofi-Aventis, Bridgewater, NJ), Warfarin (Coumadin, Bristol-Myers Squibb, Princeton, NJ), lipid lowering therapy.

Anatomic and morphologic characteristics were obtained by review of the archived images from the individual cases. Calibrated angiography was used to determine lesion lengths and infrapopliteal run-off was recorded. These data were used to assign the target lesion with a TransAtlantic Inter-Society Concensus (TASC II) classification.[4]

Specific data points were collected based on the type of revascularizaton performed. Type of graft conduit and tar-

get vessel was noted in open surgical cases. Endovascular modality (ie, angioplasty, stenting, atherectomy or cryoplasty) was documented for those undergoing endovascular revascularization. Several data points that did not impact the cost model were omitted from this manuscript for the sake of simplicity and brevity.

Long-term end points. The primary endpoint of this study was cost per patient day of patency 12 months following the index procedure. The time interval of 12 months was chosen because the fraction of patients in each group available for follow-up was equal at that time point. At later times, fewer of the endovascular patients were available for follow-up, owing to the fact that an increasing number of the endovascular cases took place in the latter half of the study. For a given patient, the cost model was used to generate the cost per day of patency at 1 year.

Primary patency and primary-assisted patency were the secondary end points in this study. Patency was determined by the guidelines of Rutherford et al. and used routine physiologic examinations in those without a palpable pulse including duplex ultrasonography, ankle brachial index (ABI), and pulse volume recordings (PVR).[3] Deterioration in clinical status or hemodynamics prompted further imaging. Duplex ultrasonography was used to follow all patients with a bypass graft and those with a stent. A peak systolic velocity ratio > 2.0 prompted further imaging in these patients. Total follow-up time was recorded for each patient as well as the time to failure of primary, primary-assisted, and secondary patency.

Statistical analysis. The software code for the cost model was developed using Microsoft Visual Basic and employed a Microsoft Excel spreadsheet to input the data and record the output of the model (Microsoft Corp., Redmond, Wash). A developmental version of this software code is freely available under the terms of the GNU General Public License.[5] The average amortized cost per day of patency was compared between open and endovascular therapy groups. Results were analyzed using the Student *t* test and are presented as mean ± standard error. A $P < .05$ was considered significant for all statistical analyses. Kaplan-Meyer life tables were created and patency was examined using log-rank analysis. Multivariate logistic regression was used to analyze the categorical variables associated with early failure of primary patency (<30 days). Variables with a $P < .10$ were considered candidate variables for this analysis. These data were analyzed using SAS 9.1 software (SAS institute Inc, Cary, NC).

RESULTS

Over a three-year period, a total of 381 femoropopliteal segments were treated in 359 patients. There were a total of 183 femoropopliteal segments treated with open revascularization and 198 treated with endovascular therapy. Both treatment groups were well matched with no significant difference in clinical variables including: Rutherford category, age, gender, diabetes, hypertension, end stage renal disease requiring dialysis, tobacco, run-off, and postoperative pharmacotherapy (Table I).

Table I. Demographic, clinical and anatomical characteristics of open and endovascular cases of femoropopliteal evascularization

	Open (n = 183)	*Endovascular (n = 198)*	P
Age (years ± SE)	63.9 ± 0.9	66.0 ± 0.9	.10
Male	63.1%	57.9%	.29
Critical limb ischemia	55.7%	43.4%	.10
Diabetes	48.1%	50.0%	.70
ESRD	13.1%	9.1%	.80
Creatinine > 1.5 mg/dl	14.8%	15.6%	.80
Runoff < 2 vessels	49.1%	53.0%	.45
TASC C or D	N/A	37.7%	N/A
Lesion length > 10 cm	N/A	21.3%	N/A
Stent	N/A	21.3%	N/A
Prosthetic graft	98%	N/A	N/A
Above-knee graft	90%	N/A	N/A
12-month follow-up	86.3%	79.8%	.10
Failed, no-reintervention	28.7%	24.6%	.35

ESRD, end stage renal disease; *TASC,* Trans-Atlantic Inter-Society Consensus.

In the open group, 165 of 183 bypasses (90%) were above-knee grafts using prosthetic conduit. Of the 198 endovascular cases, 75 (38%) were TransAtlantic Inter-Society Consensus (TASC) II classification C or D cases. Subintimal angioplasty was routinely utilized in the treatment of TASC D cases. A luminal re-entry device was used in only 5 cases (7% of TASC C or D cases). Stents were used in 42 (21%) of cases owing to a suboptimal result with standard angioplasty (>30% residual stenosis or flow-limiting dissection); and atherectomy (mechanical or laser) was used in a total of 26 (13%) of cases.

Durability data demonstrated that primary assisted patency (all indications) at twelve months was 77% ± 0.03% for the open group and 65% ± 0.04% for the endovascular group ($P < .01$). Primary assisted patency for patients with claudication at twelve months was 93% ± 0.03% in the open group versus 80% ± 0.04% in the endovascular group ($P < .01$, Fig 2). Primary assisted patency for patients with critical limb ischemia at twelve months was 66% ± 0.05% in the open group and 54% ± 0.05% in the endovascular group ($P < .01$, Fig 3).

Initial cost of open therapy was significantly higher in all subgroups (Table II). Using the model of amortized cost described above, the cost per day of patency was calculated at one year. A graphical representation of the cost model is shown in Figs 3 and 4. Despite the difference in initial cost, our model showed no statistically significant difference in amortized cost at one year between open and endovascular groups regardless of indication. For all indications, the amortized cost per day of patency at 12 months was \$229 ± \$106 for open cases and \$185 ± \$124 for endovascular cases ($P = .71$, Table III). Claudicants treated by simple angioplasty showed the lowest cost per day of patency (\$26 ± \$14) although this did not reach statistical significance when compared with open therapy in such patients (Fig 5).

The driving forces of this cost model are the initial procedural cost, the costs of all assistive procedures, and the dura-

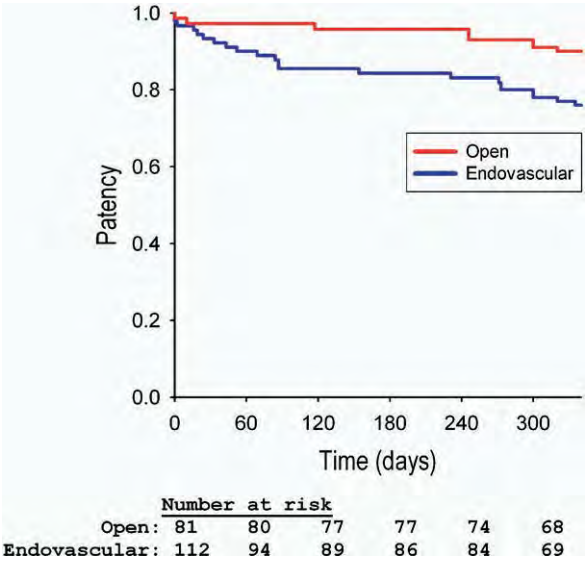

Fig 2. Kaplan-Meyer curve demonstrating probability of primary-assisted patency from time of index procedure in both open (red) and endovascular (blue) cases for patients with claudication ($P < .01$).

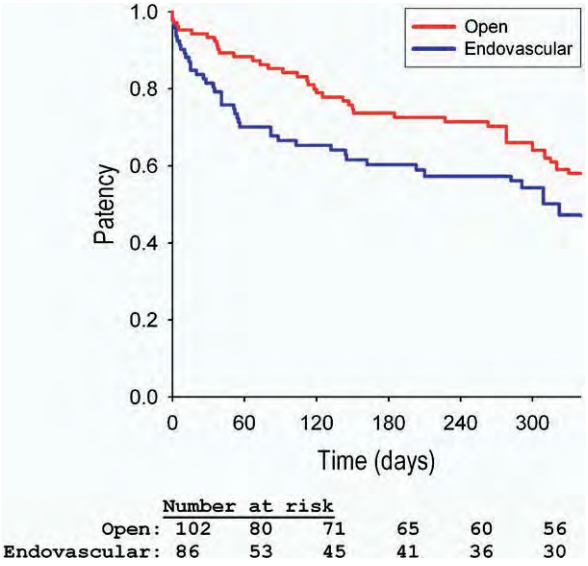

Fig 3. Kaplan-Meyer curve demonstrating probability of primary-assisted patency from time of index procedure in both open (red) and endovascular (blue) cases for patients with critical limb ischemia ($P < .01$).

bility of these procedures. The factors that contribute to the amortized portion of the model are shown in Table IV. Failures, especially those that were not subjected to reintervention, are a very significant part of this construct. A high rate of failures and lack of re-intervention is especially evident in both the open and endovascular groups with critical limb ischemia. Exact reasons for lack of re-intervention are difficult

Table II. Initial cost of open and endovascular femoropopliteal revascularization stratified by indication

	Open – Initial cost ($ ± SE)	*Endovascular – Initial cost ($ ± SE)*	P
All indications	12,389 ± 408	6,739 ± 260	<.001
Critical limb ischemia	13,277 ± 598	7,176 ± 309	<.001
Claudicants	11,042 ± 468	6,287 ± 415	<.001
Diabetes	12,233 ± 530	6,714 ± 342	<.001
Creatinine >1.5 mg/dl	14,922 ± 1510	7,602 ± 844	<.001
ESRD	12,562 ± 613	7,236 ± 586	<.001
CHF	12,414 ± 761	7,012 ± 568	<.001
Runoff <2 vessels	13,425 ± 712	7,262 ± 344	<.001
Stent placement	12,389 ± 408	9,453 ± 705	<.01
TASC C/D	12,389 ± 408	7,540 ± 492	<.001

CHF, congestive heart failure; *ESRD*, end stage renal failure, *TASC*, Trans-Atlantic Inter-Society Consensus.

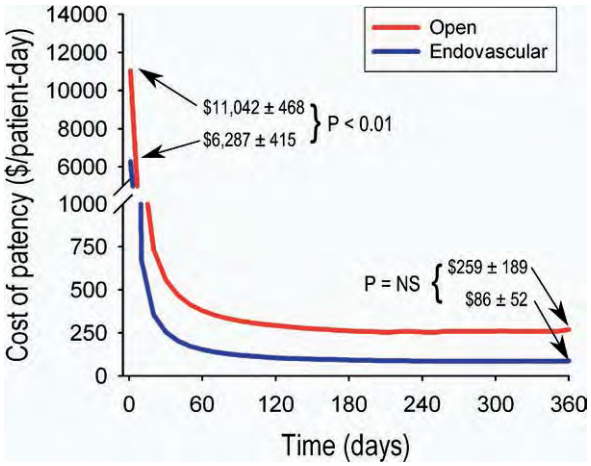

Fig 4. Cost efficacy curves in patients undergoing revascularization via both open (red) and endovascular (blue) techniques for patients with claudication.

to determine retrospectively, but are in general attributable to sub-optimal anatomic or patient co-morbid conditions, in which reintervention is thought to be just as likely to fail. Failure without re-intervention resulted in a significantly higher amortized cost compared with failure with reintervention in the endovascular group ($551 ± $184 versus $34 ± $4, $P < .01$, Table III), and a trend towards a similar higher cost in the open group ($418 ± $154 versus $157 ± $122, $P = .23$, Table III).

Utilizing the model, subgroup analysis was undertaken to identify risk factors in which one therapy was more cost effective. Patients with critical limb ischemia, end stage renal disease requiring dialysis, renal insufficiency (creatinine > 1.5 mg/dL), and congestive heart failure showed a trend towards open revascularization being more costeffective; however, this did not reach statistical significance. Because early failures have a significant impact on this model, a multivariate analysis was undertaken to indentify

Table III. Cost per patient-day of patency at 12 months from index procedure, stratified by indication

	Open – 12 months ($/patient-day patency ± SE)	*Endovascular – 12 months ($/patient-day patency ± SE)*	P
All indications	229 ± 106	185 ± 124	.71
Critical limb ischemia	210 ± 80	359 ± 143	.33
Claudicants	259 ± 189	86 ± 52	.31
Diabetes	402 ± 208	284 ± 119	.62
Creatinine >1.5 mg/dl	129 ± 51	383 ± 305	.44
ESRD	248 ± 149	495 ± 226	.39
CHF	76 ± 15	355 ± 170	.17
Runoff <2 vessels	439 ± 213	304 ± 112	.56
Stent placement	229 ± 106	150 ± 98	.70
TASC C/D	229 ± 106	228 ± 138	.98
Failed, yes reintervention	157 ± 122	34 ± 4	.28
Failed, no reintervention	418 ± 154	551 ± 184	.58

CHF, congestive heart failure; *ESRD,* end stage renal failure, *TASC,* Trans-Atlantic Inter-Society Consensus.

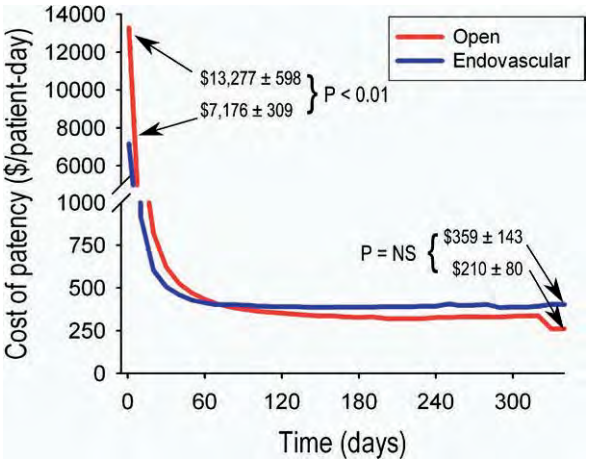

Fig 5. Cost efficacy curves in patients undergoing revascularization via both open (red) and endovascular (blue) techniques for patients with critical limb ischemia.

covariates associated with failure (Table V). End stage renal disease (ESRD) requiring dialysis was an independent risk factor for early failure in patients with critical limb ischemia for both open and endovascular therapy. (odds ratio [OR] = 3.48, $P = .048$). No other variable was a significant correlate of early failure.

DISCUSSION

Healthcare cost utilization is a poorly understood aspect of vascular surgery. When two different modalities can be used to treat the same disease process, there is an easy opportunity for comparison, including total longitudinal cost and durability. In the current environment, it is important to have an understanding of these competing modalities. There exists a considerable amount of controversy over the use of open and endovascular procedures, principally because of the diversity of vascular care providers. Historically, the lower initial costs and less invasive nature of percutaneous endovascular procedures have won out over the more expensive but potentially more durable open procedures.

This study provides a well-matched group of patients treated for femoropopliteal occlusive disease. While this study is limited by its retrospective nature, moderate sample size and the inherent treatment biases that exist in any practice, it follows the literature in that, with respect to complex femoropopliteal disease, the patency of open revascularization is superior to that of endovascular. The data presented here represent a significant number of such cases (37.7% TASC C or D). The initial cost of open revascularization is also significantly higher than endovascular therapy, as has also been described.[6,7]

Multiple attempts have been made to develop cost models. Our model of cost per patient-day of patency gives a surrogate measure of a cost benefit ratio by adding in often unconsidered factors such as overall patency and reintervention rates. This cost efficacy model becomes static during the follow-up period once a particular intervention looses assisted patency. Through this mechanism, revascularization failures, especially early ones, weigh heavily. The inclusion of total hospital costs associated with the procedure, including those associated with adverse events, accounts for the economic impact of procedural-associated morbidity.

The relationship between procedural cost and clinical success is often indirect. For instance, a 2005 study demonstrated that endovascular procedural costs were significantly higher in more complex cases compared with open surgery, and that these increased costs did not necessarily translate to an improved clinical outcome.[6] The authors conclude that when the clinical efficacy of procedures overlap, percutaneous strategies should be employed based on these economic factors. This statement holds true only if the subsequent economic burden for reintervention either favors endovascular treatment or is at least equivalent to that of open surgery. Once this relationship between cost and durability is realized, it is relatively simple to derive both procedural cost and efficacy targets for a given modality and patient co-morbidity profile.[8]

Table IV. Number of assistive procedures, total cost of assistive procedures and number of failed revascularizations not undergoing reintervention listed by number of months from index procedure, stratified by indication (Claudicant or CLI) and modality (open or endovascular)

	Claudicants – open (n = 81)			*Claudicants – endovascular (n = 112)*			*CLI – open (n = 102)*			*CLI – endovascular (n = 86)*		
Time (months)	*Proc. (n)*	*Cost (k$)*	*Failed (n)*	*Proc. (n)*	*Cost (k$)*	*Failed (n)*	*Proc. (n)*	*Cost (k$)*	*Failed (n)*	*Proc. (n)*	*Cost (k$)*	*Failed (n)*
1	1	16.6	1	1	27.9	4	3	35.8	10	0	0	18
2	0	0	0	0	0	3	0	0	4	0	0	9
3	0	0	1	1	6.8	3	0	0	2	0	0	3
4	0	0	2	0	0	1	2	24.3	4	1	13.1	2
5	1	16.4	0	1	4.9	0	0	0	5	1	13.6	1
6	0	0	0	1	7.4	1	2	20.5	1	1	8.9	1
7	0	0	0	1	19.5	1	1	6.7	0	1	7.2	1
8	1	5.1	0	1	4.7	0	1	7.6	2	0	0	1
9	2	26.1	2	1	7.2	1	1	14.2	1	1	7.7	0
10	0	0	1	0	0	2	0	0	0	0	0	1
11	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	1	0	0	0

CLI, critical limb ischemia; *Proc*, procedures.

Table V. Multivariate analysis for variables associated with early failure (< 30 days)

	Odds ratio	*95% Confidence limits*	P
Patient factors			
Age >80 years	1.738	0.411-7.359	.667
Diabetes	1.390	0.402-4.809	.453
Hypertension	0.455	0.058-3.553	.452
Hyperlipidemia	0.375	0.051-2.732	.332
ESRD	3.848	1.012-14.633	.040
CHF	2.842	0.861-9.380	.086
Pharmacology			
Statin	1.575	0.181-13.733	.681
Coumadin	1.261	0.275-5.771	.765
Anatomic			
Runoff <2 vessels	0.560	0.411-7.359	.355

CHF, congestive heart failure; *ESRD,* end stage renal failure.

The purpose of this study was to describe a cost efficacy model and to apply it to a sample data set. Similar models have been described in the literature, however, our model is unique in that we described an amortized cost per day of patency associated with a single index procedure.[6,9] Crossover to another mode of treatment was considered a failure, and the revascularization cost was held static at that time point. Therefore, documented patency and procedural durability become the main driving forces for economic success. Using endpoints such as freedom from re-operation or limb salvage are other possibilities, and likely the information obtained by applying these models would differ. This is because these soft endpoints would likely improve the durability profile of endovascular therapy, more so than open therapy. The societal definition of primary-assisted patency was utilized as our efficacy endpoint so that these data would be comparable to other contemporary series in the vascular surgery literature.

The conclusions from this analysis are based on a relatively small group of patients, and therefore the risk of statistical error is significant. The authors' intent is merely to provide an example application of this cost efficacy framework. The decision to compare open with endovascular revascularization was based on the observation that there is an increasing trend towards its acceptance as the first-line therapy for arterial occlusive disease.[10-12] These data could readily be stratified by other factors and patient co-morbidities, not just treatment modality. For example, cost per day of patency could be compared between diabetics and nondiabeteics. Furthermore, the model could easily be adapted to examine other cost efficacy scenarios such as limb salvage (cost per day of limb salvage), carotid revascularization (cost per day of stroke-free survival), coronary revascularization (cost per day of coronary-related event free survival), and aortic aneurysm repair (cost per day of aneurysm-related event free survival).

Interestingly, despite a nearly two-fold difference in initial cost, the cost savings of endovascular therapy is not carried out over time. The loss of the cost benefit of endovascular therapy lies in its lower patency rates and need for subsequent reintervention. This is evident particularly in the critical limb ischemia cohort where at one year, endovascular therapy is trending to become the more expensive modality. The 11% difference in patency at one year and the early failures of patency (<30 days) are the major influences on this high cost. This economic benefit to open revascularization in patients with critical limb ischemia has been described before for patients with complex arterial occlusive disease.[13]

Claudicants treated by endovascular therapy have a noticeable trend toward cost savings compared with open therapy, despite a 14% differential in patency at one year. In particular, those treated by simple angioplasty with no other adjunctive interventions showed the greatest savings.

This difference is driven by the fact that there were less early failures in the endovascular group and the often high expense of reintervention in the open group. The improved cost benefit ratio of angioplasty compared with bypass in the treatment of claudicants has been noted in a recent Markov decision model-based study.[14] Of course, exercise therapy is an integral component in the treatment of intermittent claudication, and may possess a positive cost efficacy profile.[15] Our current database is restricted to open and endovascular revascularizations, and therefore we are unable to comment on the application of this cost model to exercise therapy.

The cost per day of patency of open therapy appears to favor those with critical limb ischemia, ESRD, renal insufficiency and heart failure. Caution must be taken when considering these results because of low patient numbers and high error margins. The trend favoring open therapy relates to the very high early failure rates seen with endovascular reconstructions in these often poor candidates. ESRD offers a complex problem as it has a high early failure rate in both open and endovascular therapy in patients with critical limb ischemia. Based on our results, it is difficult to recommend any therapy based on our cost analysis. The poor cost benefit ratio encountered when treating ESRD patients with critical limb ischemia is prohibitive in all but a select few, and argues for conservative therapy and early primary amputation. These strikingly inferior outcomes have been well documented in the literature.[16-18]

The primary flaw of this study lies in the sample database used to illustrate the model. The data are from a single institution, and therefore demonstrate biases inherit to any individual practice pattern. Furthermore, as mentioned above, there was a heterogenous follow-up between the two groups. Because of an increasing percentage of endovascular cases in the latter half of the study, we were forced to terminate the cost calculations at 12 months. This is arguably a relatively short period of time, and further follow-up of this cohort will be required to see if the trends noted above will reach statistical significance. With respect to the cost model, we have not accounted for larger societal costs, such as rehabilitation, nursing home stays, and lost productivity associated with longer hospital stays. While this could be accounted for with some modification, we elected to not address this factor. The goal of this study was to develop a simple cost model, which utilizes standard patency and follow-up data in conjunction with readily available institutional financial data.

CONCLUSION

A cost efficacy model was developed that uses standard patency data and information readily available from any healthcare system's financial database. This model was applied to a retrospective femoropopliteal revascularization database in order to demonstrate its use and feasibility. In this model, procedural durability and reintervention costs appear to be significant factors when determining overall cost to the healthcare system. Models for healthcare utilization in vascular surgery must to take into account initial cost, patency, and reintervention rate if a sustainable growth model of healthcare is to be developed.

AUTHOR CONTRIBUTIONS

Conception and design: MS, DD, MM, JC, FP, CP
Analysis and interpretation: MS, DD
Data collection: MS, DD, MM, JC
Writing the article: MS, DD
Critical revision of the article: MS, DD, MM, JC, FP, CP
Final approval of the article: MS, DD, MM, JC, FP, CP
Statistical analysis: MS, DD, MM
Obtained funding: MS
Overall responsibility: MS, DD
MS and DD contributed equally to this work.

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