Radial Versus Femoral Access in PCI

An economic and quality analysis.

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Radial access for percutaneous coronary intervention (PCI) has been adopted by many interventional cardiologists as an alternative vascular access site during the last decade. The transradial approach is the preferred access strategy for PCI in several European countries, Canada, and Japan, with momentum building more slowly in the United States.[1-4] Previous studies have demonstrated reduced length of stay (LOS),[5,6] fewer access site complications,[4,7] improved quality of life and patient satisfaction,[5,6] and earlier ambulation[6] for transradial PCI (TRI) when compared to transfemoral PCI (TFI).

These well-documented clinical benefits, in addition to reduced LOS, transform TRI into an economically compelling strategy.[5,7-10] However, these clinical benefits for TRI occur at the cost of increased access site crossover[11,12] and reduced procedural success,[13] potentially resulting in increased resource utilization.[8,11,12] Increased operator expertise during a defined learning curve[6,14,15] improves the success rate and procedure duration for TRI.[16]

The cardiovascular services line is under tremendous pressure to provide cost-effective treatment while maintaining quality of care. Physicians and hospital administrators struggle with understanding the potential economic benefits that TRI might offer compared to TFI.[8,17] To better understand the economic impact of TRI, we compared the costs and quality outcomes (bleeding, LOS, and mortality) between TRI and TFI based on experience in a large-volume tertiary care center.

METHODS

Study Design

Our study retrospectively compared the cost and clinical outcomes between TRI and TFI at the Frederik Meijer Heart & Vascular Institute, Spectrum Health in Grand Rapids, Michigan. Spectrum Health–Butterworth Hospital is a 989-bed teaching hospital in West Michigan and is the primary teaching hospital for Michigan State University–College of Human Medicine. The study was approved by the hospital's institutional review board. Twenty-one experienced interventional cardiologists were involved in performing TFI or TRI PCI during the course of the study.

All patients who underwent PCI from January 2010 through March 2011 were included. The exclusion criteria included patients who had more than one PCI during the same hospital stay. The primary outcome measures were adjusted total, procedural, and postprocedural costs, which were used to determine cost differences between TRI and TFI. The secondary objective was to evaluate quality outcomes: post-PCI bleeding within 72 hours, LOS, and all-cause in-hospital mortality for TRI and TFI.

Study Population and Data Collection

A total of 2,972 patients were extracted from the hospital data warehouse (SAP Business Objects–Enterprise XI, Product: 12.1.0, Walldorf, Germany) using ICD-9 (International Classification of Disease–version 9) principal and secondary procedure code 0.66. Fifty-three patients were identified as having undergone repeat PCI during the same hospital stay, resulting in a final cohort of 2,919 patients. The data components with their element numbers were obtained from the National Cardiovascular Data Registry (NCDR) CathPCI Registry.

The demographic data (with their element numbers) collected included age, sex (2060), race (2070–2074), New York Heart Association class (5040, 5045), Canadian Cardiovascular Society class (5020), creatinine level (7315), hypertension (4005), coronary artery disease presentation (5000) (ST-elevation myocardial infarction [STEMI], non-STEMI, unstable angina), cardiogenic shock (5060), history of congestive heart failure (4025), PCI (4035), and peripheral vascular disease (4075). In addition, primary insurance type (3020–3027) was collected.

TABLE 1. BASELINE CLINICAL CHARACTERISTICS[a]				
Characteristics	**Total**	**Radial**	**Femoral**	***P* Value**
	(N = 2,919)	(N = 191)	(N = 2,728)	
Age, years	64.9 ± 12.2	63 ± 12	65.1 ± 12.3	.022
Sex, men	2,020 (69.2%)	133 (69.6%)	1887 (69.2%)	.894
Race				.367
Caucasian	2,799 (95.9%)	189 (99%)	2,610 (95.7%)	
African American	92 (3.2%)	2 (1%)	90 (3.3%)	
Asian	17 (0.6%)	0 (0%)	17 (0.6%)	
Native American	6 (0.2%)	0 (0%)	6 (0.2%)	
Other	5 (0.2%)	0 (0%)	5 (0.2%)	
Admission diagnosis				.03
No angina	196 (6.7%)	15 (7.9%)	181 (6.6%)	
Symptoms unlikely	117 (4%)	13 (6.8%)	104 (3.8%)	
Stable angina	407 (14%)	25 (13.1%)	382 (14%)	
Unstable angina	1,483 (50.8%)	98 (51.3%)	1,385 (50.8%)	
Non-STEMI	382 (13.1%)	30 (15.7%)	352 (12.9%)	
STEMI	332 (11.4%)	10 (5.2%)	322 (11.8%)	
Insurance type				.263
Medicare/Medicaid	1755 (60.1%)	104 (54.5%)	1,651 (60.5%)	
Private	984 (33.7%)	75 (39.3%)	909 (33.3%)	
Other	10 (0.3%)	1 (0.5%)	9 (0.3%)	
None	170 (5.8%)	11 (5.8%)	159 (5.8%)	
Hypertension	2,462 (84.3%)	163 (85.3%)	2,299 (84.3%)	.695
Cardiogenic shock < 24 h	57 (2%)	1 (0.5%)	56 (2.1%)	.179
CCS class				.036
No angina	210 (7.2%)	16 (8.4%)	194 (7.1%)	
Class 1	140 (4.8%)	11 (5.8%)	129 (4.7%)	
Class 2	383 (13.1%)	25 (13.1%)	358 (13.1%)	
Class 3	1,820 (62.4%)	129 (67.5%)	1,691 (62%)	
Class 4	365 (12.5%)	10 (5.2%)	355 (13%)	
NYHA class				.233
None	2,687 (92.1%)	184 (96.3%)	2,503 (91.8%)	
Class I	17 (0.6%)	1 (0.5%)	16 (0.6%)	
Class II	45 (1.5%)	2 (1%)	43 (1.6%)	
Class III	114 (3.9%)	3 (1.6%)	111 (4.1%)	
Class IV	56 (1.9%)	1 (0.5%)	55 (2%)	
Previous PCI	1,206 (41.3%)	85 (44.5%)	1,121 (41.1%)	.355
History of PVD	511 (17.5%)	39 (20.4%)	472 (17.3%)	.273
Previous CHF	469 (16.1%)	26 (13.6%)	443 (16.2%)	.339

TABLE 1. BASELINE CLINICAL CHARACTERISTICS[a] (CONTINUED)				
Characteristics	**Total**	**Radial**	**Femoral**	***P* Value**
Estimated GFR, mL/min/1.73 m^2	76.4 ± 25.8	79.2 ± 26.7	76.2 ± 25.7	.12
GFR	76.4 ± 26.2	79.3 ± 26.9	76.2 ± 26.1	.123
Missing	82	3	79	
Admission status: inpatient	1,986 (68%)	118 (61.8%)	1,868 (68.5%)	.055
Same-day discharge	171 (5.9%)	38 (19.9%)	133 (4.9%)	< .001
Anticoagulation				
Glycoprotein IIb/IIIa inhibitors	657 (22.5%)	84 (44%)	573 (21%)	< .001
Bivalirudin	1,205 (41.3%)	25 (13.1%)	1,180 (43.3%)	< .001
LMW heparin	161 (5.5%)	10 (5.2%)	151 (5.5%)	.861
Unfractionated heparin	1,885 (64.6%)	172 (90.1%)	1,713 (62.8%)	< .001
Closure device	889 (30.5%)	0 (0%)	889 (32.6%)	< .001
Total number of stents	1.2 ± 1.1	1.1 ± 0.9	1.2 ± 1.1	.342
Bare-metal stent	0.2 ± 0.6	0.2 ± 0.5	0.2 ± 0.6	.809
Drug-eluting stent	1 ± 1.1	0.9 ± 1	1 ± 1.1	.289
Bleeding risk				
Probability, %	2.06 ± 2.18	1.65 ± 1.49	2.09 ± 2.22	.007
Risk level				.002
Low (<1%)	961 (32.9%)	78 (40.8%)	883 (32.4%)	
Mid (1%–3%)	1,413 (48.4%)	94 (49.2%)	1,319 (48.4%)	
High (>3%)	545 (18.7%)	19 (9.9%)	526 (19.3%)	

[a]Data expressed as mean ± standard deviation or number of patients (percentages).
Abbreviations: CCS, Canadian Cardiovascular Society; CHF, congestive heart failure; GFR, glomerular filtration rate; LMW, low-molecular-weight heparin; MI, myocardial infarction; NYHA, New York Heart Association; PVD, peripheral vascular disease.

The procedural information included anticoagulant therapy (9500, 9510), access location (femoral, radial) (5350), closure device (5355), number and type of stents (7225), PCI status (7020) and indication (7035), coronary artery bypass graft (9000, 9005, 9010, 9015), and inpatient or outpatient procedure (9065). The outcomes data included bleeding events (8050, 8055, 8060, 8061, 8070, 8080, 8090, 8100), in-hospital mortality (9040, 9055), and total LOS (discharge date [9035] minus admit date [3000]).

The economic analysis probed the total cost (cost on the day of PCI through hospital discharge), procedural cost, and postprocedural cost to assess if cost differences were being determined by different stages in a hospitalization. The costs were calculated for the day of procedure (procedural costs) and the day after the procedure through discharge (postprocedural costs) based on the billing day for each item description. As part of the subanalysis, total costs alone were reported for same-day discharge patients, as they did not have postprocedural costs. All cost components were an aggregate of direct and indirect costs. The cost data were linked to the NCDR CathPCI Registry data to form a combined deidentified dataset. The study data were sent to the third-party Vita Solutions firm (a subsidiary of The Medicines Company, Parsippany, NJ) that performed data summary and statistical analysis.

Statistical Analysis

Continuous variables were expressed as mean ± standard deviations, and categorical variables were expressed as counts with percentages. Intergroup differences for continuous variables were tested using Student's *t*-test. The chi-square test was used to determine the differences in categorical variables between the TRI and TFI. Due to outliers in cost data, all costs were trimmed back to the 95% confidence level of the mean. A generalized linear mixed model[18] was developed for total cost, procedural cost, and postprocedural cost. The nine covariates in the model included PCI status, race, sex, previous congestive

TABLE 2. UNADJUSTED AND ADJUSTED COST SAVINGS[a]				
Cost Components	**Radial**	**Femoral**	**Difference**	***P* Value**
Total cost				
Unadjusted				
All patients	9,480 (8,771–10,190)	11,456 (11,187–11,724)	1,975 (944–3,007)	<.001
Low risk	9,144 (8,388–9,901)	10,017 (9,708–10,325)	872 (-190–1,935)	.107
Moderate risk	9,275 (8,138–10,412)	11,230 (10,883–11,577)	1,955 (621–3,289)	.004
High risk	11,875 (8,583–15,167)	14,437 (13,527–15,347)	2,562 (-2,263–7,387)	.297
Adjusted				
All patients	13,503 (8,540–19,375)	15,177 (10,171–20,440)	1,375 (531–2,056)	.008
Low risk	9,826 (8,829–11,110)	10,705 (9,848–11,829)	859 (50–1,638)	.041
Moderate risk	10,193 (9,187–11,528)	11,865 (11,403–12,350)	1,697 (258–2,648)	.014
High risk	14,884 (9,016–22,517)	17,077 (12,096–22,937)	1,838 (-1,161–4,628)	.468
Procedure cost				
Unadjusted				
All patients	8,481 (8,043–8,919)	9,500 (9,365–9,634)	1,019 (496–1,541)	< .001
Low risk	8,711 (7,999–9,423)	9,165 (8,941–9,389)	454 (-328–1,236)	.255
Moderate risk	8,240 (7,617–8,864)	9,592 (9,398–9,786)	1,352 (606–2,098)	< .001
High risk	8,727 (7,322–10,133)	9,829 (9,499–10,159)	1,101 (-653–2,856)	.218
Adjusted				
All patients	7,828 (7,262–8,990)	8,699 (8,399–9,713)	897 (402–1,352)	.001
Low risk	8,663 (7,969–9,453)	9,116 (8,740–9,490)	464 (-300–1,130)	.25
Moderate risk	8,504 (7,913–9,186)	9,743 (9,520–9,974)	1,237 (551–1,831)	.001
High risk	8,023 (6,659–9,524)	8,931 (8,550–10,001)	993 (-236–2,255)	.258
Postprocedure cost				
Unadjusted				
All patients	999 (488–1,511)	1,956 (1,737–2,175)	957 (119–1,794)	.025
Low risk	434 (254–614)	852 (632–1,071)	418 (-323–1,159)	.269
Moderate risk	1,035 (153–1,916)	1,638 (1,359–1,916)	603 (-467–1,673)	.269
High risk	3,148 (473–5,822)	4,608 (3,835–5,382)	1,460 (-2,639–5,560)	.484
Adjusted				
All patients	5,912 (729–11,669)	6,504 (1,384–11,882)	490 (-177–930)	.277
Low risk	1,179 (504–2,105)	1,579 (868–2,619)	410 (97–711)	.028
Moderate risk	1,649 (992–2,839)	2,104 (1,725–2,576)	467 (-770–1,091)	.452
High risk	6,880 (1,152–14,562)	8,229 (3,141–14,084)	881 (-1,924–3,142)	.713

[a]Cost data are shown in United States dollars and expressed as the mean with 95% confidence intervals. Cost savings for the low (n = 961), moderate (n = 1,413), and high (n = 545) bleeding risk strata were defined as described in the Methods section. Cost data were adjusted according to the methods described previously. Covariates in the model included PCI status, race, sex, previous congestive heart failure, peripheral vascular disease, previous PCI, New York Heart Association class, cardiogenic shock, and angina type at admission.

TABLE 3. SAME-DAY DISCHARGE: COST SAVINGS				
Total Cost	**Radial (n = 38)**	**Femoral (n = 133)**	**Difference**	***P* Value**
[a]Unadjusted	6,691 ± 2,301	7,817 ± 2,885	1,126 ± 2,767	.028
[b]Adjusted	7,007 (5,884–8,207)	8,071 (7,328–9,171)	1,064 (166–1,985)	.032

[a]Expressed as mean ± standard deviation.
[b]Shown as mean with 95% confidence interval.

heart failure, peripheral vascular disease, previous PCI, New York Heart Association class, cardiogenic shock, and angina type at admission. The bootstrap method (1,000 repetitions) with replacement was applied to account for skewness in the data[19,20] and to determine the cost difference and 95% confidence intervals (CIs).

The secondary endpoint was to determine if there were differences in LOS between TRI and TFI. These differences were estimated using a generalized linear mixed model with the covariates. Additional endpoints (in-hospital bleeding and mortality) were analyzed using unadjusted logistic regression and odds ratios calculated when appropriate. The population was further stratified into low-, moderate-, and high-bleeding-risk categories according to the NCDR CathPCI bleeding risk model,[21,22] with total, procedural, and postprocedural costs analyzed for each subgroup. Statistical significance was defined as $P \leq .05$, and all statistical analyses were performed using SAS Version 9.2 (SAS Institute, Cary, NC).

RESULTS

Demographics

Of the total study population (n = 2,919), 191 patients (6.5%) underwent TRI. Baseline clinical characteristics are summarized in Table 1. TRI patients were younger, less likely to undergo primary PCI for STEMI, had lower prevalence of Canadian Cardiovascular Society class IV, and lower probabilities of bleeding risk. Additional differences are notable in the anticoagulation strategies and closure devices used. TRI patients had more frequent use of unfractionated heparin (with or without glycoprotein IIb/IIIa inhibitors) and less frequent use of bivalirudin. The difference in closure device usage was expected because it was not required in the TRI cohort.

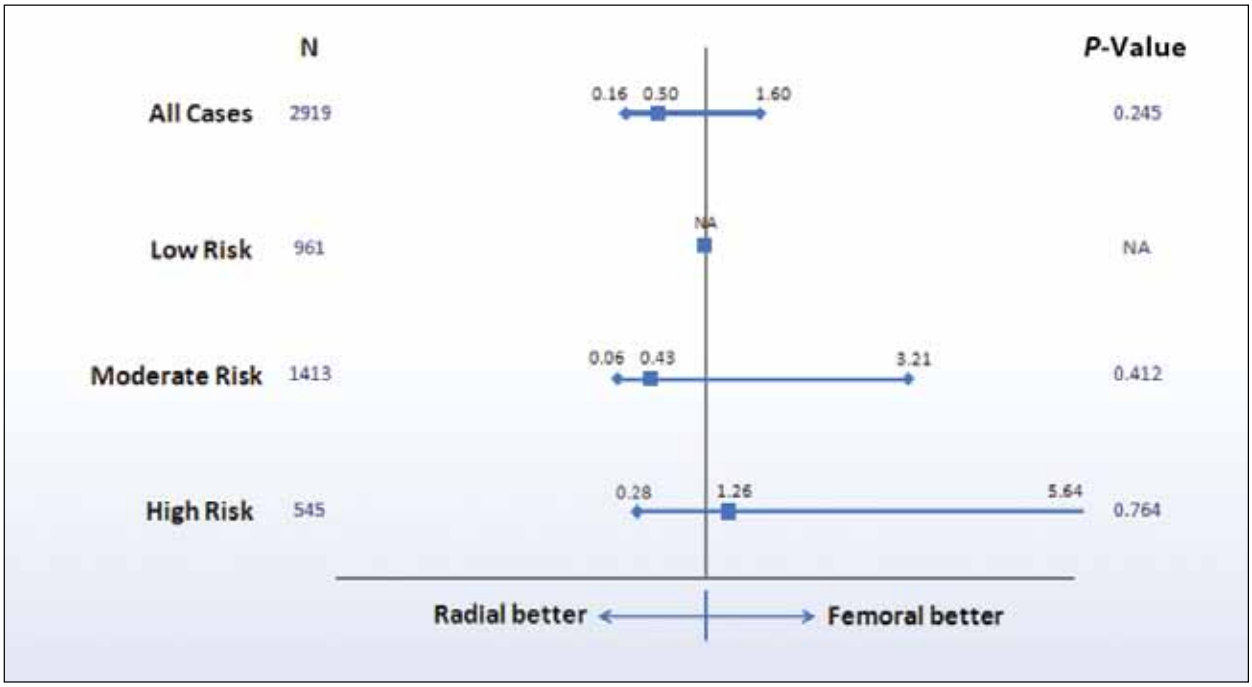

Figure 1. The differences in bleeding rates for the low-, moderate-, and high-bleeding-risk groups are shown. The number of subjects (N) in each bleeding risk category is shown on the left, with *P* value on the right. The odds ratio and 95% CI are indicated for each group.

TABLE 4. QUALITY OUTCOMES: UNADJUSTED DATA[a]				
Outcomes	**Total**	**Radial**	**Femoral**	***P* Value**
Bleeding within 72 h				
All patients	87 (3%)	3 (1.6%)	84 (3.1%)	.236
Low risk	7 (0.2%)	0 (0%)	7 (0.8%)	> .999
Moderate risk	33 (1.1%)	1 (1.1%)	32 (2.4%)	.72
High risk	47 (1.6%)	2 (10.5%)	45 (8.6%)	.675
In-hospital mortality				
All patients	37 (1.3%)	3 (1.6%)	34 (1.2%)	.732
Low risk	1 (0.03%)	0 (0%)	1 (0.1%)	> .999
Moderate risk	6 (0.2%)	0 (0%)	6 (0.5%)	> .999
High risk	30 (1%)	3 (15.8%)	27 (5.1%)	.08
Length of stay				
All patients	2.7 ± 2.8	2.1 ± 1.3	2.7 ± 2.8	.004
Low risk	2.1 ± 1.6	1.9 ± 0.7	2.2 ± 1.6	.104
Moderate risk	2.5 ± 2.1	2.1 ± 1.3	2.6 ± 2.1	.052
High risk	4 ± 4.8	3.2 ± 2.5	4 ± 4.9	.456

[a]Bleeding within 72 hours after PCI and in-hospital mortality are represented by the number of cases and rate of incidence. The length of stay is in mean days ± standard deviation. Post-PCI bleeding is defined in accordance with NCDR CathPCI Registry version 4.0 as a suspected bleeding with transfusion, a drop in hemoglobin > 3 g/dL, or a procedural intervention to correct the bleeding event.

Economic Outcomes

The study cohort consisted of 961 patients with low bleeding risk, 1,413 with moderate risk, and 545 with high risk. The unadjusted and adjusted cost savings by bleeding risk category are shown in Table 2. The total unadjusted costs were $1,975 lower in the TRI than the TFI group (95% CI, $944–$3,007; *P* < .001). After bleeding risk adjustment, the difference decreased to $1,375 (95% CI, $531–$2,056; *P* = .008). TRI patients also had statistically significant total adjusted cost savings in the low-risk and moderate-risk subgroups. In the high-bleeding-risk category, both adjusted and unadjusted costs were similar between TFI and TRI.

The unadjusted procedural cost savings for TRI was $1,019. The adjusted and unadjusted procedural costs were statistically significant in all cases and in moderate-risk subgroups, with a cost difference favoring TRI. The unadjusted postprocedural cost savings for TRI was $957 (95% CI, $119–$1,794; *P* = .025). After adjustment, the TRI group did not achieve statistically significant postprocedural cost savings. The adjusted postprocedural cost savings achieved statistical significance in the low-risk subgroup analyses, favoring TRI.

Same-Day Discharge

Utilizing our institutional same-day discharge (SDD) guidelines,[23] 5.9% of the study cohort was discharged on the same day after low-risk elective PCI. As shown in Table 1, SDD was statistically more likely to occur in the TRI cohort (19.9% vs 4.9%; *P* < .001). TRI was associated with a statistically significant unadjusted and adjusted total cost savings of $1,126 and $1,064, respectively, in the SDD population (Table 3).

Quality Outcomes

The unadjusted quality outcomes are summarized in Table 4. Overall, bleeding events (within 72 hours) in the TRI and TFI groups totaled 1.6% and 3.1%, respectively. The unadjusted bleeding events in TRI and TFI groups were similar (*P* > .05) for the entire study cohort and among different bleeding risk strata. As shown in Figure 1, the adjusted odds ratio was not statistically significant in all cases or in the subgroup analyses. Unadjusted in-hospital mortality in TRI and TFI occurred in 1.6% and 1.2% of the cases, respectively (*P* = .732). In the unadjusted model for in-hospital mortality, the difference was not statistically significant (odds ratio, 1.26; 95% CI, 0.38–4.16). The odds ratios for in-hospital mortality were not calculated by risk category due to the very low event rates in the bleeding risk strata.

The mean LOS for the TRI group was 2.1 days as compared to 2.7 days for the TFI group, a difference of 0.6 days favoring TRI (*P* = .004). There was a trend toward statistical

TABLE 5. LENGTH OF STAY: ADJUSTED DATA[a]				
	Radial	**Femoral**	**Difference**	***P* Value**
All patients	3.15 (2.16–4.14)	3.51 (2.59–4.43)	0.36 (-0.03–0.74)	.07
Low risk	2.2 (1.81–2.59)	2.5 (2.3–2.7)	0.3 (-0.06–0.67)	.103
Moderate risk	2.51 (2.09–2.93)	2.82 (2.69–2.95)	0.31 (-0.11–0.74)	.15
High risk	4.29 (1.62–6.96)	4.71 (3.06–6.37)	0.42 (-1.72–2.56)	.701

[a]Differences in length of stay in days for all patients, as well as for the low-, moderate-, and high-bleeding-risk strata, defined as described in the Methodology section. The data were adjusted according to the methods previously described.

significance in the moderate-risk category, with a 0.5-day shorter mean LOS ($P = .052$). The LOS was 0.3 days shorter ($P = .104$) in the low-bleeding-risk group and 0.8 days shorter ($P = .456$) in the high-risk group. After adjustment, the differences narrowed but remained statistically insignificant (Table 5).

DISCUSSION

This study provided a comprehensive analysis of the cost savings associated with TRI compared to TFI based on the experience of a single, large-volume tertiary care center. The fact that we were early in our TRI experience is notable, as the learning curve might hinder favorable TRI outcomes. Previous studies on small populations have shown cost savings ranging from $77 to $289 for diagnostic coronary angiography.[5,6,9] A large, nationwide administrative database demonstrated a direct hospital cost savings of $553 for TRI relative to TFI.[24] Strikingly, our observations showed an average total cost savings of approximately $1,375 per patient for TRI, primarily driven by the 0.6-day shorter LOS. In addition, significant total cost savings were seen in the low- and moderate-bleeding-risk categories. It is important to note that our cost data were an aggregate of direct and indirect costs, which may explain the larger cost savings.

The procedural costs in our population were significantly lower for TRI. Although procedural equipment costs for transradial stent procedures are slightly higher than those for femoral procedures, this could be offset by lower costs for complications.[10] We believe this could be the scenario here. Additional explanations include lower supply costs and fewer access site complications for transradial stenting procedures, as previously demonstrated by Mann et al.[8]

A general consensus has been that cost savings for TRI occur after the procedure, primarily due to lower costs of complications and nursing care. Any decrease in postprocedural complications can potentially result in a reduction in health care expenses. The postprocedural costs in our cohort showed a statistically insignificant trend, yet with some savings, toward TRI. Our observations extend our findings to suggest radial access as a preferred strategy with overall cost savings.

More than 1 million cardiac catheterizations and 500,000 PCIs are performed annually in the United States alone.[25] Radial artery cases account for < 10% of the diagnostic cases and approximately 1% of PCI cases.[4] TRI has been demonstrated to be safe, with reduced mortality, vascular complications, and major bleeding—as shown in randomized clinical trials of select populations.[13,26] Broader adoption of radial catheterization promises to provide these benefits at a reduced cost.

SDD after uncomplicated PCI has been adopted in many centers and is recognized as a safe and effective strategy.[18,27-31] In addition, payers have switched elective PCI to outpatient designation and reduced reimbursement.[32] A total SDD cost savings of approximately $1,000 per TRI in our analysis is of significant economic consideration for both payers and hospital administrators. In an increasing scenario of SDD PCI, a switch to TRI in low-risk or uncomplicated PCI could significantly decrease the cost burden. The magnitude of overall cost savings with TRI, especially when combined with SDD, should catapult hospitals into trying to implement TRI programs.

Previous studies have shown fewer bleeding complications with TRI as compared to TFI.[4,13,17,33] In contrast, our results showed similar bleeding events in both the TRI and TFI groups. The nonrandomized nature of the study may have led to this biased result.

Finally, any attempt to reduce the LOS saves cost. Consistent with multiple other studies,[5,6] our results showed reduced LOS for TRI. Of note, 5.9% of the patients were discharged on the same day as the procedure. It is imperative to understand that the TRI cohort's reduced LOS due to early ambulation and fewer vascular complications directly led to savings.

STRENGTHS AND LIMITATIONS

Several limitations of our analysis should be noted. First, these observations reflect the clinical practices of 21 experienced interventional cardiologists at a single United States academic medical center. Of note, only a minority of these interventionists used TRI as the preferred access route. The results may, therefore, not be generalizable to centers

with low volumes of PCI, early stages of TRI adoption,[14,15,34] or different practice patterns. Second, as a retrospective nonrandomized study, unmeasured confounders may have influenced physician choice of access site and caused selection bias. Our population included high-risk cohorts, such as patients with cardiogenic shock, STEMI, emergent procedures, and coronary artery bypass graft during admission. It is plausible that the TRI population had fewer high-bleeding-risk patients (9.9% vs 19.3%), which would favor more cost savings. In addition, access site crossover data were not collected. There may be a negligible variation in reported rates of TRI and TFI. Third, this study was not powered for clinical outcomes, namely bleeding events and in-hospital mortality, to derive meaningful conclusions.

Our cost data on TRI and TFI across a spectrum of bleeding risk cohorts are based on a validated bleeding prediction model. Thus, it provides detailed cost differences in clinically important subgroups. We included both inpatients and outpatients. It is conceivable that physicians could have discharged TRI cohort patients earlier due to fewer postprocedural complications or SDD preference. This would partially account for the cost differences noted in this study from reduced LOS. Our cost data were captured at the hospital level in a large administrative database and analyzed from the hospital's perspective because costs were calculated based on reports of actual hospital expenditures.

CONCLUSION

In this study, TRI was associated with a total cost savings of $1,375 per patient when compared to TFI, primarily driven by procedural costs savings and shorter LOS. The influence of such savings could provide critical momentum in the shift from a TFI to a TRI approach in PCI. ■

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