Cost Savings of Radial Artery Access for Coronary Angiography and Intervention

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BACKGROUND

Many hospitals in Europe and a few in the United States have changed from femoral artery catheterization to radial artery catheterization for diagnostic coronary angiography and percutaneous coronary intervention. Advocates of the radial approach say it reduces complications and speeds hemostasis, which potentially translates into improved patient throughput and cost savings compared to femoral artery access.

Several published studies demonstrate a reduction in vascular complications and time to hemostasis; however, an increase in procedure time and access failure in patients undergoing radial artery catheterization might offset those benefits. We performed a systematic review and cost analysis to address this question.

OBJECTIVE

Systematically review evidence from clinical trials and assess the comparative effectiveness of radial artery access and femoral artery access for diagnostic coronary catheterization and percutaneous coronary interventions.

METHODS

Searches of the Medline, Cochrane Central Register, and EMBASE databases were completed in November and December 2010. Articles were included in the review if they reported randomized controlled trials comparing success and complication rates of coronary catheterizations via radial artery and femoral artery access. Studies included patients with suspected or confirmed coronary artery disease, and excluded those with acute myocardial infarction. Outcomes analyzed were success rates for vascular access and for the entire procedure, bleeding, hematoma, and vascular complications, procedure time, fluoroscopy time, and time to hemostasis.

Quality of individual trials was assessed using a modified Jadad scale. The GRADE approach was used to evaluate the strength of the entire evidence base. Synthesis of clinical trial results followed Cochrane methods, using fixed-effects meta-analysis of odds ratios and time differences where possible, and random-effects meta-analysis where heterogeneity of results across the included studies was significant.

Costs of increased procedure time and of procedure complications were obtained from previously published articles, verified with a local cath lab director, and multiplied by procedure times and adverse event rates from the meta-analysis to yield cost estimates. The estimates were made from the hospital perspective.

Table 1. Studies included in the meta-analysis

Study	Quality	Patients	Closure devices for femoral group	Procedure outcomes	Complication outcomes	Comment
Brueck 2009	5	654 diag, 370 interv.	Interventional patients (most)	Success rate, procedure time, fluoro time, contrast	Major complications, bleeding, hematoma	
Santas 2009	5	533 diag, 572 interv.	None	Success rate, procedure time, hemostasis time, fluoro time, contrast	Major complications, minor complications	Three groups: left radial (335), right radial (335), femoral (335)
Achenbach 2008	4	228 diag, 79 interv.	None	Success rate, procedure time, fluoro time, contrast	Major complications, minor complications	Patients aged 75 and older
Lange 2006	2	195 diag, 102 interv.	Not reported	Fluoro time	None	Intended primarily as a study of radiation exposure
OUTCLAS 2005	5	644 interv.	None	Success rate, same-day discharge	MACE, bleeding	Most patients excluded from analysis Patients qualified for outpatient angioplasty
OCTOPLUS 2004	5	193 diag, 186 interv.	Some (6.8%)	Success rate, procedure time, fluoro time, contrast	Major complications, bleeding, hematoma	Patient comfort outcomes measured but not reported
Reddy 2004	4	75 diag.	Study variable	Success rate, procedure time, hemostasis time, fluoro time, contrast	Major complications, hematoma	Three groups: radial (25), femoral/AngioSeal (25), femoral/no device (25)
CARAFE 2001	5	108 diag, 92 interv.	Interventional patients only	Success rate, procedure time, fluoro time, LOS	Major complications, bleeding, hematoma	Cost and quality of life (SF-36) data also reported Three groups: left radial (70, right radial (70), femoral (70) Patient comfort and cost (French francs) also reported
†Cooper 1999	5	200 diag.	None	Success rate, procedure time, hemostasis time, fluoro time, contrast, LOS	Major complications	Cost and quality of life (SF-36) data also reported
Mann 1998	3	142 interv.	Femostop	Success rate, LOS	Major complications, bleeding, hematoma	Different physicians carried out transradial and transfemoral procedures
BRAFE 1997	5	150 interv.	Femostop	Success rate, procedure time, LOS	Major complications, bleeding, hematoma	Three groups: brachial (38), radial (56), femoral (56) Women excluded.
†ACCESS 1997	4	900 interv.	None	Success rate, procedure time, fluoro time, LOS	Major complications, bleeding	Three groups: brachial (300), radial (300), femoral (300)

RESULTS

A total of 12 studies met inclusion criteria and were used for the meta-analysis (Table 1). Patient outcomes as measured by major adverse cardiac events (MACE) did not significantly differ between patients in radial and femoral access groups (Figure 1A). While radial access was significantly more likely to be unsuccessful (8.4% vs. 1.8%, Figure 1B), there was no significant difference in procedure success rates (radial 97.3%, femoral 96.9%, p = 0.52). Radial catheterization increased procedure time by 1.4 ± 0.9 minutes (Figure 1D), but it reduced hemostasis time by 13.1 ± 5.4 minutes (Figure 1E). Major vascular complications were reduced 79% with radial catheterization (Figure 1C) and major bleeding complications were reduced 77% (Figure 1F). Differences in hematomas (Figure 1G) and in complications not related to access site were negligible. One major complication is prevented for every 46 procedures done radially (95% CI 41-58).

Procedure success rate, major adverse coronary events, hematoma, and length of stay were not significantly different between the two access routes, so they were not included in the cost calculations. Estimated costs for time in the catheterization lab and for adverse events (Table 2) were taken from previous publications. Combining them with the meta-analysis results, we estimated a $523 cost savings per patient for a radial artery access strategy (Table 3).

Since costs are reduced with radial catheterization while risk of bleeding and other complications are also reduced, radial catheterization dominates femoral catheterization in a cost-effectiveness analysis.

Figure 1. Meta-analysis results

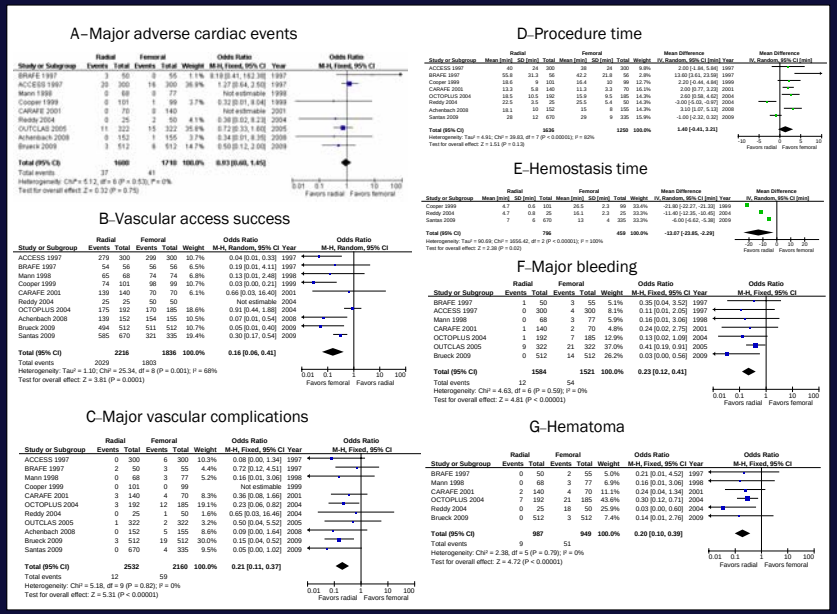

Table 2. Estimated costs for cardiac catheterization and its complications

Cost component	Cost (reference)
Access Failure	$50/event (1)
Catheterization procedure time	$900/hour (1)
Hemostasis time	$105/hour (2)
Minor complication	$2,282/event (3)
Major complication	$8,659/event (3)

Table 3. Incremental costs of radial versus femoral catheterization

	Femoral Access	Radial Access	Net Difference	Cost per Patient
Procedure Time (min)	21.5	22.9	1.4	$21.00
Hemostasis (min)	18.5	5.5	-13.0	($22.75)
Access failure	1.8%	8.4%	6.6%	$3.30
Major bleeding	3.5%	0.8%	-2.7%	($233.79)
Major vascular complications	2.7%	0.5%	-2.2%	($190.50)
Hematoma	5.3%	0.9%	-4.4%	($100.41)
Total (cost reduction)				($523.15)

CONCLUSIONS

Changing from femoral to radial access for coronary catheterization reduces procedure-related complications and reduces costs even after accounting for the possibility that radial access will be unsuccessful. Since radial and femoral procedures did not differ in effectiveness or cardiac outcomes, changing from femoral to radial access should improve patient outcomes while lowering costs.

Given that over 30 million coronary catheterizations are performed in the US annually, widespread adoption of radial access procedures could save the health system more than 15 billion dollars a year.

LIMITATIONS

The meta-analysis pools data from nearly two decades of clinical trials and may not reflect the latest improvements in vascular access techniques and equipment. However, excluding the older studies from our meta-analyses did not change their conclusions. Complication rates reported in the randomized trials are higher than those reported from other studies, perhaps because the randomized trials were more rigorous in monitoring for complications.

While some cost estimates are based on old data, the exact costs should not materially affect our conclusions, since radial access reduced complications rather than increasing them.

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