

Letters

RESEARCH CORRESPONDENCE

Successful Prevention of Inappropriate Cardiac Catheterizations by an Educational and Screening Program in a Tertiary Cardiac Referral Center



Using the 2012 American College of Cardiology (ACC)/ Society for Cardiovascular Angiography and Interventions (SCAI) Appropriate Use Criteria (AUC) for diagnostic cardiac catheterization (CC) to determine appropriateness, one-third of CCs may be unnecessary or “inappropriate” (1). At our rural tertiary medical center, some outpatients are referred directly for CC by primary care physicians (PCPs) without cardiology consultation. To minimize inappropriate CCs, we implemented an Appropriate Outpatient Catheterization (AOC) program to educate referring PCPs and specialists and screen out “inappropriate” CC patients. The term “inappropriate” was used throughout the study for consistency with the published AUC.

All patients undergoing elective CC in the year before, and the year following, the initiation of the AOC program at our medical center were identified using the ACC NCDR (National Cardiovascular Data Registry) CathPCI registry. We excluded patients <18 years of age, undergoing only right-heart CC, or undergoing pre-operative CC. All PCP-referred patients were included in the “PCP referral” group and 15 to 20 randomly selected patients per month (about 40%) referred by cardiac specialists were included in the “Card referral” group.

The AOC program was implemented over 1 month, and involved:

1. Sending to all PCPs referring CC patients (approximately 220 physicians) a copy of the ACC/SCAI AUC and a description of the new CC screening process.
2. Educating advanced practitioners, cardiology fellows, and attendings at our institution about the AUC and an SCAI smartphone application to determine appropriateness of CC. We posted the AUC in all catheterization laboratory work areas.

3. Implementing a formal process to identify “inappropriate” patients before they were scheduled for catheterization. Before the AOC program was initiated, advanced practitioners routinely obtained stress test reports and office notes from referring physicians when necessary, and assessed symptomatic status by calling patients on the phone, but did not closely scrutinize their appropriateness for CC. The AOC program required advanced practitioners to use all available data to determine appropriateness. Potentially inappropriate patients for CC were referred to an attending physician who reviewed the chart, talked with the referring physician and the patient by phone, and scheduled the patient for CC (if clinically indicated) or alternative evaluation.
4. Screening for appropriateness in the CC laboratory immediately before CC. When patients were identified on the day of CC as potentially inappropriate, an attending cardiologist discussed the situation with the patient and referring physician, and either proceeded with CC (if clinically indicated) or scheduled alternative evaluation.

Investigators used retrospective electronic medical record review to categorize patients as “appropriate,” of “uncertain appropriateness,” or “inappropriate” for CC according to the AUC. Rating questions were resolved by the senior author (J.C.B.).

Groups were compared for all baseline and procedural characteristics used in the NCDR CathPCI Registry. Differences between the groups were tested using 2-sample Student *t* tests or Wilcoxon rank sum tests. Unadjusted odds ratios (ORs) and their 95% confidence intervals (CIs) were calculated from a logistic regression model that modeled the binary outcome of inappropriate use versus appropriate/uncertain use. To address the issue of rare event counts, the Firth penalized likelihood approach was used in the logistic regression model. We did not do analyses adjusting for covariates because of the small sample size and small number of inappropriate cases.

Screening for appropriateness was easily integrated into the workflow of advanced practitioners and physicians, and required only several minutes per patient.

Baseline and procedural characteristics of patients were similar across the groups, including the number of patients with >70% stenosis in at least 1 epicardial vessel or >50% stenosis of the left main coronary artery.

TABLE 1 AUC Ratings

	PCPreferral Pre-Program (n = 81)	Cardreferral Pre-Program (n = 152)	PCPreferral Post-Program (n = 52)	Cardreferral Post-Program (n = 229)	Pre-Program vs. Post-Program		PCPreferral vs. Cardreferral	
					PCPreferral: Pre-Program vs. Post-Program p Value	Cardreferral: Pre-Program vs. Post-Program p Value	Pre-Program: PCPreferral vs. Cardreferral p Value	Post-Program: PCPreferral vs. Cardreferral p Value
AUC score, %					0.002	0.09	0.0009	0.76
1 to 3	17.3	3.3	0.0	2.2				
4 to 6	23.5	25.0	34.6	35.4				
7 to 9	59.3	71.7	65.4	62.4				
AUC score, %					0.0008	0.53	0.0002	0.59
1 to 3	17.3	3.3	0.0	2.2				
4 to 9	82.7	96.7	100.0	97.8				

Values are % unless otherwise indicated.
AUC = appropriate use criteria; Cardreferral = referred by cardiac specialists; PCPreferral = referred by primary care physicians; Program = Appropriate Outpatient Catheterization Program.

Inappropriate CCs were more frequent pre-AOC program in PCPreferral patients compared with Cardreferral patients (17% vs. 3.3%; $p = 0.0017$) (Table 1). Inappropriate CCs were more frequent among PCPreferral patients pre- versus post-AOC program (17% vs. 0%; $p = 0.0009$). Inappropriate CCs were rare among Cardreferral patients pre- and post- (3% vs. 2%; $p = \text{NS}$) AOC program.

Logistic regression analysis confirmed that the likelihood of CCs being rated as inappropriate decreased significantly post- compared with pre-AOC program (OR: 0.05, 95% CI: 0.003 to 0.85; $p = 0.039$), and that the likelihood of CCs being rated as inappropriate pre-AOC program was higher in PCPreferral patients compared with Cardreferral patients (OR: 6.50, 95% CI: 2.15 to 19.72; $p = 0.0009$). Inappropriate ratings were similar in Cardreferral patients pre- versus post-AOC program (OR: 0.81, 95% CI: 0.23 to 2.87; $p = 0.7$), and among PCPreferral and Cardreferral patients post-AOC program (OR: 0.39, 95% CI: 0.02 to 7.33; $p = 0.5$).

We did not record characteristics of each patient rated as inappropriate, but almost all of them were referred for evaluation of known or suspected coronary disease, asymptomatic or with mild stable symptoms, with stress testing either not performed or showing low risk (scenarios 5, 6, 8, 11, 15, 49, and 52 of the 2012 ACC/SCAI AUC document).

Results of this single-center study may not be generalizable. Investigators were not blinded to patient status when evaluating appropriateness. We could not track which component of the AOC program was most effective, nor whether the AOC program led to small changes in referral patterns, although we did not receive negative feedback from referring physicians, and no changes in referral were apparent. Clinically appropriate CCs might have been prevented by the AOC program, although the incidence of

elective CC did not decrease between the pre- and post-AOC program periods. Assessments of appropriateness are somewhat subjective and may have varied among raters (2). We studied only patients undergoing elective outpatient CC; however, inappropriate status is quite rare among nonelective CC patients.

In summary, among patients referred to our institution for elective CC by referring PCPs, 17% were inappropriate, and these were more frequent than in patients referred for elective CC by specialists. After implementation of a referring physician education and patient screening program, the incidence of inappropriate CCs referred by PCPs dropped significantly and was comparable to the incidence of inappropriate CCs referred by specialists. This program may serve as a template for other programs seeking to minimize inappropriate CCs.

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