Safety and Efficacy of Implementing a Multidisciplinary Heart Team Approach for Revascularization in Patients With Complex Coronary Artery Disease
An Observational Cohort Pilot Study

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**IMPORTANCE** Since the advent of transcatheter aortic valve replacement, the multidisciplinary heart team (MHT) approach has rapidly become the standard of care for patients undergoing the procedure. However, little is known about the potential effect of MHT on patients with coronary artery disease (CAD).

**OBJECTIVE** To determine the safety and efficacy of implementing the MHT approach for patients with complex CAD.

**DESIGN, SETTING, AND PARTICIPANTS** Observational cohort pilot study of 180 patients with CAD involving more than 1 vessel in a single major academic tertiary/quaternary medical center. From May 1, 2012, through May 31, 2013, MHT meetings were convened to discuss evidence-based management of CAD. All cases were reviewed by a team of interventional cardiologists and cardiac surgeons within 72 hours of angiography. All clinical data were reviewed by the team to adjudicate optimal treatment strategies. Final recommendations were based on a consensus decision. Outcome measures were tracked for all patients to determine the safety and efficacy profile of this pilot program.

**EXPOSURES** Multidisciplinary heart team meeting.

**MAIN OUTCOMES AND MEASURES** Thirty-day periprocedural mortality and rate of major adverse cardiac events.

**RESULTS** Most of the patients underwent percutaneous coronary intervention (PCI) or coronary artery bypass grafting (CABG); a small percentage of patients underwent a hybrid procedure or medical management. Incidence of 30-day periprocedural mortality was low across all groups of patients (PCI group, 5 of 64 [8%]; CABG group, 1 of 87 [1%]). The rate of major adverse cardiac events during a median follow-up of 12.1 months ranged from 12 of 87 patients (14%) in the CABG group to 15 of 64 (23%) in the PCI group.

**CONCLUSIONS AND RELEVANCE** Outcomes of patients with complex CAD undergoing the optimal treatment strategy recommended by the MHT were similar to those of published national standards. Implementation of the MHT approach for patients with complex CAD is safe and efficacious.

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The concept of a multidisciplinary care team is not new within the field of medicine. The concept is well established in the fields of oncology and solid-organ transplantation. Within cardiovascular medicine, it is an established entity in the management of heart failure and congenital heart disease in the pediatric and adult populations and is becoming the standard of care in randomized clinical trials involving complex cardiac conditions. Within the subspecialty of coronary revascularization, during the conduct of randomized clinical trials, a dedicated multidisciplinary heart team (MHT) has been used successfully. Despite the successful implementation in randomized clinical trials and the recommendation of the latest practice guidelines that the MHT approach be incorporated into clinical practice, the current literature suggests that decision making regarding treatment modalities in patients with coronary artery disease (CAD) is often not based on empirical evidence and is subject to operator bias. In a review of New York cardiac catheterization registry data for patients who met indications for coronary artery bypass grafting (CABG) and percutaneous coronary intervention (PCI), 93% were referred for PCI, 2% for medical management, and only 5% for CABG.

With this issue in mind, MHT cooperation should provide a balanced approach toward designing the optimal revascularization strategy for a given patient, taking into account patient preference, coronary anatomy, and clinical comorbidities. Implementation of the MHT approach creates transparency, ensures appropriate adherence to established societal guidelines, and provides the most objective recommendations while minimizing the influence of individual biases. The approach provides a way for cardiac surgeons and cardiologists to share the burden of decision making and outcomes. Such collaboration fosters an environment of teamwork, collegiality, and bidirectional exchange of knowledge that benefits all involved parties but most importantly the patient. Despite these benefits, the exact nature of the safety and benefits of the MHT approach for coronary revascularization requires further study and description.

In an effort to provide an individualized and unbiased approach to complex coronary disease, we instituted an MHT in May 2012 at the Heart and Vascular Institute of the University of Pittsburgh Medical Center, Presbyterian Hospital. Within this structured format, a previous report demonstrated successful feasibility of implementing an MHT approach for patients with complex coronary disease. The aims of our present study are to demonstrate the safety and efficacy of the MHT approach for patients with complex CAD and to evaluate the midterm outcomes of these patients in an observational cohort study.

Methods

Patient Population

This study was approved by the institutional review board of the University of Pittsburgh Medical Center, and informed consent was waived. From May 1, 2012, to May 31, 2013, all patients who underwent left-sided heart catheterization and met the following criteria were included in the study: (1) unprotected left main CAD; (2) 3-vessel CAD; (3) 2-vessel CAD involving the proximal left anterior descending artery; (4) CAD in the proximal left anterior descending artery in patients with diabetes mellitus; and (5) any other complex CAD in which the initial treating physician believed that revascularization could be performed reasonably using a percutaneous or a surgical approach.

Exposure

Since May of 2012, MHT meetings were convened each business weekday at 7 AM to include a board-certified attending physician from various specialties. At a minimum, cardiac surgery and intervention cardiology were represented. Details of the MHT structure and its implementation have been described previously and include detailed patient history, risk factors, frailty, review of coronary angiograms, and calculation of important risk scores, such as the SYNTAX (Synergy Between PCI With Taxus and Cardiac Surgery) score and the Society of Thoracic Surgeons risk score for mortality and morbidity. The MHT recommendation was adjudicated with the appropriateness for coronary revascularization based on the appropriate use criteria for revascularization and individual patient comorbidities. Novel innovative approaches to coronary revascularization, such as hybrid procedures involving minimally invasive CABG followed by staged PCI during the same hospitalization, were discussed during the MHT meeting when anatomically feasible and adjudicated on an individual case basis after thorough discussion with the patient regarding the advantages and disadvantages of the hybrid procedure vs other standard therapeutic options.

Outcome Measures

The safety and efficacy of MHT were evaluated by 30-day peri-procedural mortality and midterm major adverse cardiac cerebrovascular events during the median follow-up of 12.1 months. Major adverse cardiac cerebrovascular events were defined as death from any cause, the need for a second myocardial revascularization, myocardial infarction, congestive heart failure, angina, or stroke. Electronic medical records of each patient were reviewed manually.

Results

A total of 180 patients were included in this pilot study. Nearly half of the cohort (87 patients [48%]) underwent CABG, whereas PCI (64 [36%]), a hybrid procedure (3 [2%]), or medical therapy alone (26 [14%]) were recommended for the remainder of the patients. Not surprisingly, patients for whom maximum medical therapy was recommended tended to have more complex coronary artery lesions and lower ejection fractions and to be older. Patients with a significantly elevated predicted pre-operative risk for mortality according to the Society of Thoracic Surgeons criteria were usually adjudicated to undergo PCI or medical therapy alone for their complex CAD.

The 30-day mortality rate for the study cohort ranged from 0 to 12% (Figure 1). During the median follow-up of 12.1 months, the incidence of major adverse cardiac cerebrovascular events for the study cohort ranged from 0 to 23% (Figure 2).
A multidisciplinary team approach has been used in many medical and surgical specialties with improved clinical outcomes while adhering to evidence-based practice guidelines. Specifically, the fields of heart failure/transplantation and congenital heart disease depend intimately on the MHT approach owing to their inherent complexity. The MHT approach is also the well-established standard of care for evaluation and treatment of patients who need transcatheter valvular intervention. Despite the preponderance of evidence of improved clinical outcomes in other medical and surgical specialties, an MHT approach to CAD has not been well accepted or well established. The reasons may be partly owing to logistic and/or financial incentives but may also be related to the lack of clinical data on how a real-world coronary revascularization heart team influences management decisions.

One of the initiatives of our newly established University of Pittsburgh Medical Center Heart and Vascular Institute (which includes cardiology, cardiac surgery, and vascular specialists) is to provide optimal evidence-based care for patients with cardiac disease. As a result, based on the merits of MHT in transcatheter aortic valve replacement programs, a previous investigation was able to show successful novel implementation of an MHT for patients with complex CAD. In the present study, we further examined the safety and efficacy of this pilot program, specifically looking at midterm outcomes. We were able to demonstrate acceptable outcomes for patients with complex CAD using the MHT approach. The clinical outcomes of this pilot MHT program for CAD were similar to those historically published in the literature as evidenced by recent systematic reviews. Given the paucity of outcome data on the MHT approach to CAD, our study represents, to our knowledge, one of the first pilot programs to examine the safety and efficacy of such a standardized method. The relatively high mortality rate in the PCI group is related to the high-risk nature of this cohort. The mortality largely occurred in patients who required hemodynamic support for PCI, and their high risk is further reflected by their relatively high Society of Thoracic Surgeons mortality risk score.

Because treatment plans were all individualized based on each patient’s unique presentation, comorbidities, complexity of CAD, and evidence-based guidelines, we are not surprised that our findings demonstrated the safety and efficacy of such a novel MHT program for CAD. The next step in evaluating our pilot MHT program is to examine whether the MHT approach provides a more cost-efficient model for patients with CAD compared with the usual-care model. Our findings not only provide evidence favoring continuation of the MHT program for complex CAD but also provide data to initiate future prospective randomized clinical trials to determine whether an MHT program improves patient outcomes in complex CAD.

As with any new initiative, the implementation of an MHT approach for complex CAD in our institution was met with some initial barriers and obstacles that we have overcome. Two of the most notable challenges were determining the appropriate time for the MHT meeting and obtaining the commitment from various specialties to participate in the meeting. Because of the multidisciplinary nature of the program, numerous competing inter-

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**Table. Cohort Demographic Characteristics**

<table>
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<tr>
<th>Characteristic</th>
<th>PCI Only (n = 64)</th>
<th>CABG Only (n = 87)</th>
<th>Hybrid (n = 3)</th>
<th>Medical Therapy (n = 26)</th>
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<td>SYNTAX score</td>
<td>21.0 (10.1)</td>
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<td>15.3 (5.5)</td>
<td>27.3 (9.4)</td>
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<td>STS mortality risk score</td>
<td>5.0 (5.8)</td>
<td>1.8 (2.1)</td>
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<td>4.1 (3.6)</td>
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<td>LVEF, %</td>
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<td>48.4 (13.4)</td>
<td>55 (0.0)</td>
<td>45.3 (16.0)</td>
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<td>Age, y</td>
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<td>64.6 (10.1)</td>
<td>48.0 (26.5)</td>
<td>69.2 (13.4)</td>
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<td>Diabetes mellitus, No. (%)</td>
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<td>32 (37)</td>
<td>3 (33)</td>
<td>12 (46)</td>
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<td>Male sex, No. (%)</td>
<td>41 (64)</td>
<td>66 (76)</td>
<td>3 (100)</td>
<td>13 (50)</td>
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</table>

**Figure 1. 30-Day Mortality Rate for Patients With Coronary Artery Disease in the Multidisciplinary Heart Team Pilot Study**

Of 180 patients, 5 of 64 undergoing percutaneous coronary intervention (PCI) only (8%), 1 of 87 undergoing coronary artery bypass grafting (CABG) only (1%), and of 26 receiving medical therapy (12%) died within 30 days of the procedure. Patients undergoing a hybrid procedure (CABG followed by staged PCI) were excluded from the analysis because they were difficult to classify.

**Figure 2. Major Adverse Cardiac Cerebrovascular Events (MACCE) Rate for Patients With Coronary Artery Disease in the Multidisciplinary Heart Team Pilot Study**

Of 180 patients, 15 of 64 undergoing percutaneous coronary intervention (PCI) only (23%), 12 of 87 undergoing coronary artery bypass grafting (CABG) only (14%), and 6 of 26 receiving medical therapy (23%) experienced an MACCE.

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**Abbreviations:** CABG, coronary artery bypass grafting; LVEF, left ventricular ejection fraction; PCI, percutaneous coronary intervention; STS, Society of Thoracic Surgeons; SYNTAX, Synergy Between PCI With Taxus and Cardiac Surgery.
the real-time decision-making process in MHT meetings. With longer follow-up and continual recruitment of patients in the MHT program, we believe further data will support a generalized use of MHT for patients with complex CAD.

Conclusions

Our investigative team has demonstrated successful feasibility and established the relative safety and efficacy of an MHT approach for patients with CAD. Through leadership commitment from cardiology and cardiac surgery clinicians, a programmatic MHT approach can improve the delivery of quality evidence-based care in complex CAD. Future directions for our investigative team will include comparative effective analysis to further determine whether the MHT model will improve efficiency and perhaps patient satisfaction.

ARTICLE INFORMATION

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Author Contributions: Dr Chu had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Study concept and design: Chu, Anastacio, Mulukutla, Lee, Morell, Cook, Wei, Badhwar.

Acquisition, analysis, or interpretation of data: Chu, Mulukutla, Lee, Smith, Marroquin, Sanchez, Cook, Lico, Wei, Badhwar.

Drafting of the manuscript: Chu, Anastacio, Lee, Badhwar.

Critical revision of the manuscript for important intellectual content: All authors.

Statistical analysis: Chu, Anastacio, Mulukutla.

Administrative, technical, or material support: Chu, Mulukutla, Sanchez, Cook, Badhwar.

Study supervision: Chu, Lee, Smith, Morell, Badhwar.

Conflict of Interest Disclosures: None reported.

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REFERENCES


