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This report describes the presence of dilated lymphatic channels in regions of dense, mature fibrosis in a patient with HCM. The regional increase in lymphatic fluid offers the first pathologically supported explanation for the T2 signal elevation seen in one-third of these patients. These complex channels were shown by TEM to contact peripheral myocyte populations, offering the potential for pro-arrhythmic conduction along these endothelialized channels, a previously recognized substrate for malignant ventricular arrhythmia (4). Given the reported prevalence of T2 signal elevation versus the more pervasive finding of LGE, this may provide a novel imaging marker for the identification of HCM patients at high risk of malignant ventricular arrhythmias.

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Prospective Evaluation of Cardiac CT in Reoperative Cardiac Surgery

Cardiac computed tomography (CT) allows the surgeon to create a pre-operative "road map" to mitigate morbidity from surgical re-entry prior to reoperative cardiac surgery (RCS). There are few prospective data on cardiac CT and RCS because previous data on CT were based on retrospective evaluation, as well as previously applied standards of fluoroscopy and plain x-ray imaging without anatomic confirmation (1–3). Thus, the purpose of this study was to prospectively compare the accuracy of CT detection of retrosternal adhesions against the gold standard of intraoperative findings in patients with RCS. In addition, we sought to assess the association of CT findings with changes in surgical approach and with intraoperative and post-operative outcomes.

We prospectively identified patients scheduled for RCS over a 22-month period with CT performed using a retrospective electrocardiogram-gated protocol with cine reconstructions to assess for structural anatomy and adhesions. CT findings were interpreted clinically, blinded to surgical findings, and were compared with intraoperative findings for cardiac retrosternal adhesions. The primary endpoint was agreement between CT and the gold standard of intraoperative findings. Secondary endpoints were change in surgical approach, intraoperative outcomes (including bleeding), post-operative outcomes, and mortality. Baseline demographics, procedural data, and peri-operative outcomes were obtained from the Society of Thoracic Surgeons database. This study was conducted under local Institutional Review Board approval.

Our cohort consisted of 80 consecutive patients (age 62 ± 14 years; 70% male [n = 56]; mean left ventricular ejection fraction 45 ± 16%; mean Society of Thoracic Surgeons score 6 ± 7). The prior surgery took place 12 ± 9 years before the current RCS. Most commonly, the RCS was valve surgery (n = 53 [66%]) or coronary bypass (n = 26 [33%]). On a per-patient basis, 29 of 80 patients (36%) had at least 1 adherent cardiovascular structure by CT. In the operating room, 25 of 80 patients (31%; p = NS) (**Figure 1**) were confirmed to have at least 1 adherent retrosternal cardiovascular structure. On a per-patient basis, CT had sensitivity, specificity, positive predictive value, negative predictive value, and overall accuracy of 100%, 93%, 86%, 100%, and 95%, respectively. When CT detected adhesions, the surgical approach changed in 18 of 29 patients (62%) versus 4 of 51 patients

without adhesions (8%; p = 0.001). Of 18 patients with a change in surgical approach, 17 of 18 (94%) required a more careful (n = 16) and/or different sternotomy approach (n = 3) and 3 of 18 (17%) had prophylactic exposure of the peripheral vessels. Patients with adhesions had greater estimated intraoperative blood loss (550 to 1,043 ml [interquartile range (IQR): 600 to 900 ml] vs. 500 to 589 ml [IQR: 500 to 700 ml]; p = 0.03) and more intraoperative packed red blood cell transfusions (2.0 to 3.3 U [IQR: 2.0 to 4.5 U] vs. 1.0 to 1.8 U [IQR: 1.0 to 3.0 U]; p = 0.03). In the adhesion group, this difference was driven by 5 patients with major bleeding (6,000, 3,000, 3,000, 2,000, and 2,000 ml). There were no significant differences between patients with and without adhesions on CT for death, myocardial infarction, or stroke.

Our study is unique in prospectively validating the diagnostic performance of CT compared with a gold standard of intraoperative findings in the detection of retrosternal adhesions. Alternative imaging strategies, such as cardiac magnetic resonance with pericardial tagging may yield helpful information on adhesions, but the higher spatial resolution of CT makes this modality a better choice for small structures such as coronary bypass grafts. Although patient-specific variables also remain important risk factors for outcomes in RCS, CT can provide a road map that augments individual surgeon skill. CT prior to RCS has become fully entrenched as an important standard of care at our institution. We take a "heart-team" approach, with our surgeons routinely relying on collaboration with the CT physician to appropriately plan each individual surgical intervention.

This single-center study was not powered to detect differences in clinical outcomes between patients with and without CT adhesions. We did not include a group of patients randomized to redo surgery without prior CT because the performance of a CT prior to RCS has become standard of care in our institution.

In conclusion, CT has excellent sensitivity, specificity, positive predictive value, negative predictive value, and accuracy in comparison with intraoperative findings for the evaluation of retrosternal surgical adhesions. CT adhesions are associated with higher intraoperative bleeding and number of transfusions. Because these findings have important implications for patient selection, patient safety, and peri-operative outcomes, these data support the vital use of CT prior to RCS.

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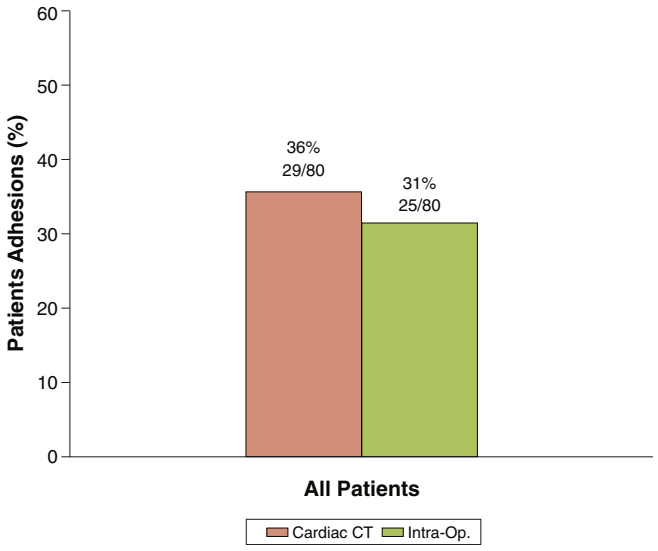
FIGURE 1 Study Outcomes: Agreement Between CT and Intraoperative Adhesions



CT = computed tomography.

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