3-2017

Eligibility for Minimally Invasive Coronary Artery Bypass Examination of Epicardial Adipose Tissue Using Computed Tomography

Kate E. M. Dillon
Western University

Marjorie Johnson
Western University, Marjorie.johnson@schulich.uwo.ca

Bob Kiaii
Western University, bob.kiaii@lhsc.on.ca

ARTICLE COVERSHEET
LWW_CONDENSED(8.125X10.875)
SERVER-BASED

Article : ITT50221
Creator : rbimbo
Date : Tuesday March 14th 2017
Time : 01:11:44
Number of Pages (including this page) : 8

Eligibility for Minimally Invasive Coronary Artery Bypass

Examination of Epicardial Adipose Tissue Using Computed Tomography

AQ1 AQ2 *Kate E. M. Dillon, MSc,* Marjorie Johnson, PhD,* Ian L. Chan, MD,† and Bob B. Kiaii, MD‡*

Objective: A variable that necessitates conversion to a conventional full-sternotomy coronary artery bypass procedure from a robotic-assisted endoscopic single-vessel small thoracotomy is the inability to visualize the left anterior descending coronary artery within the surrounding epicardial adipose tissue using the endoscopic camera. The purpose of this study was to determine whether anatomical properties of the epicardial adipose tissue examined using preoperative computed tomography (CT) images are able to predict and thus reduce the need for intraoperative conversion based on effective preoperative exclusion criteria.

Methods: Retrospective analysis of patient preoperative CT angiography scans from both converted (n = 17) and successful robotic-assisted (n = 17) procedures was performed. Where possible, measurements of epicardial adipose tissue were acquired from axial slices, at the most accessible segment of the left anterior descending coronary artery.

Results: Results indicate that patients who successfully underwent the AQ3 endoscopic single-vessel small thoracotomy procedure (mean ± SD depth, 4.9 ± 1.9 mm) had significantly less epicardial adipose tissue (38%, $P = 0.002$) overlying the vessel toward the lateral chest wall than those who were converted to the full-sternotomy approach intraoperatively (mean ± SD depth, 7.9 ± 3.2 mm). Using this as a retrospective exclusion criterion reduces the conversion rate for this group by 47%, while maintaining a high specificity (94%). No significant differences exist between the two groups with respect to the remaining epicardial adipose tissue measurements or body mass index.

Conclusions: The addition of CT angiography measurements of the epicardial adipose tissue overlying the left anterior descending coronary artery may enhance preoperative surgical planning for this procedure, thereby reducing the instances of procedural changes.

Key Words: Preoperative selection, Endo-SVST, Computed tomography angiography, Epicardial adipose tissue.

(*Innovations* 2017;12:00–00)

Accepted for publication February 17, 2017.

From the *Department of Anatomy and Cell Biology, Schulich School of Medicine and Dentistry, Western University, London, Ontario, Canada; and †Department of Radiology, and ‡Division of Cardiac Surgery, London AQ4 Health Sciences Centre, Schulich School of Medicine and Dentistry, Western University, London, Ontario, Canada.

Presented at the Annual Scientific Meeting of the International Society for Minimally Invasive Cardiothoracic Surgery, June 15–18, 2016, Montreal, Quebec, Canada.

Disclosures: Bob B. Kiaii, MD, is a consultant for Medtronic, Inc, Minneapolis, MN USA, Johnson&Johnson, Somerville, NJ USA, and Symetis SA, Ecublens, Switzerland, and is a proctor for LivaNova, London, United Kingdom. Kate E. M. Dillon, MSc, Marjorie Johnson, PhD, and Ian L. Chan, MD, declare no conflicts of interest.

AQ5 Address correspondence and reprint requests to Bob B. Kiaii, MD, Division of Cardiac Surgery, London Health Sciences Centre, 339 Windermere Rd, P.O. Box 5339, London, ON Canada N6A 3K7. E-mail: kdillon5@uwo.ca.

ISSN: 1556-9845/17/1202–0000

The robotic-assisted endoscopic single-vessel small thoracotomy (endo-SVST) coronary artery bypass graft procedure has shown promising short-term results, with reports of reduction in surgical morbidity and recovery time, higher quality of life scores, and favorable angiographic follow-up with left internal thoracic and left anterior descending (LAD) coronary artery patency, comparable with the traditional CABG approach.[1–4] AQ6

Although the endo-SVST procedure confers many benefits, the preoperative planning required for suitable patient selection remains a limitation of this procedure. Reliable preoperative diagnostic assessments are required to reduce the likelihood of unsuccessful endo-SVST procedures, where success is defined as the ability to complete the procedure endoscopically.[5] Conversion to a full-sternotomy approach is an undesirable outcome for these procedures. It is important to reduce the number of conversions required intraoperatively so as to reduce the overall operative time and cost, while managing patient quality of life and distress.

Preoperative analysis of patients' anatomical and anthropometric parameters has shown promise in its ability to determine the likelihood of success for the endoscopic procedure. Trejos et al[1] (2010) found, using a comparison analysis with retrospective data, that they could reduce the conversion rate based on an analysis of the lateral distance from the LAD to the sternum and the transverse dimension in females. Similarly, Escoto et al[5] (2014) demonstrated that patient anatomical parameters, such as chest dimensions, and the location of the LAD relative to the chest wall, can help predict the success of the procedure because of space constraints of the robotic instruments. Furthermore, preoperative anatomical considerations assessed using computed tomography (CT) scans have also been implemented in predicting operative times for robotic totally endoscopic coronary artery bypass (TECAB) procedures. Anatomical measurements, such as subcutaneous adipose tissue at certain thoracic levels, pericardial fat pad thickness, thoracic ratio, as well as the distance between lateral heart border and the chest wall in beating heart TECAB can help predict intraoperative timing, while providing surgeons with insight into potential technical challenges.[6]

Many of the factors that contribute to the need to convert have been addressed, leading to better patient selection. However, one of the variables, which still necessitates conversion, is the inability to visualize the target LAD vessel because it is buried too deeply underneath the surrounding epicardial adipose tissue.[1,5] Data obtained from studies concerning intraoperative conversions from minimally invasive CABG procedures to a full-sternotomy approach suggest that the inability to visualize the LAD underneath the epicardial adipose tissue intraoperatively presents substantial difficulties to the successful completion of the initial endoscopic procedure.[1,5] Because surgeons lack tactile feedback in minimally invasive approaches, the orientation and correct identification of target vessels are more challenging and the epicardial adipose tissue covering the LAD therefore presents an intraoperative concern.[7] The inability to visualize this target vessel presents risks for continuing robotically, because of the chance of damaging the underlying myocardium in a beating heart procedure without the use of cardioplegia. Therefore, the conversion to a full-sternotomy approach is required.

The epicardial adipose tissue that is obscuring the target vessel is typically localized in the atrioventricular and interventricular grooves of the heart.[8] The reported extent of this visceral epicardial adipose tissue is variable, and conflicting views have been expressed regarding its correlation with body mass index (BMI) and waist circumference.[9,10]

This study aims to enhance the preoperative examination of the thickness of epicardial adipose tissue covering the LAD and by improving patient selection criteria reduce the need for costly, lengthy, and distressing intraoperative conversions.

METHODS

Subject Data

The selected subjects were those who underwent minimally invasive endo-SVST procedures performed at a single institution between 2007 and 2015. Retrospective analysis of patient preoperative CT angiography scans from both converted (n = 17) and successful robotic-assisted (n = 17) endo-SVST left internal thoracic to LAD procedures using the da Vinci Surgical Robot (Intuitive Surgical, Sunnyvale, CA USA) was obtained, with approval from HSREB 107796. Procedures classified as converted were those initially attempted as minimally invasive endo-SVST procedures but were then converted intraoperatively to a full-sternotomy bypass as a result of a buried LAD. Inaccessible vessels were classified by the principal surgeon, who has more than 15 years of experience with this procedure. The decision to convert to a full sternotomy intraoperatively from a minimally invasive endo-SVST approach was made on the basis of increased epicardial adipose tissue after the pericardium was incised and the anterior surface of the heart inspected. The second group of participants were selected from the repository of successful procedures where epicardial adipose was classified intraoperatively as "moderately thick," to match, where possible, those in the converted group on the basis of sex and age. Patient age, sex, height, and weight were obtained at the time of the procedure and were used to match subjects between groups and calculate patient BMI (Table 1). T1

TABLE 1. Demographics of Groups

	Converted	Robotic-Assisted
n	17	17
Age, y	64.8 ± 10.2	66.3 ± 7.6
Female:male	2:15	4:13
Height, m	1.70 ± 0.10	1.66 ± 0.11
Weight, kg	93.1 ± 15.5	81.9 ± 14.4
BMI, kg/m^2	31.2 ± 4.6	29.5 ± 3.8

Data are presented as mean ± SD, unless otherwise indicated.
BMI, body mass index.

Preoperative CT Angiography

Gated CT angiography performed with 16 or more detectors made it possible to measure, accurately in the axial plane, the epicardial adipose, specifically surrounding the main coronary arteries including the LAD, using the parietal pericardium as the outermost limit for these measurements.[8] Because of its higher spatial resolution, CT is a more accurate quantification method for adipose tissue when compared with ultrasound and magnetic resonance imaging. Computed tomography enables AQ7 the visualization of the fibrous pericardium, thus allowing for precise measurements to be made.[11] The intraepicardial path of the LAD is also more readily assessed using CT scans than angiography because of the ability to accurately assess the surrounding structures and their relationships, rather than the vessels on their own.[7]

Preoperative imaging is conducted before all endo-SVST procedures for preoperative planning and eligibility assessment at this institution. Images were obtained from the selected patients and, where possible, scans were cardiac gated and taken in a 30-degree right lateral decubitus position, mimicking intraoperative conditions. The CT scans were taken using a 64-slice multidetector CT scanner with a 0.35-second rotation time (Lightspeed VCT; GE Medical Systems, Milwaukee, WI USA). Images were taken using radiographic contrast injected intravenously (Isovue 370; Bracco Imaging Canada, Anjou, Quebec, Canada) during the arterial phase. Patient scans were anonymized using DICOM Anonymizer PRO (NeoLogica), and measure- AQ8 ments were made using 3D Slicer 4.4.0 software.[12]

Body Mass Index and Total Thickness of Epicardial Adipose Tissue in the Anterior Interventricular Sulcus

Although visceral adipose tissue, a classification, which includes epicardial adipose tissue,[13] is more reliably assessed using measurements of waist circumference, a BMI of greater than or equal to 30 kg/m^2 is an appropriate substitute determinant of abdominal obesity when waist circumference is unavailable.[11] Patient body mass indices were calculated by using patient mass (kilogram) and height (meter) taken before the procedure. Measurements of the total thickness of the epicardial adipose were performed in the anterior interventricular sulcus at the most accessible segment of the LAD between the third and fifth anterior intercostal spaces. Where possible these measurements were made in the fourth intercostal space, though when the vessel was inaccessible, measurements were made underneath the fifth rib, or in the upper fifth intercostal space, and were noted. The epicardial adipose thickness measurement was made from the deepest portion of the anterior interventricular sulcus from the myocardium to intersect the F1 fibrous pericardium perpendicularly (Fig. 1A).

Measurements of Epicardial Adipose Overlying the Left Anterior Descending Coronary Artery

Three measurements describing the thickness of adipose tissue overlying the LAD were made. The first was made from the anterior aspect of the LAD toward the anterior chest wall to F2 the pericardium (Fig. 2A), the second measurement was made from the lateral aspect of the LAD toward the lateral chest wall to the pericardium (Fig. 2B), and the final measurement bisected the previous two measurements from the LAD toward the pericardium (Fig. 2C). These measurements were chosen for their reproducibility and their characterization of the field of view of the endoscopic camera used during the endo-SVST procedure.

Statistical Analysis

Data were analyzed using SPSS Software Version 22 (IBM Corporation, Armonk, NY USA, 2013). Normality was assessed using a Shapiro-Wilk test, and if the data were normally distributed, a Student independent *t* test was used to assess differences between groups. When the assumptions for normality were not met, a Mann-Whitney *U* test was performed. A *P* value of less than 0.05 was considered significant. Intrarater reliability was assessed by intraclass correlation coefficient. Correlation was assessed using Pearson correlation coefficient.

RESULTS

Body Mass Index and Thickness of Epicardial Adipose Tissue

The mean ± SD BMIs did not seem to differ significantly between the robotic-assisted (29.5 ± 3.8 kg/m^2, n = 17) and

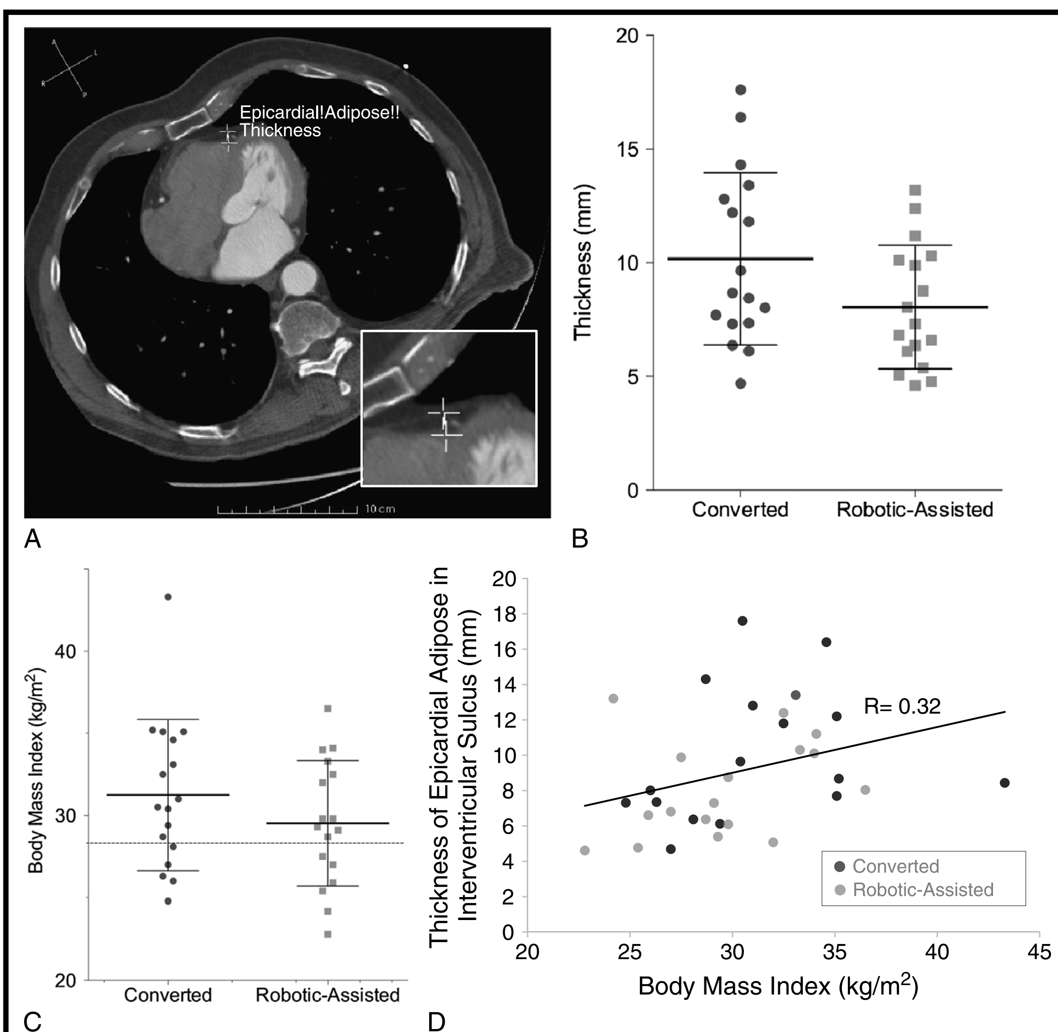

FIGURE 1. Characterization of the relationship between epicardial adipose tissue and BMI. A, Measurement of the total thickness of epicardial adipose tissue. B, Comparison of mean ± SD of the total thickness of epicardial adipose in the interventricular sulcus in converted (n = 17) and robotic-assisted (n = 17) groups. C, Comparison of distributions around the mean ± SD of BMI for converted (n = 17) and robotic-assisted (n = 17) groups because they relate to the World Health Organization obesity index (30 kg/m^2). D, Correlation of the thickness of epicardial adipose in the anterior interventricular sulcus measured on CT images to BMI (n = 34) (P = 0.06).

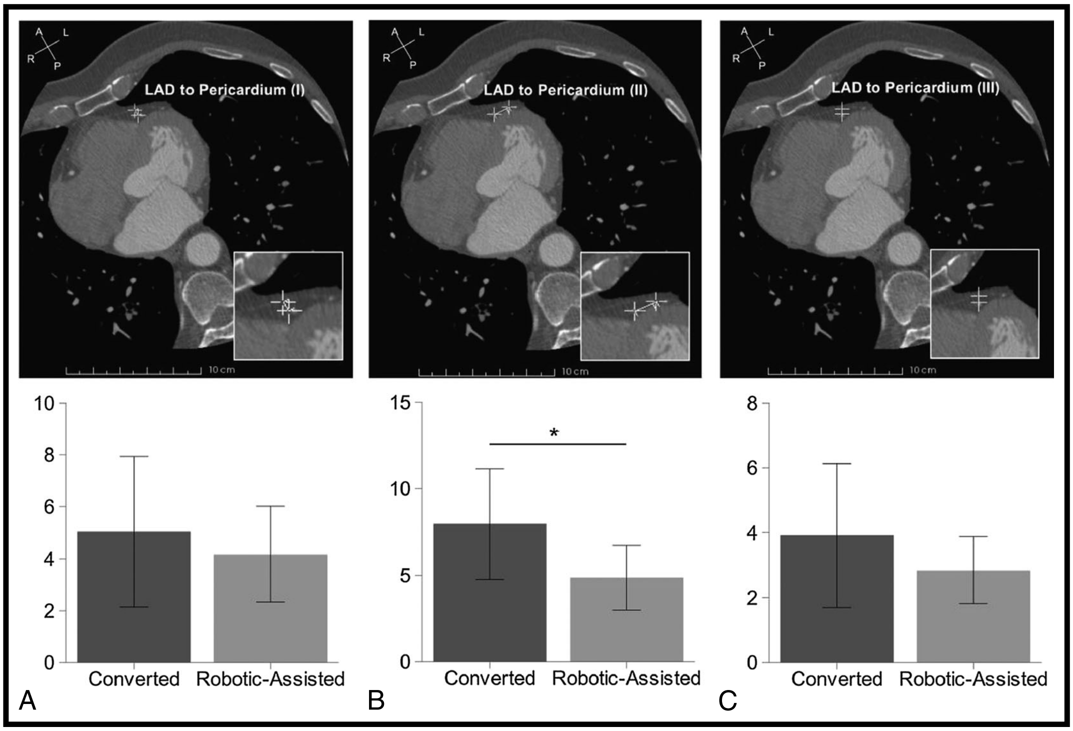

FIGURE 2. Measurements and comparisons of the mean ± SD of the thickness of epicardial adipose tissue overlying the LAD coronary artery in converted (n = 17) and robotic-assisted (n = 17) patients. A, Thickness of adipose tissue overlying the LAD toward the anterior chest wall. B, Thickness of adipose tissue overlying the LAD toward the lateral chest wall. C, Thickness of adipose tissue overlying the LAD bisecting A and B. *$P = 0.002$.

converted groups (31.2 ± 4.6 kg/m^2, n = 17) with both groups showing a similar spread around the clinical obesity index defined by the World Health Organization, a BMI of 30 kg/m^2 (Fig. 1C). There were no differences found between the means of successful robotic-assisted (8.0 ± 2.7 mm, n = 17) and converted groups (10.2 ± 3.8 mm, n = 17) with respect to the thickness of epicardial adipose in the anterior interventricular sulcus at the fourth anterior intercostal space; however, the converted group did seem to trend toward increased total epicardial adipose thickness (Fig. 1B). These data also suggest that a moderate, but nonsignificant, positive correlation ($R = 0.32$, $P = 0.06$, n = 34) exists between BMI and the total thickness of epicardial adipose tissue in the anterior interventricular sulcus (Fig. 1D) as determined by Pearson correlation coefficient.

Epicardial Adipose Thickness Over the LAD

Measurements of the thickness of epicardial adipose tissue overlying the LAD demonstrated that significant differences ($P < 0.05$) exist between the robotic-assisted (4.9 ± 1.9 mm, n = 17) and converted (7.9 ± 3.2 mm, n = 17) groups on the basis of the thickness of epicardial adipose tissue found in the measurement toward the lateral chest wall (Fig. 2B). Although no significant differences exist between groups based on measurements of epicardial adipose overlying the LAD in the bisecting or anterior measurements, a trend seems to emerge in these participants, where increased thickness of epicardial adipose is seen in the converted groups. In the bisecting measurement (Fig. 2C), converted participants (3.9 ± 2.2 mm, n = 17) seem to have greater thickness of epicardial adipose overlying the LAD than successful robotic-assisted participants (2.8 ± 1.0 mm, n = 17). The anterior measurement (Fig. 2A) also showed a similar trend in which converted participants (5.0 ± 2.9 mm, n = 17) seemed to have increased thickness of adipose compared with the robotic-assisted group (4.2 ± 1.8 mm, n = 17).

DISCUSSION

These findings suggest that BMI alone cannot account for the need to convert to a full-sternotomy approach on the basis of a buried LAD, and therefore, a simple examination of BMI is not sufficient to exclude a patient from the minimally invasive surgery. This procedure may impart additional benefits to this subpopulation because researchers have found associations with increased risk for sternal wound complications in patients with a BMI value greater than 30 kg/m^2 who undergo traditional full-sternotomy procedures.[13] Previous studies have examined the association between higher BMI (30 kg/m^2) and overall outcomes in minimally invasive coronary artery bypass procedures and have observed that patients with higher BMI seemed to undergo longer operating times and physicians may have increased difficulty in land marking, port placement, and robot maneuverability. However, intraoperatively, there was no increase in complication rate resulting in conversions to a full sternotomy in patients with a BMI value greater than 30 kg/m^2; in addition, no differences in postoperative outcomes were apparent with postoperative complication rates remaining low.[14] Furthermore, in this population of patients who are susceptible to sternal wound complications, there were no reported port or thoracotomy incision site infections or complications, which would suggest an added benefit for this subpopulation over full-sternotomy procedures.[14]

Although the association between epicardial adipose tissue and BMI did not offer a robust screening tool, in the current study, the measurement of the thickness of the epicardial adipose obscuring the LAD may provide additional preoperative insight into the patient's eligibility for the endo-SVST procedure. These data suggest that a transverse thickness of adipose overlying the LAD of 7.9 ± 3.2 mm indicates a greater likelihood for intraoperative conversion to a full sternotomy. Other measurements of the epicardial adipose overlying the LAD also showed trends toward increased thickness in the converted group when compared with the robotic-assisted group, although these differences were not significant. Using the information gained from this retrospective analysis, it is possible to assess the risk of conversion on the basis of this newly established parameter. By adding this to existing measurements performed preoperatively, this inclusion has the potential to reduce the number of intraoperative conversions for patients with an increased amount of epicardial adipose tissue in the anterior interventricular groove around the target vessel.

This preoperative assessment is also used as a means of deciding a patient's suitability to undergo a TECAB approach. If the preoperative assessment of the epicardial adipose tissue on CT scan determines that the patient is more suitable to undergo TECAB, because the LAD is more accessible with endoscopic exposure, then the patient will be selected to undergo TECAB. However, these patients with significant epicardial adipose making the LAD inaccessible generally had this finding throughout the long segment of the LAD, making these patients also unsuitable for TECAB procedures.

When the mean, 7.9 mm, for the converted group is used as the exclusion criterion, the sensitivity of the transverse measurement within this sample is 47%, whereas the specificity is F3 94% (Fig. 3B). This high specificity allows for the maximum number of prospective patients to benefit from the reduced morbidity associated with the robotic-assisted approach while also reducing conversions associated with this intraoperative complication by 47%.

Future Directions

Based on the results of this study, future directions will aim to further test the proposed eligibility criteria. The newly implemented preoperative CT measurements of the epicardial adipose tissue described in this study will be performed prospectively on upcoming endo-SVST cases preoperatively. The aim of these future studies will be to evaluate the benefits of the proposed measurements in a clinical setting, outside of our current retrospective sample group before they are implemented into routine practice. With an increase in the number of cases performed, new data can be amassed to continue to improve and narrow the sensitivity of this particular exclusion criterion.

CONCLUSIONS

The results of this study indicate that additional measurements made specifically of the thickness of epicardial adipose over the LAD coronary artery toward the lateral chest wall at the fourth or fifth anterior intercostal space have the potential to reduce conversions from robotic-assisted to full-sternotomy procedures intraoperatively by 47% within a retrospective study group when this measurement is performed as part of the preoperative analysis of patient CT scans. This epicardial adipose exclusion criterion is highly specific, with moderate sensitivity, ensuring that patients who are eligible for the robotic-assisted procedure are not being erroneously excluded, allowing them to benefit from the reduced morbidity associated with the minimally invasive approach. Further research is required to ascertain the validity of these measurements outside of this study group.

LIMITATIONS

The limitations of this study include the low sample size, which limits the analyses available and the conclusions that can be drawn from the data set. We hope to address this limitation by performing a prospective analysis of our proposed measurements to ensure the efficacy of these exclusion criteria within the clinical population, before implementing it in routine preoperative analyses.

In addition, the variability seen in individual patient anatomy can lead to increased variability in the anatomical

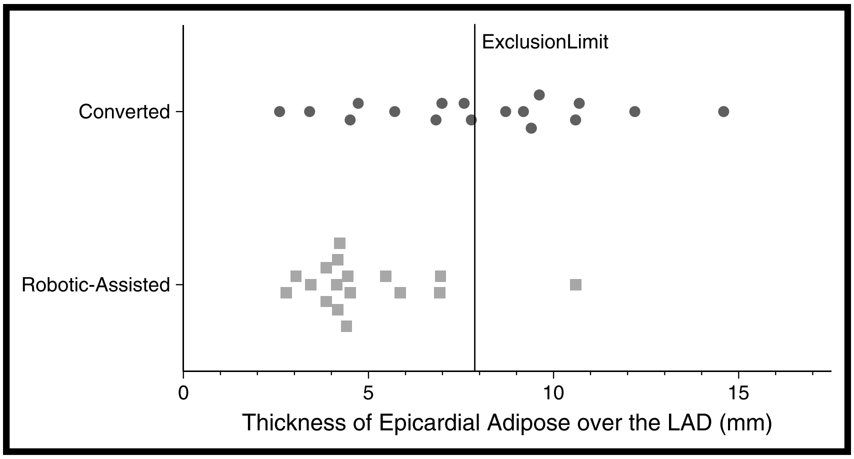

FIGURE 3. Retrospective decision matrix regarding conversions, with exclusion criterion defined as the mean of the converted group, 7.9 mm in the measure of the thickness of epicardial adipose tissue over the LAD toward the lateral chest wall (Fig. 2B) of converted (n = 17) and robotic-assisted (n = 17) groups.

measurements, which is most likely because of the interobserver inconsistencies in the recognition of the measurement boundaries and the variability in placement of the cursor when performing measurements.[11] However, because two-dimensional measurements remain the clinical standard until further advances in imaging techniques become readily available and can decrease the time, training, cost, and efficacy required for these preoperative measurements to be performed, the methods proposed in this study continue to be relevant to current preoperative analyses of patient CT scans. With the addition of the current CT protocol at our institution, which includes anatomical measurements made preoperatively, the number of intraoperative conversions has been reduced and therefore has provided a useful tool for eligibility assessment.

REFERENCES

1. Trejos AL, Ross I, Scalesse C, et al. Preoperative evaluation of patient anatomy to increase success of robotics-assisted bypass surgery. *Innovations*. 2010;5:335–340.
2. Leyvi G, Forest SJ, Srinivas VS, et al. Robotic coronary artery bypass grafting decreases 30-day complication rate, length of stay, and acute care facility discharge rate compared with conventional surgery. *Innovations*. 2014;9:361–367.
3. Bonaros N, Schachner T, Wiedemann D, et al. Quality of life improvement after robotically assisted coronary artery bypass grafting. *Cardiology*. 2009;114:59–66.
4. Seco M, Edelman JJ, Yan TD, Wilson MK, Bannon PG, Vallely MP. Systematic review of robotic-assisted, totally endoscopic coronary artery bypass grafting. *Ann Cardiothorac Surg*. 2013;2:408–418.
5. Escoto A, Trejos AL, Patel RV, Goela A, Kiaii B. Anatomy-based eligibility measure for robotic-assisted bypass surgery. *Innovations*. 2014;9:349–353.
6. Wehman B, Lehr EJ, Lahiji K, et al. Patient anatomy predicts operative time in robotic totally endoscopic coronary artery bypass surgery. *Interact Cardiovasc Thorac Surg*. 2014;19:572–576.
7. Herzog C, Dogan S, Diebold T, et al. Multi-detector row CT versus coronary angiography: preoperative evaluation before totally endoscopic coronary artery bypass grafting. *Radiology*. 2003;229:200–208.
8. Bertaso AG, Bertol D, Duncan BB, Foppa M. Epicardial fat: definition, measurements and systematic review of main outcomes. *Arq Bras Cardiol*. 2013;10:e18–e28.
9. Silaghi A, Piercecchi-Marti MD, Grino M, et al. Epicardial adipose tissue extent: relationship with age, body fat distribution, and coronaropathy. *Obesity*. 2008;16:2424–2430.
10. Corradi D, Maestri R, Callegari S, et al. The ventricular epicardial fat is related to the myocardial mass in normal, ischemic and hypertrophic hearts. *Cardiovasc Pathol*. 2004;13:313–316.
11. Gorter PM, van Lindert AS, de Vos AM, et al. Quantification of epicardial and peri-coronary fat using cardiac computed tomography; reproducibility and relation with obesity and metabolic syndrome in patients suspected of coronary artery disease. *Atherosclerosis*. 2008;197:896–903.
12. Fedorov A, Beichel R, Kalpathy-Cramer J, et al. 3D Slicer as an image computing platform for the Quantitative Imaging Network. *Magn Reson Imaging*. 2012;30:1323–1341.
13. Sacks HS, Fain JN. Human epicardial adipose tissue: a review. *Am Heart J*. 2007;153:907–917.
14. Hemli JM, Darla LS, Panetta CR, et al. Does body mass index affect outcomes in robotic-assisted coronary artery bypass procedures? *Innovations*. 2012;7:350–353.

CLINICAL PERSPECTIVE

This is an interesting study in which the authors performed a retrospective analysis of preoperative computed tomography angiography scans from successful robotic-assisted endoscopic single-vessel small thoracotomy (SVST) procedures (n = 17) and compared those with 17 patients who underwent attempted SVST but required conversion to median sternotomy. Their results indicated that the patients who successfully underwent the SVST procedure have significantly less epicardial adipose tissue ($P = 0.0002$) overlying the vessel toward the lateral chest wall than those who were converted to full sternotomy. If they used the mean depth of epicardial fat of 7.9 mm in the group, which required conversion as an exclusion criterion, they would have reduced the conversion rate by 47% while maintaining a high specificity (94%).

This observation may be helpful in prospectively identifying patients who are poor candidates for an endoscopic procedure. Clearly, the limitations of this study were its retrospective analysis and small sample size. The authors are planning to prospectively evaluate the sensitivity and specificity of this exclusion criterion in future studies, which will better define its clinical utility.

AUTHOR QUERIES

AUTHOR PLEASE ANSWER ALL QUERIES

AQ1 = Please check if authors name are correctly captured for given names (in red) and surnames (in blue) for indexing after publication.

AQ2 = Please check if the author names and academic degree were captured correctly.

AQ3 = All plus-minus (±) constructions were assumed as mean ± SD and were styled as such. Please check in each occurrence if correct.

AQ4 = Please check if the author affiliations were captured correctly.

AQ5 = Please check if the address and e-mail details of the corresponding author were captured correctly.

AQ6 = Please provide the expanded form of CABG.

AQ7 = Please check if the given expanded form of MRI is correct.

AQ8 = Please provide manufacture details of "NeoLogica" and "3D Slicer 4.4.0 software."

END OF AUTHOR QUERIES