Perioperative diastolic dysfunction during vascular surgery and its association with postoperative outcome

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Objective: To assess the association of perioperative cardiac dysfunction during elective vascular surgery with postoperative outcome.

Background: Patients with normal systolic function can have isolated diastolic dysfunction. Routine preoperative evaluation of left ventricular (LV) function does not include an assessment of diastolic function. We hypothesized that perioperative assessment of both diastolic and systolic function with tranesophageal echocardiography (TEE) may improve our ability to predict postoperative outcome.

Methods: Perioperative TEE examinations were carried out on patients undergoing elective vascular surgery under general anesthesia. Abnormal systolic function was defined as LV ejection fraction (LVEF) <40%. Left ventricular diastolic function was assessed using transmitral flow propagation velocity (Vp); Vp <45 cm/sec was considered abnormal. We determined the association between LV function and the primary outcome of postoperative adverse outcome, defined as one or more adverse events: myocardial infarction (MI), congestive heart failure (CHF), significant arrhythmia, prolonged intubation, renal failure, and death.

Results: Three hundred thirteen patients undergoing vascular surgery were studied. We found that 8% (n = 24) of patients had isolated systolic dysfunction, 43% (n = 134) had isolated diastolic dysfunction, and 24% (n = 75) both systolic and diastolic dysfunction. The most common postoperative adverse outcome was CHF 20% (n = 62). By multivariate logistic regression, we found that patient age, Vp, type of surgery, female gender, and renal failure were predictive of postoperative adverse outcome.

Conclusion: The presence of perioperative diastolic dysfunction as assessed with Vp is an independent predictor of postoperative CHF and prolonged length of stay after major vascular surgery. Patient age, gender, type of surgery, and renal failure were also predictors of outcome. Perioperative systolic function was not a predictor of postoperative outcome in our patients. (J Vasc Surg 2009;50:70-6.)

A history of congestive heart failure (CHF) significantly increases the risk of postoperative morbidity and mortality after non-cardiac surgery. CHF is a clinical diagnosis that can be due to both systolic and diastolic ventricular dysfunction; whether patients with history of CHF should be treated differently based on their specific cardiac dysfunction is not known, and preoperative risk assessment in non-cardiac surgery has thus far been limited to the evaluation to ventricular systolic function or wall motion abnormalities. However, when evaluated in conjunction with other clinical risk factors, left ventricular systolic function has not been found to add significant predictive value of postoperative cardiac complications. On the other hand, the evaluation of diastolic function as a characteristic that may exert an independent effect on postoperative morbidity has thus far been limited. Further, assessment of diastolic function prior to surgery is not routinely performed. We hypothesized that independently examining both systolic and diastolic ventricular function using tranesophageal echocardiography (TEE) during high-risk vascular surgery may improve our ability to predict postoperative adverse outcome.

METHODS

After obtaining institutional review board approval, consecutive patients undergoing elective vascular surgery under general anesthesia (GA) between January 2005 and December 2007 were evaluated for participation in this prospective observational study. The exclusion criteria were emergency surgery, surgery under regional anesthesia, severe valvular disorders (severe aortic/mitral stenosis or regurgitation), or contraindications to TEE.

Intraoperative care. Patient received continuous intraoperative monitoring with intra-arterial blood pressure, central venous pressure, pulse oximetry, electrocardiography, inspired oxygen, and expired carbon dioxide tension. Induction of GA was standardized with propofol (2.0 mg/kg) or etomidate (0.3 mg/kg) if LV ejection fraction (LVEF) was known to be ≤45% for induction. Anesthesia was maintained with 0.5%-0.75% inspired sevoflurane in a 50% nitrous oxide and oxygen mixture. Muscle relaxation was initiated using succinylcholine (1.5 mg/kg) and main-
tained with intermittent doses of vecuronium as necessary. Surgical analgesia was provided with intravenous fentanyl, dose of which was determined by the anesthesiologist, and intravenous morphine for pain relief postoperatively. Tachycardia, defined as a sustained heart rate greater than 90 beats/minute, was treated with either metoprolol or esmolol, with the selection based on the clinical situation. All patients were planned to be extubated at the conclusion of the procedure using standardized criteria. Patients who failed to meet the criteria for extubation at the end of the procedure were ventilated in a monitored recovery unit.

A TEE probe was inserted after induction of GA, and a comprehensive TEE examination was carried out by study investigators (FM, RM, BS, PP, JM) who were certified in perioperative TEE by the National Board of Echocardiography. All the studies were performed with Philips IE33 or SONOS 5500 ultrasound system (Phillips Medical Systems, Andover, Mass) with Omniplane II probes. Studies were recorded digitally in Digital Imaging for Communication in Medicine format and later reviewed on the Echo Picture Archiving and Communication System station (GE Medical Systems, Waukesha, Wisc) for accuracy. The TEE probe was kept in situ for the duration of the surgical procedure.

Assessment of systolic function. Systolic function was assessed with a visual quantitative estimation (VQE) of left ventricular ejection fraction (LVEF) in the transgastric short axis view. The wall motion abnormalities were recorded in multiple mid-esophageal and transgastric views of the left ventricle. An LVEF of ≤40% was categorized as abnormal. The VQE method of LVEF assessment has shown excellent correlation with radionuclide-derived LVEF (r = 0.967; P < .001) and provides highly comparable results to the invasively derived EF assessment with experience.

Assessment of diastolic function. Assessment of diastolic function was performed by measuring the transmitral flow propagation velocity (Vp) using described methodology. Briefly, with the TEE probe in the mid-esophageal four chamber view, and ensuring parallel alignment of the Doppler beam and adjustment of the Nyquist limit to obtain a clear wave front of flow propagation, the color flow box was positioned on the LV cavity. The slope of the first aliasing velocity was followed from the mitral valve opening to 4 cm into the LV cavity. A Vp value of <0.45 m/sec was considered consistent with diastolic dysfunction (Fig 1).

Measurement of Vp has also shown excellent reproducibility (r = 0.96) and intra and inter-observer variability (2.0 ± 1.1% mean and 2.2 ± 1.4% mean, respectively).

Postoperative care. After discharge from the post-anesthesia recovery unit (PACU) the patients were admitted to the vascular surgery intensive care unit (VICU). All patients had a 12-lead electrocardiogram (EKG) on arrival in the PACU and every six hours for the next 48 hours. Troponin-T levels were measured on patients postoperatively who experienced anginal symptoms with or without hemodynamic instability, ST segment changes, left bundle branch block, or new Q waves on EKG. A portable chest X-ray was obtained on arrival in the PACU and further films were obtained as indicated by the clinical situation. The following adverse events were identified: myocardial infarction (MI), CHF, significant arrhythmia, prolonged intubation, renal failure, and death. Events were defined as:

1. MI: Troponin-T level >0.01 ng/ml or Creatine Phosphokinase-MB (CPK-MB) elevation or new Q waves in two adjacent leads.
2. CHF: Clinical AND radiological evidence of pulmonary edema that required diuresis AND supplemental oxygen by facemask or endotracheal intubation.
3. Significant arrhythmias: New onset brady- or tachyarrhythmias associated with hemodynamic changes requiring medications or electrical cardioversion.
4. Renal failure: Increase in creatinine concentration of >2 gm/dl, or new requirement of postoperative hemodialysis.
5. Requirement for postoperative intubation of greater than 24 hours was categorized as prolonged intubation.

Statistical analysis. We analyzed the relationship between adverse events and TEE measures of left ventricular systolic and diastolic function (LVEF and Vp). The primary outcome was the incidence of postoperative adverse outcome, defined as the occurrence of one or more adverse events. Secondary outcomes consisted of individual adverse events. Associations between cardiac function and outcomes were assessed using Pearson chi-squared analysis with Yates correction. The relationship between systolic and diastolic function was performed using Spearman correlation. Multivariate logistic regression was performed to identify the independent factors associated with adverse outcome. Characteristics that were found to be associated with an adverse outcome to the P ≤ .25 level were included. Both LVEF and Vp were forced into the analyses. Data is presented as mean ± standard deviation when
Table I. Baseline demographic characteristics of the study population

<table>
<thead>
<tr>
<th>Demographic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr)</td>
<td>71 (62-79)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>37% (118)</td>
</tr>
<tr>
<td>M</td>
<td>63% (197)</td>
</tr>
<tr>
<td>CAD</td>
<td>58% (184)</td>
</tr>
<tr>
<td>MI</td>
<td>34% (107)</td>
</tr>
<tr>
<td>CABG</td>
<td>20% (63)</td>
</tr>
<tr>
<td>HTN</td>
<td>85% (269)</td>
</tr>
<tr>
<td>CHF</td>
<td>14% (45)</td>
</tr>
<tr>
<td>CVA</td>
<td>10% (33)</td>
</tr>
<tr>
<td>DM</td>
<td></td>
</tr>
<tr>
<td>Oral</td>
<td>24% (75)</td>
</tr>
<tr>
<td>Insulin</td>
<td>28% (88)</td>
</tr>
<tr>
<td>RF</td>
<td>14% (44)</td>
</tr>
<tr>
<td>EBL (cc)</td>
<td>350 (200-760)</td>
</tr>
<tr>
<td>Fluid inputs (cc)</td>
<td>2500 (1800-4900)</td>
</tr>
<tr>
<td>LVEF</td>
<td>50% (40%-55%)</td>
</tr>
<tr>
<td>Vp (cm/sec)</td>
<td>40 (32-49)</td>
</tr>
<tr>
<td>Surgery aortic peripheral</td>
<td>31% (97)</td>
</tr>
<tr>
<td></td>
<td>69% (216)</td>
</tr>
</tbody>
</table>

Data presented as median (interquartile range) or percentage of cohort, as appropriate.

CABG, History of coronary artery bypass surgery; CAD, Coronary artery disease; CHF, Medical history of congestive heart failure; CVA, History of a cerebrovascular accident; DM, Diabetes melitis receiving oral therapy including either diet or medication for control; EBL, Estimated blood loss during surgery; fluid inputs: represents intraoperative crystalloid administration; LVEF, Left ventricular ejection fraction; MI, History of myocardial infarction; RF, Renal failure; Vp, Mitral valve flow propagation velocity. Surgery is reported as aortic (abdominal aneurysm or aortic occlusion) or peripheral (lower extremity revascularization or amputation).

normally distributed, or median (25%-75% interquartile range [IQR]) when not. Incidences presented as percentage of whole or group, and 95% confidence intervals (95CI) are presented for outcomes, where appropriate. Statistical significance was determined at the $P \leq .05$ level. SPSS 14.0 (SPSS Inc, Chicago, Ill) was used for analysis.

RESULTS

We completed the study on 325 patients. Twelve patients were excluded from the study; seven due to severe aortic stenosis, and five due to severe mitral regurgitation. The baseline demographics and surgical procedures are found in Table I. We found 26% (n = 80) of patients had normal left ventricular function, 8% (n = 24) isolated systolic dysfunction, 43% (n = 134) isolated diastolic dysfunction, and 24% (n = 75) both systolic and diastolic dysfunction. We found a small but statistically significant correlation between systolic and diastolic function ($P = .0044; r = 0.16$). By univariate analysis, systolic dysfunction was associated with a history of CAD, MI, CHF ($P < .001$ for all), and DM ($P = .03$), but not hypertension or increasing age. Diastolic dysfunction was only associated with increasing age ($P = .04$), but no other demographic factors.

The most common adverse outcome in our population was CHF 20% (n = 62), followed by arrhythmia 8% (n = 26), prolonged intubation 7% (n = 22), MI 7% (n = 21), and death 0.6% (n = 2). Overall, 30% (n = 94) of patients experienced at least one adverse outcome in the perioperative period. Patients who had any postoperative complication had significantly longer length of hospital stay (Fig 2); notably, CHF and prolonged intubation were associated with longer length of stay ($P < .001$ for both), but MI, arrhythmia, and postoperative death were not.

The association between left ventricular function and adverse outcomes is presented in Table II. We found that patients who had an abnormal Vp were twice as likely to have at least one adverse outcome (36% [75] vs. 18% [19]; $P = .002$) and a significantly longer length of stay ($7$ days [range, 5-10 days] vs. $5$ days [range, 4-6 days]; $P < .001$) compared with subjects with a normal measure. This was primarily due to an increased incidence of CHF; we found a statistically significant increase in adverse outcomes with decreasing Vp (Fig 3). While the incidences of all other adverse events were greater among patients, these did not reach statistical significance. In our investigation, EF was not a significant predictor of any adverse event or increased length of stay.

As shown in Table III, patients with diastolic dysfunction, whether isolated or combined with systolic dysfunction, were more likely to experience adverse events than patients with either normal cardiac function or isolated systolic dysfunction. By multivariate logistic regression (Table IV), we found that several factors were independently predictive of postoperative adverse outcome. Notably, diastolic dysfunction was associated with adverse outcome, but systolic dysfunction was not.

There were no complications relating to perioperative TEE use.

DISCUSSION

Our study highlights that the presence of diastolic dysfunction is an independent predictor of adverse outcome after major vascular surgery. We found that patients with diastolic dysfunction, defined as Vp $< 45$ cm/sec, had a significantly increased risk of developing postoperative adverse outcome and had a longer length of stay. Additionally, in our study diastolic dysfunction was associated with the postoperative complications most likely to increase a patient’s length of stay: CHF and prolonged intubation. By contrast, systolic dysfunction was not associated with adverse outcomes or with increased length of stay. A history of CHF has previously been shown to be a predictor of adverse outcome after high-risk vascular surgery.1,3 Xu-Cai et al22 reported that patients with a history of CHF and normal systolic function (ie, presumed diastolic dysfunction) had longer length of stay and higher re-admission rate after vascular surgery than patients with CHF and abnormal systolic function and controls. Results of our study agree with their findings. While the identification of perioperative diastolic dysfunction using echocardiography during vascular surgery has previously been reported, an association with postoperative outcome has not been thoroughly described.23,24 The findings of our study suggest that the
accurate assessment of perioperative diastolic dysfunction is an important, independent variable in postoperative outcome, and that further study is warranted.

Diastolic dysfunction is common in the population of patients undergoing high-risk vascular surgery. In our study, cohort isolated diastolic dysfunction occurred in 43% of subjects. Similarly, Phillip et al. reported that more than 50% of geriatric patients undergoing cardiac and non-cardiac surgery had preoperative diastolic dysfunction with normal LVEF. They concluded that a comprehensive left ventricular functional assessment should include evaluation of both systolic and diastolic function, and our data would suggest that this is an appropriate approach. If preoperative assessment were limited to systolic function alone, a significant proportion of patients with diastolic dysfunction who are at risk for postoperative adverse events would not be identified. Whether identification of these patients could lead changes in care that would result in improved outcome remains a point of future study. For example, one hypothesis may be that utilizing a care pathway that includes aggressive fluid restriction and early diuresis might reduce the incidence of postoperative CHF. This and other strategies remain to be tested, but we believe that our findings provide evidence that such research is possible.

Diastolic function has not received significant study as a factor in outcome research possibly due to the absence of a universal, non-invasive method of classification and diagnosis. Traditionally, assessment was based on the pulse wave Doppler interrogation of the transmitral and pulmonary venous inflow. This method can sometimes be inconclusive, in part due to the natural history and progression of relaxation abnormalities (impaired relaxation to pseudo-normal to restrictive). Furthermore, rapidly changing loading conditions in the operating room make it more challenging to accurately assess perioperative diastolic function with the traditional PWD measures. We chose to assess diastolic function using a more recently described method: transmitral flow propagation velocity, or Vp. Despite limitations, Vp is easily obtained, reproducible, and does not require post-acquisition manipulation. Also, Vp is a reliable method during periods of changing loading condition and fluctuating heart rate. These features makes it useful for assessment of perioperative relaxation abnormalities in the OR setting.

Table II. Univariate analysis of adverse outcomes by patient characteristic

<table>
<thead>
<tr>
<th>Factor</th>
<th>Adverse outcome</th>
<th>No complication</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr)</td>
<td>76 (65-81)</td>
<td>69 (60-77)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Male gender</td>
<td>27% (52)</td>
<td>36% (42)</td>
<td>.12</td>
</tr>
<tr>
<td>HTN</td>
<td>80% (75)</td>
<td>34% (15)</td>
<td>.66</td>
</tr>
<tr>
<td>CAD</td>
<td>32% (59)</td>
<td>28% (35)</td>
<td>.49</td>
</tr>
<tr>
<td>MI</td>
<td>34% (37)</td>
<td>28% (57)</td>
<td>.24</td>
</tr>
<tr>
<td>CHF</td>
<td>36% (17)</td>
<td>29% (77)</td>
<td>.41</td>
</tr>
<tr>
<td>DM</td>
<td>25% (41)</td>
<td>36% (53)</td>
<td>.06</td>
</tr>
<tr>
<td>RF</td>
<td>42% (19)</td>
<td>28% (75)</td>
<td>.08</td>
</tr>
<tr>
<td>CVA</td>
<td>44% (15)</td>
<td>28% (79)</td>
<td>.09</td>
</tr>
<tr>
<td>LVEF (&lt;40%)</td>
<td>50 (40-50)</td>
<td>50 (40-55)</td>
<td>.35</td>
</tr>
<tr>
<td>Vp (&lt;45 cm/sec)</td>
<td>43 (34-50)</td>
<td>35 (30-44)</td>
<td>.002</td>
</tr>
<tr>
<td>Surgery abdominal</td>
<td>49% (46)</td>
<td>23% (51)</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

Data presented as median (interquartile range) or percentage of cohort, as appropriate. Comparison was performed using Mann-Whitney test or Pearson chi-square with Yates correction, as appropriate. CAD, Coronary artery disease; CHF, Medical history of congestive heart failure; CVA, History of a cerebrovascular accident; DM, Diabetes mellitus receiving oral therapy including either diet or medication for control; EBL, Estimated blood loss during surgery; fluid inputs: represents intraoperative crystalloid administration; LVEF, Left ventricular ejection fraction; MI, History of myocardial infarction; RF, Renal failure; Vp, Mitral valve flow propagation velocity. Surgery is reported as the percentage of abdominal cases (aneurysm or occlusion).
It has been suggested that preoperative assessment of cardiac function using dipyridamole-Thallium or transthoracic echocardiography does not add significant incremental predictive value of postoperative complications over the clinical assessment.4,43-46 One possible explanation might be that these diagnostic tests primarily assess the systolic function of the left ventricle. We likewise found the assessment of systolic function of the left ventricle to be of lesser value in predicting immediate adverse events after surgery. We can identify certain limitations in our study. GA is known to alter the hemodynamic loading conditions, which can affect the Doppler filling pattern of the LV. We chose to use Vp as the single diagnostic criteria for diastolic function because it has been known to be less affected by loading conditions and can be reliably used in the operating room.23 Measurement of Vp has shown excellent reproducibility and intra- and inter-observer reliability.20,21 However, we cannot be certain that our measure of diastolic function taken after the induction of anesthesia would be comparable to a transthoracic measure taken prior to surgery. We used subjective assessment of LVEF as method of quantification of LV systolic function, which has been shown to be as accurate and reproducible.16,47 Also, our patient follow-up was limited to the duration of hospital admission and the effects of diastolic function on the long-term outcome in our patients are not known. Although we have demonstrated the predictive value of perioperative assessment of diastolic function, because of the lack of a specific therapy, the true significance of this

Table III. Comparison of adverse events by classification of left ventricular cardiac function

<table>
<thead>
<tr>
<th>Cardiac function</th>
<th>Normal</th>
<th>Isolated systolic</th>
<th>Isolated diastolic</th>
<th>Combined systolic/diastolic</th>
</tr>
</thead>
<tbody>
<tr>
<td>n = 80</td>
<td>n = 24</td>
<td>n = 134</td>
<td>n = 75</td>
<td></td>
</tr>
<tr>
<td>Adverse outcome</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHF</td>
<td>21% (17)</td>
<td>8% (2)</td>
<td>38% (51)*</td>
<td>32% (24)*</td>
</tr>
<tr>
<td>Arrhythmia</td>
<td>6% (5)</td>
<td>0</td>
<td>11% (15)</td>
<td>8% (6)</td>
</tr>
<tr>
<td>Prolonged intubation</td>
<td>5% (4)</td>
<td>0</td>
<td>8% (11)</td>
<td>9% (7)</td>
</tr>
<tr>
<td>MI</td>
<td>6% (5)</td>
<td>4% (1)</td>
<td>6% (8)</td>
<td>9% (7)</td>
</tr>
<tr>
<td>Death</td>
<td>3% (2)</td>
<td>0</td>
<td>3% (4)</td>
<td>1% (1)</td>
</tr>
</tbody>
</table>

Data presented as percentage of cohort. Comparison between groups was performed using Mantel-Haenszel statistic.

It has been suggested that preoperative assessment of cardiac function using dipyridamole-Thallium or transthoracic echocardiography does not add significant incremental predictive value of postoperative complications over the clinical assessment.4,43-46 One possible explanation might be that these diagnostic tests primarily assess the systolic function of the left ventricle. We likewise found the assessment of systolic function of the left ventricle to be of lesser value in predicting immediate adverse events after surgery. We can identify certain limitations in our study. GA is known to alter the hemodynamic loading conditions, which can affect the Doppler filling pattern of the LV. We chose to use Vp as the single diagnostic criteria for diastolic function because it has been known to be less affected by loading conditions and can be reliably used in the operating room.23 Measurement of Vp has shown excellent reproducibility and intra- and inter-observer reliability.20,21 However, we cannot be certain that our measure of diastolic function taken after the induction of anesthesia would be comparable to a transthoracic measure taken prior to surgery. We used subjective assessment of LVEF as method of quantification of LV systolic function, which has been shown to be as accurate and reproducible.16,47 Also, our patient follow-up was limited to the duration of hospital admission and the effects of diastolic function on the long-term outcome in our patients are not known. Although we have demonstrated the predictive value of perioperative assessment of diastolic function, because of the lack of a specific therapy, the true significance of this

Table IV. Results of multivariate logistic regression identifying the independent factors associated with postoperative adverse outcome

<table>
<thead>
<tr>
<th>Factor</th>
<th>P-value</th>
<th>Odds ratio</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>*Surgery</td>
<td>&lt;0.01</td>
<td>3.4</td>
<td>1.9</td>
</tr>
<tr>
<td>*Age (per 10 yr)</td>
<td>&lt;0.01</td>
<td>3.4</td>
<td>1.7</td>
</tr>
<tr>
<td>*Vp</td>
<td>&lt;0.01</td>
<td>2.5</td>
<td>1.3</td>
</tr>
<tr>
<td>*RF</td>
<td>0.02</td>
<td>2.6</td>
<td>1.2</td>
</tr>
<tr>
<td>*Female</td>
<td>0.03</td>
<td>1.9</td>
<td>1.1</td>
</tr>
<tr>
<td>CVA</td>
<td>0.07</td>
<td>2.0</td>
<td>0.9</td>
</tr>
<tr>
<td>DM</td>
<td>0.29</td>
<td>1.4</td>
<td>0.7</td>
</tr>
<tr>
<td>LVEF</td>
<td>0.64</td>
<td>1.3</td>
<td>0.7</td>
</tr>
</tbody>
</table>

*Denotes significant association to the P ≤ .05 level.
CVA, History of a cerebrovascular accident; DM, Diabetes mellitus; LVEF, Abnormal left ventricular ejection fraction; RF, Renal failure; Vp, Mitral valve flow propagation velocity.
Female gender included vs. male.
Surgery entered as Abdominal (aneurysm or occlusive) vs. Peripheral (lower extremity revascularization or amputation).
finding remains uncertain. Until the availability of a specific
lupisotropic therapy, the mainstay of therapy will likely re-
 mains anti-ischemic heart rate control, avoidance of fluid
overload, and diuretic therapy. Establishment of an accu-
rate diagnosis is the first step to develop an effective predic-
tive and therapeutic strategy, and we have demonstrated in
our study that utilizing TEE it is possible to diagnose
diastolic function in the perioperative arena.

In conclusion, the presence of perioperative diastolic
 dysfunction, as assessed with Vp, was an independent pre-
dictor of postoperative CHF and prolonged length of stay
after major vascular surgery as compared to patients with-
out diastolic dysfunction. Perioperative systolic function
was not a predictor of postoperative outcome in our pa-
tients. Future studies will be needed to assess the benefits
of inclusion of diastolic function during preoperative risk
stratification, and also goals for treatment.

AUTHOR CONTRIBUTIONS
Conception and design: RM, PP, BS, FP, JM, FM, PH
Analysis and interpretation: RM, BS, PH, FM
Data collection: RM, FM, RB, JM, PP
Writing the article: RM, FM, PH, BS
Critical revision of the article: FM, PP, FP, BS, JM, RB
Final approval of the article: FM, PH, RM
Statistical analysis: PH
Obtained funding: N/A
Overall responsibility: FM

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