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ORIGINAL PAPER

Low dose wall motion score predicts the short and long-term benefit of surgical revascularization in patients with ischemic left ventricular dysfunction

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Abstract

We investigated the influence of the extent of viability using low dose dobutamine wall motion score index (WMS) on the survival benefit of surgical revascularization (CABG) versus medical therapy. In the STICH trial, viability assessment was not helpful in determining the benefit of CABG. However, the extent of viable myocardium with contractile function was not assessed in the trial. Dobutamine echocardiography was performed in 250 patients with ischemic left ventricular dysfunction (125-medically treated, 125-CABG). The mean ejection fraction (EF) was 32% in both groups. WMS during low dose dobutamine infusion was used to classify patients into groups with extensive (WMS < 2.00), intermediate (WMS 2.00–2.49), and limited (WMS ≥ 2.50) viability. Survival free of cardiac death was assessed at 2 years and for the complete duration of follow-up. There were 44 (35.2%) and 67 (53.6%) cardiac deaths in the revascularized and medically treated patients respectively (follow-up of 5.7 ± 5.8 years). Revascularized and medically treated patients with extensive viability had similar 2-year survival (p = 0.567) but revascularized patients had improved long-term survival (p = 0.0001). In those with intermediate viability, revascularization improved both 2 year (p = 0.014) and long-term survival (p = 0.0001). In patients with limited viability, 2-year survival was worse in revascularized patients (p = 0.04) and long-term survival was similar (p = 0 .25) in revascularized and medically treated groups. Patients with extensive and intermediate amounts of viability have improved survival with CABG but those with limited viability have poorer short-term outcome and no long-term benefit.

Keywords Dobutamine stress echocardiography · Myocardial viability · Ischemic cardiomyopathy · Surgical revascularization (CABG)

Abbreviations

ACEI	Angiotensin converting enzyme inhibitor
CABG	Surgical revascularization
CAD	Coronary artery disease
CHF	Congestive heart failure
EF	Ejection fraction
LAD	Left anterior descending
LV	Left ventricular
WMS	Wall motion score

Introduction

Testing for myocardial viability was felt to a be an essential part of the evaluation of patients with ischemic left ventricular (LV) systolic dysfunction in the era of nonrandomized studies demonstrating that patients with substantial myocardial viability had better outcomes than patients without viability and in the presence of viability revascularization greatly improved survival compared to medical treatment [1, 2]. The Surgical Treatment of Ischemic Heart Failure (STICH) trial randomized subjects who had ischemic LV dysfunction (EF ≤ 35%) to coronary artery bypass grafting (CABG) or optimal medical therapy [3]. A subset of patients

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in STICH underwent viability testing to determine if the presence of viability predicted better outcomes in patients with CABG and optimal medical treatment versus optimal medical treatment alone. The presence of viability was shown to have no significant influence on outcome [3]. The publication of the STICH trial called into question the value of assessment of viability, but the trial was acknowledged to have limitations including the definition of viability based on the presence of contractile reserve in ≥ 5 segments with resting dysfunction. This definition of viability was adopted from some previous studies demonstrating that contractile reserve in approximately 25% of the LV was associated with revascularization related improvement in EF ≥ 5% (5 ejection fraction points), and reduction in short-term mortality [4–7]. The limitations of a binary classification of patients as having "viability" or "nonviability" based on a fixed number of segments with contractile reserve was discussed by Dr Bonow in a 2002 commentary [8].

The results of other investigations have suggested that measures of viability that encompass assessment of global contractility, such as wall motion score or EF with low dose dobutamine, may have more prognostic value compared to assessment of contractile reserve in a fixed number of dysfunctional segments [9–13]. In ischemic cardiomyopathy, the functional response of normal, remodeled, and nontransmurally infarcted segments to dobutamine may have an impact on outcome in addition to the response of segments with hibernation or stunning. Additionally, the extent of myocardium with transmural infarction and no contractile function has been shown to impact prognosis [14]. Wall motion score which assesses global function with dobutamine may better reflect the contribution of both viable and nonviable segments to outcome in patients with advanced ischemic LV dysfunction.

In this retrospective study we sought to determine if the extent and magnitude of viability, assessed by wall motion score during low dose dobutamine, enables prediction of the short and long-term benefits of CABG compared to medical therapy in patients with ischemic LV dysfunction.

Methods

Patient population

The study was approved by the Institutional Review Board of Indiana University. The study group was selected from patients with ischemic LV dysfunction (resting wall motion abnormalities in 4 or more segments and reduced ejection fraction or fractional shortening) who underwent dobutamine echocardiography for assessment of viability and ischemia between 1991 and 2003 at Indiana University Hospitals. Patients who had coronary angiography within five months of the dobutamine exam and were found to have multivessel disease (≥ 50% diameter stenosis of ≥ 2 epicardial coronary arteries) were included. Patients evaluated within one week after transmural myocardial infarction, those with single vessel disease, and those who subsequently had percutaneous revascularization were excluded. The final study population was comprised of 125 medically treated subjects and 125 patients who were surgically revascularized within 5 months of the dobutamine exam.

Dobutamine echocardiography and echocardiographic analysis

Dobutamine was administered using a previously described protocol [12]. Echocardiograms in the parasternal long- and short-axis and apical 4- and 2-chamber views were digitally stored at rest, at the end of the 5 and 10 μg/kg/min (low dose) stages, and at peak dose. All echocardiograms were analyzed from the digitally stored images by at least one investigator blinded to the clinical, angiographic, stress testing, and follow-up data. Wall motion and thickening were assessed in 16 segments using a previously described scoring system [12].

Dysfunctional segments exhibiting improvement in wall motion or thickening by one grade from rest to low dose (5 or 10 μg/kg/min of dobutamine) were considered to have contractile reserve. Segments that were akinetic or dyskinetic at rest and remained without improvement at low dose were defined as "nonviable". Segments that exhibited worsening of wall motion at any stage of the exam were defined as "ischemic" (except akinesis to dyskinesis). The percent of myocardium with normal wall motion at rest, with "contractile reserve" (dysfunctional with improvement at low dose), "nonviable" (akinetic at rest without improvement at low dose), and "ischemia" were determined. Wall motion scores (WMS) at rest, at low dose and at peak dose were obtained by dividing the sum of individual segment scores by the number of segments scored. Based on a previously defined scheme for categorizing patients based on the extent of viability, subjects were divided into 3 groups according to low dose wall WMS: Extensive Viability (WMS ≤ 2.00) (Group1); Intermediate Viability (WMS 2.00–2.49) (Group 2); and Limited Viability (WMS ≥ 2.50) (Group 3) [13]. The utility of assessing the extent of viability using these threshold values has been documented by our laboratory [12, 13].

Ejection fraction (EF) measurements were obtained using Simpson's or the Truncated ellipse method. For the sake of uniformity, EF reported in this study was derived from WMS at rest using a regression equation derived from comparison of EF measurements using Simpson's method and resting WMS in 140 patients with a wide range of LV systolic function. The regression equation was EF = − 18.8 (rest WMS) + 70.2, r = 0.753.

Angiography

Significant coronary disease was defined as ≥ 50% diameter stenosis of major epicardial coronary artery. The presence or absence of significant stenosis was determined by visual or caliper assessment of the angiograms by an experienced interventional cardiologist blinded to the results of follow-up.

Follow up

Treatment decisions were made by referring physicians who had access to the clinical interpretation of the dobutamine studies. Patients who had coronary artery bypass grafting within 5 months of dobutamine echocardiography were assigned to the surgically revascularized group. Follow-up was primarily retrospective and conducted by telephone interview, and extensive review of electronic medical records. In cases of hospital readmission or death, medical records and in selected cases death certificates were obtained for documentation. Cardiac death was the endpoint of the study. This was defined as death due to intractable heart failure, myocardial infarction, ventricular arrhythmia or sudden death within an hour of symptom onset without an obvious noncardiac cause. Follow-up of medically treated patients who underwent late revascularization and follow-up of patients who had heart transplantation were censored at the time of these procedures.

Statistical analysis

Continuous variables are reported as mean ± one standard deviation. A p value of < 0.05 was considered to be statistically significant. Continuous variables were compared using independent t-test, and categorical variables were compared using Chi-square. The % of normal, nonviable, and ischemic myocardium as well as % contractile reserve were compared between the cohorts with extensive, intermediate, and limited viability using one-way ANOVA. The reproducibility of assessment of low dose WMS was assessed by linear regression and % agreement between blinded interpretation of the echocardiograms and clinical readings. Survival was assessed with Kaplan–Meier analysis. Survival curves were compared between medically treated and revascularized patients using the log rank test. Statistical analysis was performed with SPSS 25.0 (SPSS Inc., Chicago, Illinois).

Results

Reproducibility of low dose score

The reproducibility of low dose WMS was examined by comparing scores derived from blinded interpretation and scores derived from clinical interpretation at the time of the dobutamine exam in 30 subjects with a wide range of LV systolic function. The correlation coefficient was 0.915 by linear regression, and the agreement for categorizing patients into extensive, intermediate, and limited viability groups was 87%.

Baseline characteristics

The mean age was 61 ± 11 years and 23% of patients were women. The prevalence of smoking, hypertension, hyperlipidemia and diabetes were 73%, 69%; 46% and 46% respectively. Three vessel diseases was present in 80% of patients and 38% had NYHA Class 3 or 4 heart failure. In revascularized patients, 93% had at least one arterial graft and 76% were completely revascularized with grafts to all major arteries with significant stenosis. The mean EF by the regression equation was 32 ± 7% and the mean rest, low dose and peak wall motion scores were 2.05 ± 0.40, 1.94 ± 0.04 and 1.99 ± 0.40 respectively.

Table 1 compares clinical and echocardiographic variables between revascularized and medically treated patients. The data on medical therapy reflects drugs the patients were taking at the time of dobutamine echocardiography. There were no significant differences between the two groups in clinical and echocardiographic variables except for hyperlipidemia and the presence of three vessel disease which were more common in the revascularized group.

The mean baseline EF by echocardiography was 37 ± 5%, 27 ± 4%, and 21 ± 3% in those with extensive, intermediate, and limited viability, respectively. The mean % of myocardium with normal wall motion at rest, contractile reserve, nonviability and ischemia in each viability group is shown in Table 2. The extent of nonviable myocardium increased with decreasing viability by low dose score. The extent of normal myocardium progressively decreased with decreasing viability by low dose score. There was no significant difference in the mean percentage of dysfunctional myocardium with contractile reserve or the extent of ischemia among the groups.

Follow-up

The mean duration of follow up was 5.7 ± 5.8 years with a range of up to 26 years. There were 111 patients who had cardiac death, including 67 (53.6%) in the medically treated group and 44 (35.2%) in the revascularized group ($p = 0.003$). There were 2 perioperative deaths (1.6%) in the revascularized group (extensive viability—1, intermediate viability—1). Survival curves show a maximum of 15 years of follow-up since there were very few surviving patients beyond this duration.

Figure 1 shows survival curves in patients with extensive viability. Two- year survival was similar in medically treated

Table 1 Comparison of clinical, echocardiographic and angiographic characteristics in revascularized and medically treated patients

Variable	Revascularized	Medical treatment	P Value
Female	30 (24%)	27 (22%)	0.65
Age (years)	60.1 ± 10	61.6 ± 12	0.31
Hypertension	88 (70.4%)	85 (68%)	0.68
Diabetes mellitus	54 (43%)	61 (49%)	0.37
Hyperlipidemia	73 (58%)	45 (36%)	0.001
Smoker	87 (70%)	95 (77%)	0.21
ACEI	74 (59%)	77 (61%)	0.80
Beta-blocker	53 (42%)	47 (38%)	0.52
ICD	7 (6%)	4 (3%)	0.33
EF (regression)	0.32 ± 0.07	0.32 ± 0.08	0.697
Rest WMS	2.04 ± 0.40	2.06 ± 0.40	0.728
Low WMS	1.92 ± 0.40	1.97 ± 0.40	0.323
Peak WMS	1.96 ± 0.43	2.02 ± 0.42	0.183
% of myocardium with CR	18.5 ± 15%	15.0 ± 15%	0.099
Proportion of patients with ischemia	98 (78.4%)	94 (75.2%)	0.549
Three vessel disease	108 (86%)	91 (73%)	0.008
LAD disease	121 (96.8%)	119 (95.2%)	0.519
Low WMS < 2.00	72 (57.6%)	62 (49.6%)	0.446
Low WMS 2.0–2.49	40 (32%)	48 (38.4%)	0.643
Low WMS ≥ 2.5	13 (10.4%)	15 (12%)	0.412

ACEI angiotensin converting enzyme inhibitor, *CR* contractile reserve, *EF* ejection fraction, *ICD* implantable cardioverter defibrillation, *LAD* left anterior descending, *WMS* wall motion score

Table 2 Echocardiographic variable of the three different low wall motion score groups

Variable	Extensive viability (n = 134)	Intermediate viability (n = 88)	Limited viability (n = 28)	P value
EF by regression	37 ± 5%	27 ± 4%	21 ± 3%	< 0.001
Rest WMS	1.77 ± 0.27	2.29 ± 0.21	2.63 ± 0.15	< 0.001
Low dose WMS	1.63 ± 0.23	2.21 ± 0.13	2.61 ± 0.14	< 0.001
Peak dose WMS	1.71 ± 0.28	2.23 ± 0.23	2.60 ± 0.24	< 0.001
Rest to low WMS change	− 0.14 ± 0.19	− 0.07 ± 0.17	0.00 ± 0.20	0.001
% Normal myocardium	46 ± 18	22 ± 15	9 ± 11	< 0.001
% With contractile reserve	18 ± 16	16 ± 15	13 ± 13	0.180
% Ischemic myocardium	17 ± 18	18 ± 14	14 ± 14	0.521
% Nonviable myocardium (akinetic at low dose)	14 ± 11	35 ± 14	52 ± 16	< 0.001

EF ejection fraction, *WMS* wall motion score

and revascularized patients (p = 0.57). Cardiac mortality was 14.5% (9/62) in medically treated patients and 12.5% (8/72) in revascularized patients (p = 0.609) at 2 years of follow-up.

However, after 2 years, an increasing proportion of medically treated patients had cardiac death, and by the end of follow up long-term survival was significantly better in the revascularized group (p = 0.0001). Long-term cardiac mortality was 45.2% (28/62) and 26.4% (19/72) in medically treated and revascularized patients, respectively (p = 0.030).

In patients with intermediate viability, revascularized patients showed early improvement in survival compared with medically treated patients (p = 0.014) (Fig. 2). Two-year cardiac mortality was 37.5% (18/48) and 15% (6/40) in the medically treated and revascularized groups, respectively (p = 0.029). The survival advantage of revascularization increased with long-term follow-up (p = 0.001) (Fig. 2). For the total duration of follow-up, cardiac mortality was 62.5% (30/48) in medically treated patients and 37.5% (15/40) in revascularized patients (p = 0.032).

In patients with limited viability (baseline EF = 21%) revascularized patients had worse short-term survival compared to medically treated patients (p = 0.041) (Fig. 3).

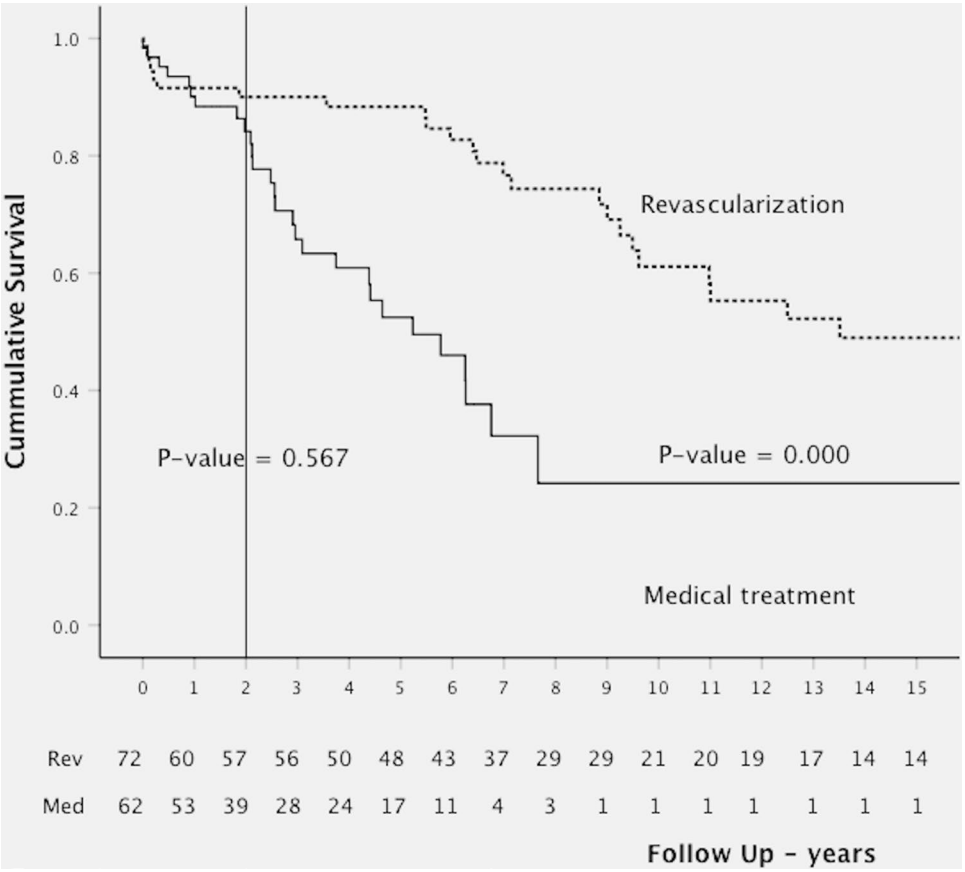

Fig. 1 Survival curves in patients with extensive viability. Revascularized and medically treated patients had equally good survival at 2 years. By the end of follow up revascularized patients had significantly better survival

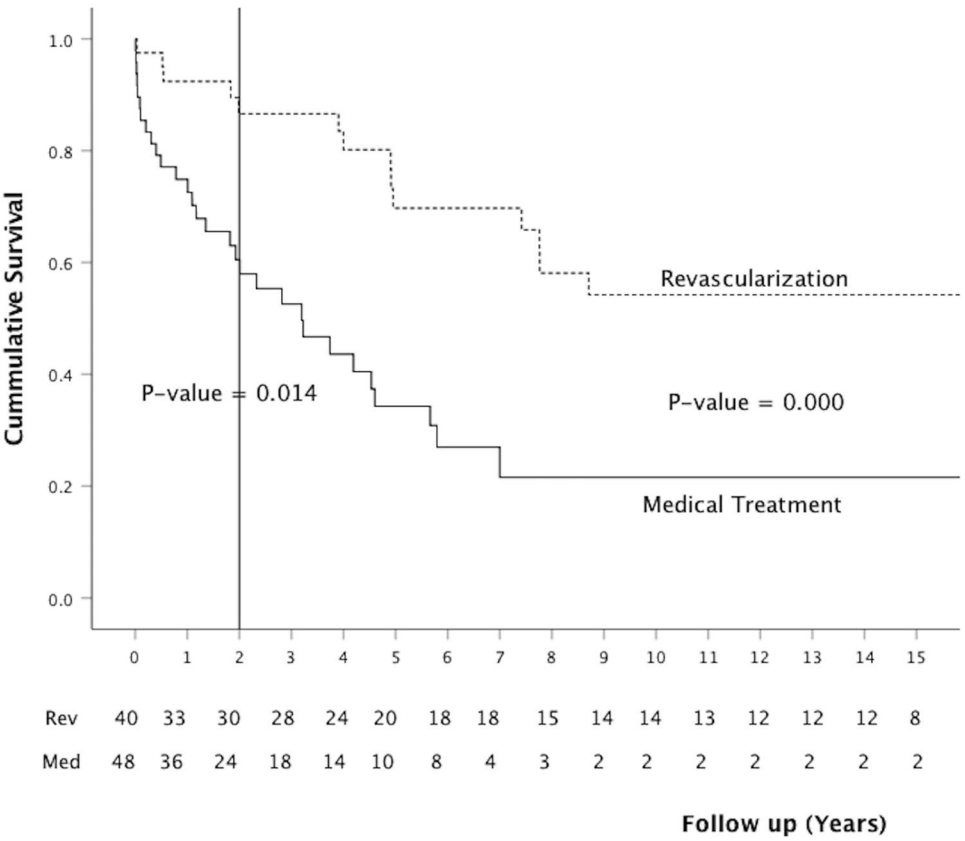

Fig. 2 Survival curves with intermediate viability. Revascularized patients showed early improvement in survival vs. medically treated patients which was sustained to the end of follow up

Two-year cardiac mortality was 13.3% (2/15) in medically treated patients and 53.8% (7/13) in revascularized patients (p = 0.042). Long-term survival was not significantly different in the revascularized and medically treated groups (p = 0.253) (Fig. 3). For the total duration of follow-up cardiac mortality was 60% (9/15) in medically treated patients and 89.6% (11/13) in revascularized subjects (p = 0.221).

Discussion

In this study, the magnitude and extent of viability as determined by low dose wall motion score identified those who did and did not have improvement of short and/or long-term survival with CABG.

Survival in patients with extensive viability

CABG provided no early improvement of survival in patients with extensive viability and moderate baseline LV dysfunction (mean EF 37%). The reason for the lack of improved survival at 2 years in revascularized patients is uncertain. Two year cardiac mortality was relatively high (12.5%) in this group. The lack of an early benefit with CABG in patients with LV dysfunction has been attributed to increased perioperative mortality [15]. The absence of a survival advantage of CABG at 56 months of follow-up in the STCH trial was attributed to perioperative and increased early mortality of CABG patients compared to those treated medically [16, 17]. In our study there was only one perioperative death in those with extensive viability.

In contrast to the short-term results, long-term cardiac mortality was reduced by 43% in those who had CABG with the survival advantage continuing to increase well beyond 5 years of follow-up (Fig. 1). The markedly improved long-term survival of revascularized patients (approximately 80% at 7 years) may be credited to the extensive amount of normal myocardium in this group (Table 2).

Survival in patients with intermediate viability

Patients with intermediate viability and severe baseline dysfunction (EF 27%), had early improvement in survival with revascularization. In spite of severe baseline dysfunction, there was only one perioperative death in patients who had CABG. The two-year cardiac mortality of medically treated patients in this group was 38% which was similar to the 16% annual mortality of medically treated patients in the meta-analysis of Allman, et al. The high early mortality of medically treated patients with viability and severe dysfunction has been attributed to ischemic events including an increased risk of sudden arrhythmic death [18]. The survival advantage of CABG continued to increase beyond 5 years. Improvement of long-term survival in revascularized patients with severe LV dysfunction may be partially attributed to improvement of ejection

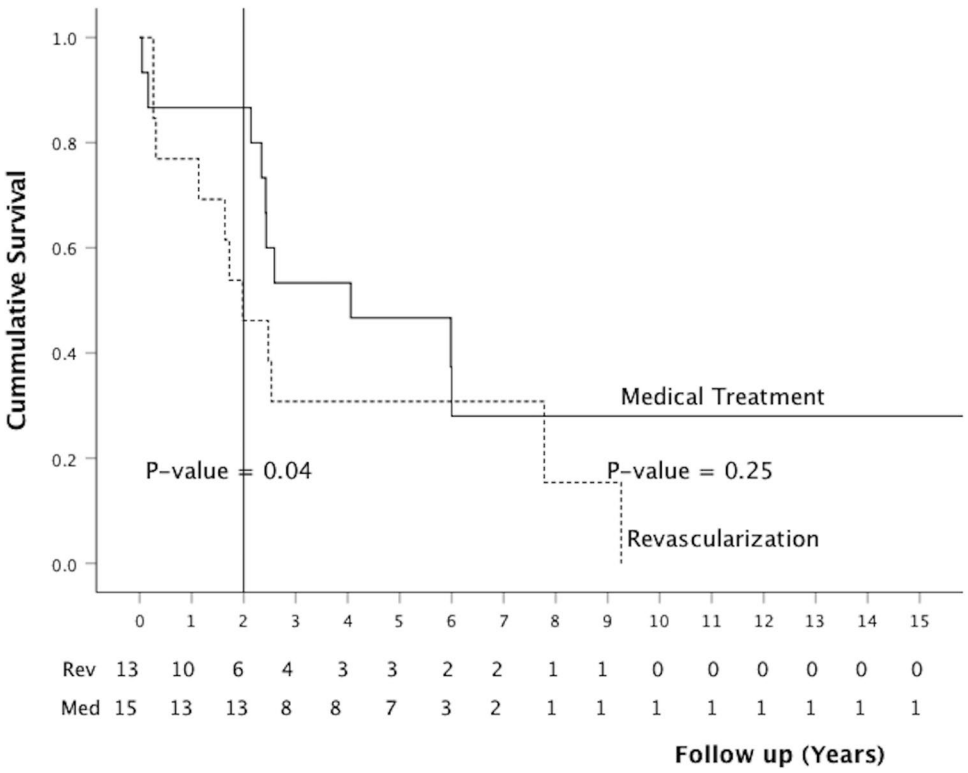

Fig. 3 Survival curves with limited viability. Revascularized patients had worse short-term survival compared to medically treated patients. However, by the end of follow up, survival was not significantly different in revascularized and medically treated patients

fraction from functional recovery of hibernating and stunned myocardium [19].

Survival in patients with limited viability

In our study, patients with limited viability had worse two-year survival with revascularization compared to medical therapy although there were no perioperative deaths in this group. Shortly after two years, the survival curves converged and there was no difference in survival between the two treatment groups. In the meta-analysis of Allman, et al., revascularized and medically treated patients without viability had comparable two- year mortality (7.7 and 6.2%) suggesting that revascularization has no adverse effect on the prognoses of patients without viability. In our study, two-year cardiac mortality in CABG patients was over 50% in those with limited viability.

The lack of an apparent harmful effect of revascularization has led some to suggest that revascularization should be considered in all patients regardless of the presence or extent of viable myocardium [20]. However, the beneficial or harmful effect of revascularization in patients without significant viability has not been adequately tested in those with very severe LV dysfunction. The average EF of the 24 studies included in Allman's meta-analysis was 32%. Additionally, cohorts categorized as "nonviable" in prior studies have been identified as such based on the absence of ischemia or contractile reserve rather than on the total amount of viable or nonviable tissue. As a result, few studies have enrolled patients with extensive nonviable myocardium. In our study, patients with limited viability had severe baseline systolic dysfunction (mean EF 21%), very small proportions of myocardium with normal contraction at rest (average of 9% of the LV) and very large proportions (average of 50% of the LV) of nonviable myocardium (Table 2). Patients with limited viability based on low dose score had a similar extent of contractile reserve, and ischemia to the groups assigned with extensive and intermediate amounts of viability suggesting that prognosis in patients with very severe LV dysfunction may primarily depend on the extent of nonviable myocardium. Using cardiac magnetic resonance imaging (MRI), Kwon et al. showed that in patients with severe ischemic LV dysfunction (mean EF 24%), increasing scar burden was associated with increased mortality [14]. An increasing extent of nonviable myocardium has also been associated with increased survival benefit from defibrillator implantation [21].

Viability assessment using wall motion score versus contractile reserve in a fixed number of segments

The STICH trial defined the presence of significant viability as ≥ 5 segments with contractile reserve based on the results of some previous studies showing that contractile reserve in 4 to 5 segments (≥ 25% of the LV) was associated with ≥ 5% improvement in ejection fraction and improved short-term outcome with revascularization [4–7]. The limitations of a binary classification of patients as having "viability" or "nonviability" based on a fixed number of segments with contractile reserve was pointed out by Dr Robert Bonow in a 2002 editorial. He noted that binary grouping, "oversimplifies the complex, inter-related continua of severity of LV dysfunction, extent and severity of inducible ischemia and magnitude of dysfunctional but viable myocardium" [8].

The limitations of a 5 segment definition of viability was shown by Meluzin et al., who correlated the number of segments exhibiting contractile reserve with the degree of improvement in EF and outcome in revascularized patients [22]. In patients with 2 to 5 viable segments, revascularization improved EF by an average of 6% (34 to 40%), but the rate of cardiac events after revascularization was similar to those with < 2 viable segments. In contrast, in patients with ≥ 6 viable segments, mean EF improved from 35 to 47% and cardiac events were significantly lower than in the other two groups. Other studies have shown that contractile reserve in 4 or 5 segments and a small revascularization related increase in EF of 5% are not associated with improved outcome. Joshi et al. showed that contractile reserve in 25% of segments did not predict EF improvement or outcome after revascularization. This study did show that ≥ 8% improvement in EF with revascularization was an independent predictor of long-term survival. The 8% threshold was considered significant improvement in function on the basis of being twice the mean inter-observer difference (3.7%) in EF measurement. Another investigation has shown a strong linear correlation (r = 0.91) between the number of segments with contractile reserve and post-revascularization improvement in EF suggesting that the degree of functional recovery and presumably outcome could be better assessed using a more continuous measure of viability [23].

In our study, patients were designated as having extensive, intermediate, and limited viability based on low dose wall motion score. Short and long-term outcomes and the survival benefit of revascularization versus medical therapy differed markedly among the three groups even though there was no significant difference in the percentage of dysfunctional myocardium with contractile reserve among the 3 groups. Our results suggest that classification of patients as having viability or nonviability based on a fixed proportion of myocardium with contractile reserve may be a suboptimal measure of viability for assessment of prognosis compared to low dose wall motion score. For example, a patient with extensive viability by low dose score could be classified as "nonviable" in the presence of a modest sized area of scar, and extensive normal myocardium but with less than 4 or 5 dysfunctional segments that augment with dobutamine.

Conversely, a patient with limited viability by low dose score could be classified as "viable" based on 4 or 5 dysfunctional segments with augmentation in spite of > 50% of myocardium with scar and minimal normal myocardium. It is likely that outcome with or without revascularization would be worse in the second patient with "viability" based on contractile reserve in 4 or 5 segments but limited viability by low dose score. Thus, low dose wall motion score appears to be a measure of viability that better reflects the relative contributions of normal myocardium, dysfunctional myocardium with contractile reserve, and nonviable myocardium with no contractile function to outcome. In those with extensive and intermediate amounts of viable myocardium by low dose score, outcome is impacted by the large extent of normal myocardium along with the contractile response of dysfunctional myocardium. In those with limited viability by low dose score, outcome may be primarily driven by presence of extensive scar which would not be accounted for by the definition of viability used in the STICH trial. Our results are in agreement with previously published studies showing that assessment of global function using wall motion score or ejection fraction with dobutamine enables identification of those who exhibit functional recovery and improved prognosis with revascularization [10–13, 19].

Limitations of the current study and the STICH trial

The number of patients in the three viability subgroups were relatively small especially in the cohort with limited viability. The comparative survival results between revascularized and medically treated patients should be considered in this context. Our investigation has limitations including the retrospective nature of the study with no randomization of therapy. However, there were no significant differences in clinical and echocardiographic variables between groups except that the frequency of hyperlipidemia and multivessel disease was higher in the revascularized group. The frequency of ACEI (60%) and beta-blocker (40%) use in our study would be considered suboptimal compared to medical therapy employed in the STICH trial. However, the frequency of ACEI and beta-blocker use in our study was very similar to CMS survey data acquired between the years 1995 to 2005, with 58% of heart failure patients receiving an angiotensin-converting enzyme (ACE) inhibitor or angiotensin receptor blocker (ARB) and 37% receiving a beta-blocker [24, 25]. We expect that the substandard use of ACEI and beta-blockers in our study would not have significantly affected the results comparing survival between the two treatment groups since both groups had comparable use of these medications at the time of enrollment. However, changes in medical and device therapy over the long duration of follow-up could have impacted our study results if one group was treated more intensively than the other. The high frequency of triple vessel disease (80% overall) in our population may have contributed to poorer outcomes in those who were not revascularized. In contrast to our study, approximately 60% of patients enrolled in STICH had triple vessel disease [16, 26].

In addition to the definition of viability used in STICH, this randomized trial had some other limitations. These included; the selective use of viability studies, cross-over of 17% of medically treated patients to CABG and 6% to percutaneous revascularization, lack of revascularization in 9% of subjects randomized to CABG, inability to verify baseline EF by quantitative criteria in 27%, and the finding of EF > 35% in 19% of subjects who had quantitation of function by the echo core lab [27]. As previously noted, the proportion of patients with three vessel disease was less than what might be expected in a population of patients with LV dysfunction who were felt to be better served by CABG than percutaneous intervention.

Clinical implications

The results of our study suggest that assessment of viability using wall motion score as a measure of global contractility during low dose dobutamine infusion appears to provide useful short and long-term prognostic information in patients with ischemic LV dysfunction who are candidates for CABG. Magnetic resonance imaging with assessment of myocardium with delayed enhancement and positron emission tomography with assessment of myocardium with fluorodeoxyglucose uptake are popular methods for viability assessment. However, these methods cannot be utilized in patients confined to the ICU. In contrast, echocardiographic assessment of global function during low dose dobutamine infusion can be readily performed in the ICU providing rapid information on the extent of viability.

Compliance with ethical standards

Conflict of interest The authors have no conflicts of interest to disclose.

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