



# Extent of Coronary and Myocardial Disease and Benefit From Surgical Revascularization in LV Dysfunction

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## ABSTRACT

**BACKGROUND** Patients with ischemic left ventricular dysfunction have higher operative risk with coronary artery bypass graft surgery (CABG). However, those whose early risk is surpassed by subsequent survival benefit have not been identified.

**OBJECTIVES** This study sought to examine the impact of anatomic variables associated with poor prognosis on the effect of CABG in ischemic cardiomyopathy.

**METHODS** All 1,212 patients in the STICH (Surgical Treatment of IsChemic Heart failure) surgical revascularization trial were included. Patients had coronary artery disease (CAD) and ejection fraction (EF) of  $\leq 35\%$  and were randomized to receive CABG plus medical therapy or optimal medical therapy (OMT) alone. This study focused on 3 prognostic factors: presence of 3-vessel CAD, EF below the median (27%), and end-systolic volume index (ESVI) above the median (79 ml/m<sup>2</sup>). Patients were categorized as having 0 to 1 or 2 to 3 of these factors.

**RESULTS** Patients with 2 to 3 prognostic factors (n = 636) had reduced mortality with CABG compared with those who received OMT (hazard ratio [HR]: 0.71; 95% confidence interval [CI]: 0.56 to 0.89; p = 0.004); CABG had no such effect in patients with 0 to 1 factor (HR: 1.08; 95% CI: 0.81 to 1.44; p = 0.591). There was a significant interaction between the number of factors and the effect of CABG on mortality (p = 0.022). Although 30-day risk with CABG was higher, a net beneficial effect of CABG relative to OMT was observed at >2 years in patients with 2 to 3 factors (HR: 0.53; 95% CI: 0.37 to 0.75; p < 0.001) but not in those with 0 to 1 factor (HR: 0.88; 95% CI: 0.59 to 1.31; p = 0.535).

**CONCLUSIONS** Patients with more advanced ischemic cardiomyopathy receive greater benefit from CABG. This supports the indication for surgical revascularization in patients with more extensive CAD and worse myocardial dysfunction and remodeling. (Comparison of Surgical and Medical Treatment for Congestive Heart Failure and Coronary Artery Disease [STICH]; [NCT00023595](https://clinicaltrials.gov/ct2/show/study/NCT00023595)) (J Am Coll Cardiol 2014;64:553-61) © 2014 by the American College of Cardiology Foundation.

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**ABBREVIATIONS  
AND ACRONYMS****CABG** = coronary artery bypass graft surgery**CAD** = coronary artery disease**EF** = ejection fraction**ESVI** = end-systolic volume index**LV** = left ventricular**NHLBI** = National Heart, Lung, and Blood Institute**OMT** = optimal medical therapy**PCI** = percutaneous coronary interventions

Unlike any other form of left ventricular (LV) dysfunction, patients with ischemic cardiomyopathy have the potential to improve their prognosis with revascularization. Recent randomized controlled trials have shown that revascularization with coronary artery bypass graft (CABG) surgery is superior to that with percutaneous coronary interventions (PCI) in patients with multivessel coronary artery disease (CAD) (1,2). However, the decision to pursue CABG is usually difficult in ischemic cardiomyopathy patients, particularly because the presence and severity of LV dysfunction impose a higher operative risk (3,4). The STICH (Surgical Treatment of IsChemic Heart failure) trial recently tested the hypothesis that surgical revascularization with CABG improves the survival of patients with ischemic LV dysfunction compared with that of patients receiving optimal medical therapy (OMT) without revascularization (5). During a median follow-up of 56 months, STICH demonstrated a trend toward better survival with CABG that did not reach statistical significance ( $p = 0.12$ ) (5). Importantly, the treatment effect of CABG over medical therapy occurred in a clear time-dependent pattern, with an early (within 30 days) increased hazard related to the operative mortality and a late ( $\geq 2$  years) survival benefit (Fig. 1).

SEE PAGE 562

Several previous studies have shown that among patients with CAD, the number of vessels with angiographically detected stenoses, the LV ejection fraction (EF), and the LV end-systolic volume index (ESVI) are associated with prognosis (3,4,6-12). However, how these variables should be incorporated into the decision regarding revascularization in patients with ischemic cardiomyopathy is unclear. Hazard ratio (HR) analyses of pre-determined subgroups in STICH did not identify any variable with a statistically significant interaction with treatment allocation (see Fig. 3 Velazquez et al. [5]) and the lack of statistical significance for the primary endpoint in STICH has led to the concept that the indication for surgical revascularization in ischemic cardiomyopathy can be safely deferred until medical therapy fails or the

patient becomes unstable (13,14). However, previous analyses did not address whether the time-dependent survival relationship between the 2 treatment arms varies according to baseline risk.

Accordingly, the purpose of this study was to examine the impact of key anatomic variables used in routine clinical practice and known to be associated with prognosis on the time-dependent hazard of CABG relative to that of OMT in patients enrolled in the surgical revascularization hypothesis of the STICH trial. We hypothesized that this analysis could lead to the recognition of a group of patients whose early surgical risk is rapidly surpassed by subsequent survival benefit and in whom, therefore, the indication for CABG is more clearly supported.

**METHODS**

**STUDY POPULATION.** STICH was a prospective, multicenter, nonblinded, randomized trial sponsored by the National Heart, Lung, and Blood Institute (NHLBI) that recruited 2,136 patients with CAD and LV EF of  $\leq 35\%$  between 2002 and 2007. The trial was designed to address 2 primary hypotheses: 1) that CABG combined with OMT improved survival compared with OMT alone (surgical revascularization hypothesis); and 2) that surgical ventricular reconstruction added to CABG improved survival free of cardiovascular hospitalization compared with CABG alone in patients with significant anterior wall akinesis (surgical ventricular reconstruction hypothesis). The trial design and results of the 2 primary hypotheses have been reported previously (5,15,16). For the purpose of this study, only the 1,212 patients included in the surgical revascularization arm were considered.

All patients had angiographic documentation of CAD that favored a diagnosis of CABG and EF of  $\leq 35\%$ . Patients with left main coronary stenosis of  $>50\%$ , cardiogenic shock, myocardial infarction within 3 previous months, or who demonstrated a need for aortic valve surgery were excluded. Patients were randomly assigned to receive CABG with medical therapy or medical therapy alone. PCI was not considered among the revascularization strategies in the STICH protocol. According to the original design of the trial (15), PCI during follow-up was regarded as downstream medical care associated with either

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