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Are two internal thoracic artery grafts as safe as one? Experience from Green Lane Hospital

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Abstract

Aim To compare short-term mortality and major morbidity between patients undergoing elective primary isolated CABG with bilateral internal thoracic artery (BITA) or single internal thoracic artery (SITA) grafts at Green Lane Hospital (Auckland, New Zealand).

Methods We conducted a retrospective study of short-term outcomes in 5955 patients receiving SITA and 637 patients receiving BITA grafts between 1990 and 2004. Only patients undergoing elective primary isolated coronary artery surgery were included. The primary outcome was a composite end-point (early death, perioperative MI, reoperation for sternal wound complications or significantly prolonged hospital stay). Patients receiving BITA grafts were case-matched with patients receiving SITA grafts for confounding factors and comparison was made between perioperative outcomes in the two groups.

Results After case-matching, no statistically significant difference was found in the incidence of our primary endpoint between patients receiving BITA versus SITA grafts [odds ratio 0.84 (95% CI 0.59, 1.21)]. Furthermore, there was no difference in rates of reoperation for sternal wound complications between the two groups [odds ratio 1.00 (95% CI 0.29, 3.44)].

Conclusions Given the potential long-term clinical advantages of BITA grafting, our results support the increased use of BITA grafts in selected patients.

The value of coronary artery bypass graft (CABG) surgery in the treatment of coronary artery disease has been well established over the last 50 years, but few randomised trials have been conducted concerning any of the variations in this type of surgery.[1] The currently accepted standard (using a single internal thoracic artery graft for the left anterior descending artery with supplemental vein grafts for bypassing lesions in other vessels) is based on evidence derived from large observational studies rather than randomised controlled trials.[2,3] While this strategy provides excellent short to medium-term results, its long-term success is limited by progressive vein graft failure.[3]

There have been no randomised trials comparing SITA to BITA grafts. However, several large observational studies have compared the two techniques. Lytle et al conducted a retrospective, non-randomised, long-term (mean follow-up interval of 10 postoperative years) study of patients undergoing elective primary isolated coronary artery bypass surgery who received either single (8123 patients) or bilateral ITA grafts (2001 patients), with or without additional vein grafts.[1]

Various statistical methods (including propensity matching) were used to address the issues of patient selection and heterogeneity. The study showed better survival (84% vs 79% at 10 years, p <0.001) and reoperation rates (1% vs 3%, p <0.01) for BITA grafting. Kurlansky et al have recently published their retrospective 30-year follow-up experience with 4584 patients receiving BITA (2215 patients) or SITA (2369 patients) grafts.[4] They demonstrated a long-term survival benefit in propensity matched groups receiving BITA grafts (p=0.001).

Early studies regarding the safety of BITA grafting suggested an increased perioperative risk in patients offered BITA grafts.[5] The major concern was the risk of sternal wound infection, particularly in obese, diabetic females of advanced age.[5-7] More recent studies have disputed this, suggesting no increased risk with BITA grafting in diabetic patients.[8] However, many surgeons continue to reserve BITA grafting for patients with low surgical risk. According to the Society of Thoracic Surgeons (STS) National Adult Cardiac Surgery Database, only 4% of CABG operations in the USA involve BITA grafts.[9]

The objective of this study on primary isolated coronary artery bypass surgery was to compare short-term mortality and major morbidity between patients undergoing primary CABG with BITA or SITA grafts at our institution.

Methods

This was a retrospective observational study. Ethics approval was provided by the Northern Ethics Regional Committee.

Table 1. Outcomes assessed and included in our composite endpoint

Early death (30-day mortality)	Mortality within 30 days of operation, either in hospital or after discharge
Perioperative myocardial infarction	AST ≥100 mmol/L on first day post-op[10]
Reoperation for sternal wound complications	Reoperation in same admission for sternal wound complications (mediastinitis or dehiscence)
Significantly prolonged hospital stay	Hospital stay longer than the mean by at least two standard deviations

We identified all 8004 patients who underwent coronary artery bypass graft surgery involving either single or bilateral internal thoracic artery grafts (with or without additional vein / radial artery grafts) by the Green Lane Cardiothoracic Surgical Unit between 1990 and 2004. 1412 patients who had emergency surgery, concurrent valvular surgery or redo-cardiac surgery were excluded from the study. We made no distinction in our analyses between patients who received pedicled or skeletonized grafts.

Data were collected from the Green Lane Cardiothoracic Surgical Database (which records patient information based on hospital records, catheterization, echocardiography and operative reports, including follow up information following discharge regarding mortality and readmission to hospital within the first 30 days of operation).

Patients receiving BITA grafts (637 patients) were case-matched with patients of similar surgical risk receiving SITA grafts (total 5955 patients). Patients were matched for major risk factors known to significantly affect surgical risk and the risk of mediastinitis[11] in particular (see Table 2). To avoid confounding due to operator selection bias, experience of the operating surgeon was also matched. Conditional logistic regression models were used to estimate the odds ratios for different outcome measures between patients receiving BITA grafts relative to patients receiving SITA grafts.

Table 2. Matching criteria

Variable	Definition
Demographics	
Gender	
Age	<65 vs >65
Body surface area (m^2)	<1.81, 1.81-1.99, >1.99
Comorbidities	
Diabetes mellitus	Diabetes treated with oral hypoglycaemics / insulin OR recorded diagnosis of diabetes in patient's notes
Hypertension	Hypertension requiring treatment OR recorded diagnosis of hypertension in patient's notes
Cardiac morbidity	
Recent MI	Infarction within 6 weeks of operation
Symptomatic CHF	NYHA class III or IV
Surgeon	
Surgeon's experience	Less experienced BITA surgeons: case mix including < 10% BITA grafts

Results

We found 6592 patients who met our inclusion criteria, 637 with BITA grafts and 5955 with SITA grafts. After case-matching, the groups for further analysis were well balanced (Table 3):

Table 3. Baseline data

Patient characteristics	BITA (N=637)	SITA (N=637)
Age, mean (SD)	56 (10.1)	59 (8.7)
Male, n (%)	528 (83)	528 (83)
Body surface area, mean (SD)	1.93 (0.188)	1.93 (0.192)
Diabetes, n (%)	181 (28)	181 (28)
Hypertension, n (%)	276 (43)	301 (47)
Myocardial infarction within 6 weeks of operation, n (%)	524 (82)	524 (82)
NYHA class III or IV, n (%)	36 (6)	33 (5)

There was no significant difference in our composite primary endpoint between patients receiving BITA grafts and those receiving SITA grafts [odds ratio 0.84 (95% CI 0.59, 1.21)], nor in any of the component outcomes (Table 4).

Table 4. Outcome data

Outcomes	BITA n=637 N (%)	SITA n=637 N (%)	Odds Ratio (95% CI)
Early death (1)	6 (0.9)	9 (1.4)	0.66 (0.24, 1.87)*
Perioperative MI (2)	41 (6.4)	52 (8.2)	0.76 (0.50, 1.17)*
Reoperation for sternal wound complication (3)	5 (0.8)	5 (0.8)	1.00 (0.29, 3.44)*
Significantly prolonged hospital stay (4)	17 (2.7)	12 (1.9)	1.41 (0.67, 2.99)*
Adverse clinical event (1+2+3+4)	62 (9.7)	72 (11.3)	0.84 (0.59, 1.21)*

*all p-values > 0.1.

Discussion

In our patients, there was no statistically significant difference in the risk of death or in specified major morbidities in the short-term between patients receiving BITA versus SITA grafts [odds ratio 0.84 (95% CI 0.59, 1.21)]. In particular, there was no difference in rates of reoperation for sternal wound complications [odds ratio 1.00 (0.29, 3.44)].

Our findings are consistent with published data regarding the perioperative risks of BITA grafting. The systemic review conducted by *Taggart et al.*[12] revealed an operative mortality with BITA grafting of 1%-2%, which was no higher than the operative mortality associated with SITA grafting.

Other studies have shown that risks of sternal wound complications are minimal in the absence of factors which increase the risk of sternal wound morbidity (diabetes, morbid obesity, female gender, respiratory impairment).[11,13-14]

Although our study did not distinguish between pedicled and skeletonized techniques of ITA harvesting, there is evidence that harvesting of the ITA using the skeletonized rather than pedicled technique further diminishes the risk of sternal wound complications.[15]

Our study's primary limitation is that it is retrospective, with the inherent potential for selection bias. This is also a limitation of previous research on the topic, including the large observational study conducted by Lytle et al.[1] No prospective randomized controlled trials comparing the clinical outcomes of BITA to SITA grafting have yet been published.

The Arterial Resvascularization Trial (ART) is a large randomized controlled trial designed to provide a definitive comparison of the two techniques that has recently completed recruitment of patients.[16] However, 10-year follow up data from this study will be available only in 2017 (the authors of the ART trial have stated an aim to publish preliminary 5-year data in 2012).

Evidence-based medicine implies making clinical decisions for each patient on the basis of the best evidence currently available, and until the results of ART become available surgical decisions regarding BITA versus SITA grafting will necessarily be informed by observational evidence alone.[17] Our data demonstrate that surgeons in

our unit have been able to utilise BITA grafts in selected patients without increased risk of perioperative adverse outcomes, including sternal wound complications. Given the suspected long-term clinical benefit of BITA grafting over SITA grafting, we would recommend increased utilization of BITA grafting in selected patients.

Competing interests: None declared.

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