

# Use of bilateral internal thoracic artery during coronary artery bypass graft surgery in Canada: The bilateral internal thoracic artery survey

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**Objective:** The internal thoracic artery is the gold standard conduit in coronary artery bypass grafting. Although the right and left internal thoracic arteries are excellent conduits, the use of the bilateral internal thoracic artery is not widespread. A recent report of the Society of Thoracic Surgery revealed that only a small percentage of patients receive a bilateral internal thoracic artery in North America. The aim of this study was to determine the current use of the bilateral internal thoracic artery during coronary artery bypass grafting among cardiac surgeons in Canada and identify the main concerns that limit the use of these conduits.

**Methods:** We developed an online survey with 17 questions about the use of the bilateral internal thoracic artery in different clinical scenarios. An invitation to participate was sent to all the adult cardiac surgeons currently in practice in Canada.

**Results:** A total of 101 surgeons (69%) of 147 currently in practice across 27 different hospitals completed the survey. Forty percent of surgeons use the bilateral internal thoracic artery only sometimes (6%–25% of cases), 37% of surgeons use the bilateral internal thoracic artery very infrequently (<5% cases), 16% of surgeons use the bilateral internal thoracic artery often (26%–50%), and only 7% of surgeons use the bilateral internal thoracic artery very often (>50%). The most common concerns in the use of the bilateral internal thoracic artery are the risk of sternal wound infection and the unknown superiority of the right internal thoracic artery over other conduits.

**Conclusions:** The majority of Canadian cardiac surgeons consider few clinical features, such as insulin-dependent diabetes mellitus or morbid obesity, as contraindications to the use of bilateral internal thoracic artery. However, the reported use of the bilateral internal thoracic artery is low. A wider diffusion of this technique is warranted to improve the results of coronary surgery. (*J Thorac Cardiovasc Surg* 2012;144:874-9)

The internal thoracic artery (ITA) is considered the gold standard conduit in coronary artery bypass grafting (CABG). The use of the left internal thoracic artery (LITA) to bypass the left anterior descending artery has been associated with improved survival at 10 years and a reduced incidence of myocardial infarction, cardiac events, and reoperation compared with the use of vein grafts alone.<sup>1,2</sup> Surgeons have proposed that the use of bilateral internal thoracic arteries (BITAs) would further improve the long-term outcomes of coronary revascularization. This hypothesis has been supported by recent clinical studies demonstrating improved survival and decreased reoperation with BITA grafting compared with single ITA

use.<sup>3-5</sup> Moreover, angiographic studies have revealed a long-term patency rate of the right ITA (RITA) to be equivalent to the LITA and superior to the radial artery and the saphenous vein grafts.<sup>6</sup> However, this strategy has not been universally accepted because of skepticism of the degree of the incremental benefit and the perceived increased risks of BITA grafting, such as sternal wound complications.<sup>7-10</sup> A recent analysis of the Society of Thoracic Surgeons Database revealed that BITA grafting is used in a small percentage of patients undergoing CABG in the United States.<sup>11</sup> In Great Britain, BITA use seems to be only slightly more common.<sup>12</sup>

We discuss the current use of BITA grafting among cardiac surgeons in Canada during CABG surgery and identify the main concerns and perceptions that limit the use of this strategy.

## MATERIAL AND METHODS

A questionnaire was developed to assess the use of BITAs during CABG among Canadian cardiac surgeons. The survey consisted of 17 questions relating to the use of BITAs in different clinical scenarios. Surgeons were asked to indicate how often they use BITAs and to identify concerns and limiting factors to a widespread use of these arterial conduits. The text of the questionnaire is available in the [Appendix](#).

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### Abbreviations and Acronyms

BITA	= bilateral internal thoracic artery
BMI	= body mass index
CABG	= coronary artery bypass graft
COPD	= chronic obstructive pulmonary disease
ITA	= internal thoracic artery
LITA	= left internal thoracic artery
RITA	= right internal thoracic artery

A list of all cardiac surgeons practicing in Canada was developed. The accuracy of the list was confirmed by cross-referencing it to online databases such as CTSNet, university and hospital websites, and e-mails to program directors and division chiefs. The final list consisted of 147 surgeons.

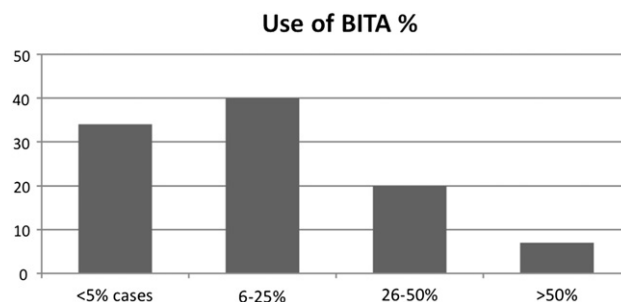
The survey was developed as an online tool in a user-friendly format. A link to the online survey was e-mailed to all practicing cardiac surgeons in Canada. Pediatric cardiac surgeons were excluded from the study. Each surgeon was assigned a unique log-in that allowed completing the survey only once. The survey was completed online through a secure Web page. Statistical analysis was performed using chi-square tests to compare frequencies of categorical variables.

### RESULTS

A total of 147 surgeons received the invitation to participate in our survey. To increase the response rate, surgeons who did not complete the survey within 1 month from the first e-mail were contacted again by e-mail, fax, or telephone. Eighty-five surgeons received a second invitation, 84 surgeons received a third invitation, 73 surgeons received a fourth invitation, and 69 surgeons received a fifth invitation. Thirty-eight surgeons were also contacted by phone 1 time, 24 surgeons were contacted by phone 2 times, 23 surgeons were contacted by phone 3 times, and 21 surgeons were contacted by phone 4 times. Finally, 101 surgeons (69%) of 147 adult cardiac surgeons currently in practice in Canada across 27 different cardiac surgery units completed the survey. Thirty-nine percent of respondents were in practice less than 10 years, 33% of respondents were in practice for 11 to 20 years, and 28% of respondents were in practice for more than 20 years.

The reported use of BITAs in isolated multivessel CABG operations is shown in Figure 1. There was no difference in the routine use of BITAs between young surgeons (in practice < 10 years, group A) and senior surgeons (in practice > 10 years, group B): Some 77% of group A use BITAs only sometimes or infrequently (infrequent users < 25% or < 5% of cases) versus 71% of group B, and 23% use BITAs often or very frequently (frequent users > 25% or > 50% of cases) in group A versus 29% of group B ( $P = .64$ ).

The single main factor influencing BITA use was the risk of sternal wound infection in 35% of surgeons, the limited length of the RITA in 28% of surgeons, the perceived lack of confidence of the superiority of the RITA over saphenous



**FIGURE 1.** Stratification of responding surgeons according to the percentage of cases in which they use BITAs. BITA, Bilateral internal thoracic artery.

vein or radial artery in terms of long-term outcome in 30% of surgeons, and increased operative time or bleeding in 6% of surgeons. The 2 groups of surgeons showed significantly different ( $P = .01$ ) main concerns to the use of BITAs (Table 1), with sternal wound infection the most common concern for group A, whereas the unknown long-term superiority of RITA over other conduits is most common in group B. However, there was a similar prevalence of main concerns to the use of these conduits between frequent and infrequent users of BITAs ( $P = .35$ ). The distribution of frequent users and infrequent users according to each hospital is shown in Figure 2.

We then presented a clinical scenario with a hypothetical patient undergoing CABG varying the clinical conditions to isolate perceptions related to specific patient variables as they related to BITA use. When asked about the age cutoff to BITA use, there was no statistically significant difference between frequent users and infrequent users for male patients but a trend toward the use of BITAs even in elderly patients among frequent users ( $P = .09$ ). There was no statistically significant difference for the age cutoff to the use of BITAs for female patients between infrequent and frequent users ( $P = .19$ ).

The majority (80%) of respondents did not consider active smoking a limiting factor for the use of BITAs. Half of the respondents did not consider diabetes a limiting factor, 29% of the respondents considered insulin-dependent diabetes a contraindication, and 21% of the respondents did not consider any form of diabetes a contraindication. A significantly higher proportion of frequent users (55%) did not consider diabetes a limitation to the use of BITAs compared with infrequent users (47%) ( $P < .05$ ). Furthermore, 60% of surgeons would not consider the use of BITAs in patients with a body mass index (BMI) more than 30, whereas 27% did not consider obesity a limiting factor. Among frequent users, 35% did not consider obesity a limiting factor, whereas 20% of infrequent users did; however, this difference was not statistically significant ( $P = .25$ ).

Ninety percent of surgeons would consider BITAs in the setting of a recent (<2 weeks) acute coronary syndrome, but

**TABLE 1. Prevalence of common concerns to bilateral internal thoracic artery use among young surgeons (<10 years in practice, group A) and senior surgeons (>10 years in practice, group B) (*P* = .01)**

Main concern	Group A n = 40	Group B n = 61
Sternal wound infection	51%	24%
Reduced length of RITA	23%	31%
Unknown superiority of RITA over other conduits	16%	40%
Operative time	10%	3%
Bleeding	0%	2%

48% would not consider the use of BITAs in presence of severe ejection fraction reduction (ejection fraction < 30%). In 45% of surgeons, the presence of ventricular dysfunction is not a contraindication to the use of BITAs.

In patients with chronic obstructive pulmonary disease (COPD), 44% consider this disease a contraindication to the use of BITAs if the forced expiratory volume in 1 second is less than 50% of the predicted value. In 21% of surgeons, any degree of COPD is a contraindication to the use of BITAs, whereas in 18% of surgeons, COPD is not considered a factor in this decision. In the presence of poor coronary targets, the surgeons are almost equally distributed between those who would use BITAs (47%) and those who would not (53%).

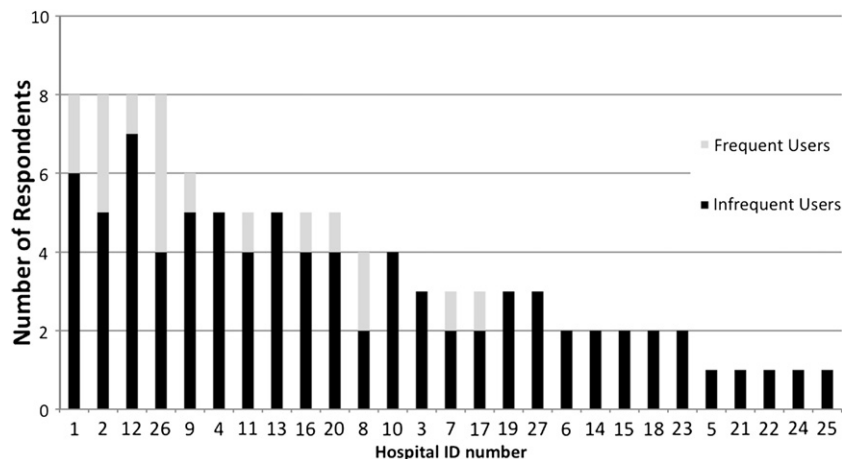
The final section of the survey addressed technical question regarding the use of BITAs. In patients with good coronary targets, the preferred target for the RITA is the left circumflex artery for 56% of respondents, the right coronary artery for 34% of respondents, and the left anterior descending for 10% of respondents. The technique of choice for BITA harvesting is non-skeletonized in 56% and skeletonized in 27% of respondents. Although skeletonization technique is more frequent among frequent users (37%)

than infrequent users (20%), the difference was not statistically significant (*P* = .28). The rationale that influences the technique of choice is a perceived reduced risk of injury to the ITA with the non-skeletonization for 33% of respondents, a perceived reduced risk of chest wall injury or infection with skeletonization for 15% of respondents, a perceived longer conduit length with skeletonization for 25% of respondents, and a perceived reduced operative time with non-skeletonization for 10% of respondents. Finally, in case of insufficient length of the RITA in situ to reach the coronary target, 89% of surgeons would use the RITA as a free or composite graft.

**DISCUSSION**

This survey was completed to delineate perceptions among Canadian cardiac surgeons that influence the use of BITAs. We demonstrated that although Canadian surgeons consider relatively infrequent clinical features as absolute contraindications to BITA use (eg, insulin-dependent diabetes mellitus, BMI > 30 or age > 70 years), the majority (76%) still report using BITAs in only a minority of cases (<25%).

There is strong clinical evidence that BITA use results in improved long-term outcomes. BITA use has been associated with lower 30-day mortality and a reduced incidence of death, reoperation, and coronary angioplasty at 10 and 15 years postoperatively compared with single ITA use.<sup>5,13,14</sup> This concept is further supported by the results of 2 recent meta-analyses<sup>15,16</sup> comprising 9 studies with more than 15,000 patients, both showing a significant improvement of survival for the BITA group compared with the single ITA. However, a recent analysis of the Society of Thoracic Surgeons' database revealed that in more than 541,000 patients undergoing operations in 745 hospitals across the United States between 2002 and 2005, only 4% of patients received BITA grafts.<sup>11</sup>



**FIGURE 2.** Distribution of frequent users and infrequent users according to hospital response.

Furthermore, even in very young patients (aged <50 years), less than 10% received BITA. In 54.6% of US hospitals participating in the database, BITA use was less than 2% and 11.4% of units did not use BITAs at all. Of note, there was no correlation between BITA use and hospital volume.

In contrast, the Sixth National Adult Cardiac Database Report of the Society for Cardiothoracic Surgery of Great Britain and Ireland revealed that in more than 114,300 isolated CABG operations, 15% of patients received 2 arterial grafts (not specifying if the second graft was the RITA or others).<sup>12</sup> We can argue that the percentage of BITA use is then also lower than this and that this percentage seems to have changed little since 2002. Patients who received 2 arterial grafts were more likely to be at low surgical risk: usually aged less than 65 years, mainly male, and with BMI less than 25, no diabetes, and good LV function. In the recent SYNTAX Trial, despite a mean age of 65 years and a study protocol encouraging the use of arterial grafts, only 22.7% of patients received BITA.<sup>17</sup>

The most common concerns among Canadian surgeons regarding the use of BITAs are the risk of sternal wound infection, the limited length of RITA, and the unknown superiority of RITA over other conduits. Younger surgeons are usually more concerned about the risk of sternal complications, whereas more experienced surgeons are more concerned about the results of RITA over other conduits, such as radial artery or saphenous vein.

Several studies have shown an increased risk of sternal wound infection with BITAs, especially in diabetic patients, with a relative risk of 3.2 times (BITA vs single ITA).<sup>18</sup> This increased risk has to be balanced in daily practice with the potential benefits of BITA, particularly in diabetic patients who show a reduced patency rate of vein grafts in the long term. The skeletonization technique, although technically more laborious, has been associated with a decreased risk of sternal complications, particularly in diabetic patients,<sup>7,19-22</sup> decreased chest wall pain, and improved sternal perfusion.<sup>23</sup>

In the current survey, it was demonstrated that the majority of surgeons would consider RITA as a free or composite graft. This strategy is consistent with the literature supporting the use of this conduit as a composite graft connected proximally to the LITA and distally to the left coronary system.<sup>24</sup>

Common objections to the use of BITA, such as active smoking, recent acute coronary syndrome, or COPD, are not considered absolute contraindications to the use of BITAs among the majority of surgeons. Furthermore, frequent users of BITA among Canadian surgeons seem to be also more “liberal” compared with the infrequent users in terms of their indications. Indeed, they usually report a higher cutoff for the use of BITAs in terms of age for both male and female patients, grade of obesity, type of diabetes, and class of ventricle. Despite this, frequent users

are usually more concerned about wound infection and thus more often harvest the BITA with the skeletonization technique.

Although the majority of surgeons would consider the use of BITAs aggressively, this perception is discordant with the current practice in North America whereby the use of BITAs remains restricted.

### Study Limitations

These data represent the results of a voluntary participation to an online questionnaire and are subject to a number of limitations. Answers were not verified for accuracy. Although every effort was made to maximize the response rate, 31% of Canadian cardiac surgeons did not participate in the survey. It is possible that the current practice of these surgeons could significantly differ from the surgeons who participated in the survey.

### CONCLUSIONS

Numerous studies have shown the benefit of BITAs in terms of long-term graft patency and patient survival. However, the use of BITAs still seems to be low among cardiac surgeons in Canada. The most common concern that limits the use of BITA is the risk of sternal wound infection. The risk of wound infection or other complications should be balanced with the long-term benefit of 2 arterial grafts. The perceptions reflected will serve as an excellent foundation to validate the equipoise of supporting a prospective trial assessing the value of BITA grafting during coronary surgery.

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## APPENDIX 1. Text of the online bilateral internal thoracic artery survey

Dear colleague,

We invite you to participate in a survey about the use of bilateral internal thoracic arteries (BITAs) during coronary surgery in Canada. The survey will take approximately 10 minutes to complete.

It is recognized that bypass of the left anterior descending artery with the left internal thoracic artery (LITA) is the key factor responsible for the survival advantage of coronary surgery compared with medical therapy and stenting. Many have advocated that concomitant use of the right internal thoracic artery (RITA) may further improve clinical outcomes. There are little data on the prevalence of BITA use among Canadian cardiac surgeons.

When answering the following questions and clinical scenarios, please assume the following: 1) elective or urgent (in-house – waitlist > 24 hours) cases with hemodynamic stability (non-emergency); 2) isolated coronary surgery

(no major concomitant procedures, eg, valve, aortic, aneurysm); 3) all possible conduits available (eg, no vein stripping, radial artery not previously cannulated); 4) ascending aorta nondiseased such that on pump surgery and traditional proximal anastomoses feasible

Question 1. How many years have you been in practice as a staff cardiac surgeon? A: <5 years, B: 6–10 years, C: 11–15 years, D: 16–20 years, E: >21–25 years, F: >25 years.

Question 2. In your opinion, which issue limits the use of BITA in current practice? Select all that apply. A: the risk of superficial/deep sternal wound infection; B: increased operative time; C: the limited length of RITA; D: unknown superiority of RITA over saphenous vein or radial artery in terms of long-term outcome.

Question 3. In your current practice, how often do you use both the left and right internal thoracic arteries (BITA) as conduits in isolated multivessel CABG? A: very frequently (>50% of cases); B: often (26%–50%); C: sometimes (6%–25%); D: very infrequently (<10%).

Question 4. In an otherwise healthy patient (nonsmoker, no diabetes, no obesity, normal left ventricular (LV) function, good coronary target), male gender, what age cutoff would you not use BITA? A: >50 years; B: >60 years; C: >70 years; D: >80 years; E: Age is not a limiting factor.

Question 5. In an otherwise healthy patient (nonsmoker, no diabetes, no obesity, normal LV function, good coronary target), female gender, what age cutoff would you not use BITA? A: >50 years; B: >60 years; C: >70 years; D: >80 years; E: Age is not a limiting factor.

Question 6. In your practice, do you consider active smoking (>0.5 packs/day) a contraindication to the use of BITA in a patient who would otherwise be a candidate regardless of age or other factors? A: Yes, I would not consider BITA; B: No, I would still consider BITA.

Question 7. In an otherwise healthy patient, young (aged < 50 years), nonsmoker, no obesity, normal LV function, good coronary targets, would diabetes be a limiting factor for the use of BITA? A: only insulin-dependent diabetes (IDDM); B: with orally treated diabetes (non-IDDM) or IDDM; C: any diabetes would be; D: Diabetes is not a limiting factor.

Question 8. In an otherwise healthy patient (young [aged < 50 years, nonsmoker, no obesity, normal LV function, good coronary targets), would diabetes be a limiting factor for the use of BITA? A: if the patient is overweight (BMI > 25); B: only if the patient is severely obese (BMI > 30); C: Obesity is not a limiting factor.

Question 9. In an otherwise healthy patient (young, nonsmoker, no diabetes, no obesity, normal LV function, good coronary targets) would a recent acute coronary syndrome (<2 weeks) as an isolated risk factor be a limiting factor for considering the use of BITA? A: Yes, I would not use BITA; B: No, I would still consider BITA.

Question 10. In an otherwise healthy patient (young, non-smoker, no diabetes, no obesity, good coronary targets), would LV dysfunction be a limiting factor for considering the use of BITA? A: always; B: only if ejection fraction (EF) is < 50%; C: only if EF is < 40%; D: only if EF is < 30%; E: LV dysfunction is not a limiting factor.

Question 11. In an otherwise healthy patient (young, no diabetes, no obesity, good coronary targets) is chronic obstructive pulmonary disease (COPD) a contraindication for the use of BITA? A: always; B: only if forced expiratory volume in 1 second (FEV<sub>1</sub>) is < 75% predicted; C: only if FEV<sub>1</sub> is < 50% predicted; D: COPD is not a limiting factor.

Question 12. In an otherwise healthy patient (young, nonsmoker, no diabetes, no obesity, normal LV), are poor coronary targets (small vessels, diffuse disease) a contraindication to the use of BITA? A: Yes, I would not use BITA; B: No, I would still consider BITA.

Question 13. In an otherwise healthy patient (young, non-smoker, no diabetes, no obesity, normal ventricle) with triple-vessel disease and good coronary targets, what is your preferred target for the RITA? A: right coronary artery; B: left circumflex artery; C: left anterior descending.

Question 14. Which is your preferred harvesting technique for BITA? A: non-skeletonized; B: skeletonized; C: 1 non-skeletonized, 1 skeletonized; D: other.

Question 15. What factors influence on your preferred harvesting technique? Select all that apply. A: increased length with skeletonized; B: reduced operative time with non-skeletonized; C: reduced infection with skeletonized; D: reduced chest wall injury with skeletonized; E: improved ITA flow with skeletonized; F: reduced ITA injury with non-skeletonized.

Question 16. If the length of the RITA in situ is not enough to reach the preferred target, would you use the RITA as a free graft or composite graft? A: Yes, I would use the RITA as a free graft; B: Yes, I would use the RITA as a composite graft; C: Yes, I would use the RITA as a free or composite graft; D: No, I would not use the RITA as a free or composite graft.

Question 17. In your practice, which is the most important issue that limits the use of BITA? Select only one. A: the risk of superficial/deep sternal wound infection; B: increased bleeding; C: increased operative time; D: unknown superiority of RITA over saphenous vein or radial artery in terms of long-term outcome; E: limited length of RITA.