



Original Article

Bilateral internal thoracic artery grafting in India—Time to raise the bar

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ABSTRACT

Objectives: Bilateral internal thoracic artery (BITA) grafting strategy is the current trend in coronary artery bypass grafting for multivessel coronary artery disease. Although better long-term outcomes have been shown, BITA grafting is underutilized as a main strategy for revascularization by most of the surgeons. The survey was conducted to ascertain the current usage and concerns of BITA grafting in India.

Methods: Database of 856 Indian cardiac surgeons currently with predominantly adult practice was prepared and a questionnaire was sent about use of single and bilateral ITA grafts and BITA grafting strategy in different clinical scenarios.

Results: A total of 112 surgeons (13.08%) from 75 institutions responded and 92 surgeons (10.7%) completed the survey. Single ITA is used by 79% of surgeons in more than 90% of their patients. 31% and 29% of surgeons use BITA grafting in 5–10% and 11–98% of their patients respectively. 53% of surgeons avoided the usage of BITA grafting in patients with smoking, 35% of surgeons in chronic obstructive pulmonary disease, 58% of surgeons in obesity and 62% of surgeons in acute coronary syndrome, 36% of surgeons in patients with left ventricular dysfunction and 61% of surgeons in patients with poor coronary anatomy. The concerns for BITA usage are risk of deep sternal wound infection (DSWI) (40%), increased operative time (27%), unknown superiority (12%) and limited length of right ITA (5%).

Conclusions: The usage of BITA grafting is restricted to 10% in India and main concerns are DSWI and increased operative time.

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1. Introduction

The objective of coronary artery bypass graft (CABG) surgery is to ameliorate the symptoms of patients with coronary artery disease and of long-term survival benefit.¹ The use of left internal thoracic artery (LITA) to bypass stenosed left anterior descending (LAD) coronary artery as a surgical strategy in patients undergoing coronary artery bypass grafting has demonstrated improved survival which may be due to the higher rates of long-term patency of LITA grafts.^{2–4} The evidence of improved survival from several observational studies is so convincing that over 95% of patients undergoing CABG in the United States and 90% of patients in United Kingdom receive at least one ITA graft.^{5,6} Although it has taken long time to prove the advantage of using two ITA grafts for coronary revascularization, currently there is mounting evidence supporting the survival benefit and major adverse cardiac event free survival of bilateral ITA (BITA) grafting over single ITA grafting

strategy.^{7–11} The angiographic patency rates of ITA grafts are superior to the patency rates of radial artery and saphenous vein grafts.¹² Despite the available outcome data on long-term survival of patients receiving ITA grafts, the use of two ITA grafts is not optimal and is about 5% in US 12% in Europe, 12.6% in Australia and about 30% in Japan.^{13,14} In a meta-analysis of 16,000 patients (11269 Single ITA vs 4693 Bilateral ITA) with a mean period of 10 years of follow up documented a significant survival benefit in patients receiving BITA grafts.¹⁵ Many large observational studies provided a consistent evidence that BITA grafting does not increase postoperative mortality and showed a significant survival advantage in several subsets of patients receiving BITA grafting.^{7,8,16–18} Several strategies are recommended to minimize sternal wound infections following BITA harvest technique¹⁹ and currently the rates of deep sternal wound infection are on decline with an incidence of 0.9% for skeletonized harvest technique,²⁰ 0.3–4.2% for pedicled^{21–23} and 0.6% for modified pedicled technique.²⁴ In a propensity match study the benefits of BITA increased at 12 years of follow up with a reference to the need for redo surgery is an approximately 40% in SITA and 8% in BITA groups.¹⁸ Interim analysis of outcomes of Arterial Revascularization Trial (ART) at 5 years follow up showed no significant difference between single

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ITA and bilateral ITA grafting with respect to mortality or the rates of cardiovascular events.²⁵

The unique features of coronary artery disease in Indians are young age at presentation, higher incidence of multi-vessel CAD, diffuse disease, distal disease and significant left ventricular (LV) dysfunction at presentation.^{26,27} Although a large number of coronary bypass surgical procedures are done, the national cardiac surgical database in India is still in its infancy. Hence, the present survey was conducted to know the trends and concerns in the BITA grafting, a promising strategy for long term palliation of multi-vessel coronary artery disease.

2. Methods

The period of the survey was from March 2015 through June 2015. The survey was designed with 23 questions to assess the use of BITA grafting strategy during CABG among cardiac surgeons in India. The cardiac surgeons with a predominantly adult practice were identified from the registry of Indian Association of Cardiovascular and Thoracic Surgeons (IACTS), CTS net, hospital websites, Indian Association Annual Meetings and continuous medical education programs (CMEs). The final list consisted of 856 surgeons who were predominantly operating on adult patients. An initial invitation to participate was sent to 856 surgeons comprising of 4 survey questions relating to the percentage of CABG procedures and usage of LITA and BITA grafting in their practice. A second invitation was sent to the respondents of an initial invitation comprising of 19 questions relating to the use of the BITA strategy in different clinical scenarios, to identify the preferred techniques of harvest, concerns and limiting factors to widespread use of ITA conduits. To increase the response rate we maintained a continuous contact with all surgeons through reminder emails, telephone calls and messages. We also contacted the respondents of second invitation comprising of 2 questions relating to the use of beating heart technique and whether off-pump technique is a deterrent for the usage of BITA grafting or not.

3. Statistical analysis

Analysis was done using Chi-square test. Based on the experience of the surgeons and frequency of usage of BITA grafting the survey questionnaires were analyzed to determine the influence on the usage of BITA grafting during CABG. All statistical analyses were performed using SAS version 9.2 (SAS institute, Cary, NC) software. A p value less than or equal to 0.05 was considered statistically significant.

4. Results

A total of 856 surgeons received an invitation to participate in the survey (Appendix A in Supplementary file). 112 surgeons out of 856 surgeons responded and received a second invitation (Appendix B in Supplementary file). Finally, a total of 92 surgeons from 75 hospitals had completed the survey. Out of 112 surgeons, 30.4% of respondents were in practice for less than 10 years and 69.6% of respondents were in practice for more than 10 years. Surgeons with less than or equal to 10 years of experience are considered as young surgeons (group A) and surgeons with more than 10 years of experience are considered as senior surgeons (group B). Surgeons using BITA grafting in $\leq 5\%$ of patients are taken as infrequent users (group C) and surgeons using BITA grafting in $>5\%$ of patients are taken as frequent users (group D) of BITA grafting.

4.1. Years of experience versus percentage of CABG procedures in the practice

The CABG procedures comprised of $>75\%$ of their practice in 48% of young surgeons and 54% of senior surgeons.

4.2. BITA and LITA usage

Thirty one percentage (31%) of surgeons use BITA strategy in 5–10% of their patients while 29% of surgeons use 11–98% of this strategy in their patients undergoing CABG (Fig. 1A). 79% of surgeons use single ITA in more than 90% of their patients (Fig. 1B).

4.3. Perceived preoperative factors that limit BITA usage

About 57% of the surgeons reported that 21–30% of patients undergoing CABG are under 59 years of age. 30% of surgeons reported 60 years is the cut off age and another 30% of respondents reported 70 years as cut off age for using the BITA grafting. 63% surgeons reported that more than 41% of patients undergoing CABG were diabetics in their practice. 37% of surgeons considered diabetes is not a limiting factor for use of BITA. The usage of BITA is limited by a few risk factors, such as current smoking (for 53% of surgeons), chronic obstructive pulmonary disease (COPD) (for 35%), obesity (BMI >30 kg/m²) (for 58%), recent acute coronary syndrome or myocardial infarction (for 62%), left ventricular ejection fraction less than 30% (36%) and poor coronary anatomy (for 61% of surgeons). Analysis of perceived preoperative factors: Young surgeons (group A) and senior surgeons (group B)

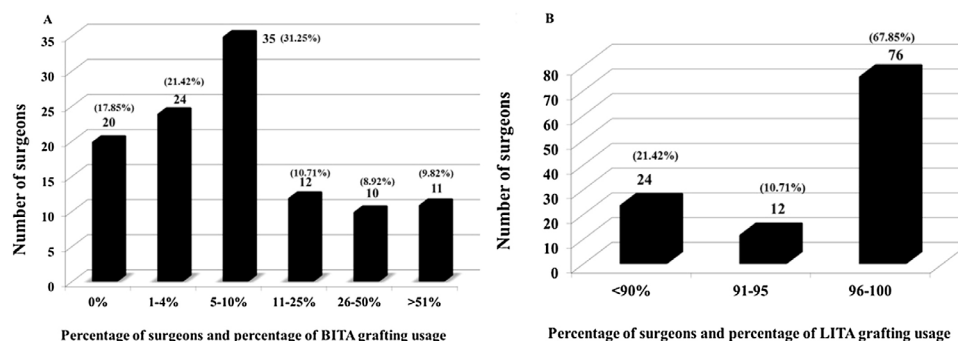


Fig. 1. (A) Percentage of BITA usage in India. BITA – bilateral internal thoracic artery. (B) Percentage of LITA usage in India. LITA – left internal thoracic artery.

considered advanced age (11.5% vs 30.3% $p=0.048$) and LV dysfunction (11.5% vs 24.2% $p=0.034$) as limiting factors for usage of BITA grafting (Table 1). Analysis of perceived preoperative factors among frequent and infrequent users of BITA strategy. There is a significant difference in the opinion between infrequent (group C) and frequent (group D) users of BITA grafting strategy with respect to smoking (72.1% vs 36.7%, $p=0.002$), COPD (14.0% vs 34.7% $p=0.035$) and obesity (11.6% vs 28.6% $p=0.041$) as limiting factors for the usage of BITA (Table 2).

4.4. Intraoperative strategies for BITA grafting

41% of surgeons preferred pedicled harvesting technique for BITA harvest. 52% of surgeons considered RCA as preferred target for RITA graft and 45% of surgeons use RITA graft either as a composite or as a free graft to reach the preferred target. Analysis of intraoperative strategies: No significant difference was observed in the choice of target for RITA graft, preferred technique for BITA harvesting and use of RITA as a free graft or composite graft between young and senior surgeons (Table 1).

Analysis of intraoperative strategies based on frequent or infrequent users of BITA grafting. Infrequent users considered RCA as the preferred target artery for RITA graft ($p=0.045$). No significant difference was observed between the two groups in the technique of harvesting of BITA and use of RITA as a free graft or composite graft (Table 2).

4.5. Concerns for BITA usage

40.2% of surgeons expressed the risk of sternal wound infection for BITA usage as a concern. The other concerns in the decreasing frequencies are increased intraoperative time (27.17%), unknown superiority of RITA (11.95%), limited length of RITA (5.43%) and increased bleeding (2.17%). Analysis of concerns: Increased operating time is a concern for usage of BITA among senior surgeons while risk of sternal wound infection is a concern among young surgeons. There is a significant difference regarding concerns between young and senior surgeons ($p=0.040$) (Table 1). For frequent users of BITA, the sternal wound infection and increased operative time is a concern while limited length of RITA is a common concern among infrequent users (Table 2). Off-pump technique has been evaluated as a possible deterrent for routine

application of BITA grafting strategy. 36 (39.13%) surgeons responded to the third questionnaire (Appendix C in Supplementary file) and 86% of the respondents did not feel off-pump technique is a deterrent for BITA usage.

5. Discussion

Based on this current survey 79% of surgeons use LITA in more than 90% of their patients which is in concurrence with the prevalence of LITA usage in USA and United Kingdom. In India 42% of surgeons use BITA strategy in 5–25% of their patients and less than 10% of surgeons use BITA strategy in more than 50% of their cases which is comparable to usage in Canada (42% and <10%).²⁸ According to this survey 30% of patients undergoing CABG are under 59 years of age and 41% of patients undergoing CABG are diabetics in India. Current smoking was considered as a limiting factor for BITA usage by 53% of surgeons in India which is comparatively higher than in the Canadian study where only 20% respondents considered smoking is a limiting factor.^{10,28} In contrast to the Canadian survey where 60% of surgeons did not consider obesity as a limiting factor, only 20% of our respondents did not consider obesity (BMI >30 kg/m²) as a limiting factor. Diabetes is not considered as a limiting factor for 40% of surgeons in India and 50% of the respondents in Canada. The application of BITA strategy in a setting of recent acute coronary syndrome is less frequently applied in India than in Canada (38% vs 90%). However COPD and low ejection fraction is considered a risk factor for use of BITA grafting in one third of surgeons in India. Catarino & colleagues conducted a survey on the use of BITA grafting strategy among UK cardiac surgeons who gave reasons for not performing BITA included in the order of declining frequency, learning curve, concern that morbidity may be higher, the procedure may take too long, mortality maybe higher and absence of proof of benefit.²⁹ The use of BITA grafting is low among surgeons in India due to concerns regarding the risk of sternal wound infection, increased operative time, the unknown superiority of RITA over other conduits and the limited length of RITA. The responses of Indian surgeons with those of Canadian and UK surgeons compared in Table 3. In India current usage of pedicled harvest is 41% and one pedicled and one skeletonized harvest is 36% and skeletonized harvest of both ITAs is 13%. RITA is used as an in situ graft (70%) or LITA and RITA 'Y' graft (25%). Even though risk of infection is as major issue for BITA usage,

Table 1
Prevalence of common limitations, differences in technical aspects and main concerns to BITA use among young surgeons (Group A; ≤ 10 yrs) and senior surgeons (Group B; >10 yrs).

Common limiting factors		Group A (26)	Group B (66)	P value
Age		23(88.5)	46(69.7)	0.048
LV dysfunction		23(88.5)	44(66.7)	0.034
Preferred target artery for the RITA graft	RCA	14(53.8)	26(39.4)	0.130
	LCx	7(26.9)	16(24.2)	
	LAD	4(15.4)	13(19.7)	
	Combined	0	9(13.6)	
	Not answered	1 (3.85)	2(3.03)	
Preferred harvest technique of BITA	Pedicled	9(34.6)	29(43.9)	0.610
	Skeletonized	3(11.5)	9(13.6)	
	Either	14(53.8)	28(42.4)	
Main concerns	Risk of infection	16(61.5)	19(28.8)	0.040
	Increased operative time	3(11.5)	21(31.8)	
	Limited length of RITA	3(11.5)	12(18.2)	
	Unknown superiority of RITA	1(3.8)	6(9.09)	
	Increased bleeding	0	2(3.0)	
	Combination of concerns	2 (7.7)	1(1.5)	
	Not answered	1 (3.8)	5 (7.7)	

BITA: bilateral internal thoracic artery, LV: left ventricle, RITA: right internal thoracic artery, RCA: right coronary artery, LCx: left circumflex artery, LAD: left anterior descending

Table 2Prevalence of common limitations, differences in technical aspects and concerns to BITA usage among infrequent users (Group C; $\leq 5\%$) and frequent users (Group D; $> 5\%$).

Common limiting factors		Group C (43)	Group D (49)	P value
Percentage of patients undergo CABG are < 59 yrs of age	$< 20\%$	0	4(8.2%)	0.025
	21–30%	22(51.2)	30(61.2)	
	$\geq 31\%$	21(48.8)	15(30.6)	
Smoking		12(27.9)	30(61.2)	0.002
COPD		36(83.7)	32(65.3)	0.035
Obesity		38(88.4)	35(71.4)	0.041
Preferred target artery for the RITA	RCA	23(53.5)	17(34.7)	0.045
	LCx	8(18.6)	15(30.6)	
	LAD	10(23.3)	7(14.3)	
	Combined	1(2.3)	8(16.3)	
	Not answered	1(2.3)	8(16.3)	
Preferred harvest technique of BITA	Pedicled	17(39.5)	21(42.9)	0.476
	Skeletonized	4(9.3)	8(16.3)	
	Either	22(51.2)	20(40.8)	
Major Concerns	Risk of infection	14(32.6)	21(42.9)	0.053
	Increased operative time	10(23.3)	14(28.5)	
	Limited length of RITA	11(25.6)	4(8.2)	
	Unknown superiority of RITA	5(11.6)	2(4.08)	
	Increased bleeding	0	2(4.08)	
	Combined	2(4.6)	1(2.04)	
	Not answered	1(2.3)	5(10.20)	

BITA: bilateral internal thoracic artery, CABG: coronary artery bypass surgery, COPD: chronic obstructive pulmonary disease, RCA: right coronary artery, LCx: left circumflex artery, LAD: left anterior descending, RITA: right internal thoracic artery

Table 3

Comparison of the responses of Indian survey with Canadian and UK surgeons.

Survey questions	India	Canada	UK
Survey conducted on	BITA usage	BITA usage	Multiple arterial grafting
Number of surgeons participated in the survey	92	147	142
Usage of BITA grafting strategy	31% of surgeons use BITA strategy in 5–10% of their cases	40% of surgeons use BITA strategy in 6–25% of their cases	85% of surgeons do not utilize more than one arterial graft
Preferred target for RITA graft	RCA – 45%	RCA – 34%	–
	LCx – 25%	LCx – 56%	
	LAD – 23%	LAD – 10%	
	RCA & LCx – 7%		
Technique of harvest	Skeletonized – 13%	Skeletonized – 27%	–
	Pedicled – 41%	Non skeletonized – 56%	
	1 pedicled 1 skeletonized – 36%		
Major concerns	Risk of infection	Sternal wound infection	Existence of learning curve
	Increased operative time	Reduced length of RITA	Perceived higher morbidity & mortality
	Limited length of RITA	Unknown superiority of RITA over other conduits	Increased operative time
	Unknown superiority of RITA	Operative time	
	Increased bleeding	Bleeding	

BITA: bilateral internal thoracic artery, RITA: right internal thoracic artery, RCA: right coronary artery, LCx: left circumflex artery, LAD: left anterior descending

91.3% of surgeons reported the incidence of DSWI in single ITA group to be $< 3\%$ where as 57.6% of surgeons reported the incidence of DSWI in BITA group to be $< 3\%$ (Fig. 2A & 2B).

Similar to the adult cardiac surgical database of the Society of Thoracic Surgeons (STS) and European Association for Cardio-Thoracic Surgery (EACTS) there is a necessity for developing a robust Indian National Database for adult cardiac surgery to assess the quality of care and to analyze the outcomes of cardiac surgical procedures, to know the trends in cardiac surgery.

6. Study limitations

These data represent the results of a voluntary participation to an online questionnaire and are subject to a number of limitations. Inherent to any survey there is a level of researcher imposition in

developing the questionnaire and making personal decisions and assumptions hence, other important information about the BITA grafting strategy may be missing in the survey. Answers were not verified for accuracy. Although effort was made to maximize the response rate, only 11% of Indian cardiac surgeons participated in the survey. It is possible that the current practice of these surgeons could significantly differ from the surgeons who did not participated in the survey.

7. Conclusions

Despite robust evidence of survival benefit and decreased incidence of major adverse cardiac events and a need for repeat revascularization after the adoption of BITA grafting strategy, the utilization of this technique is about 10% in India.

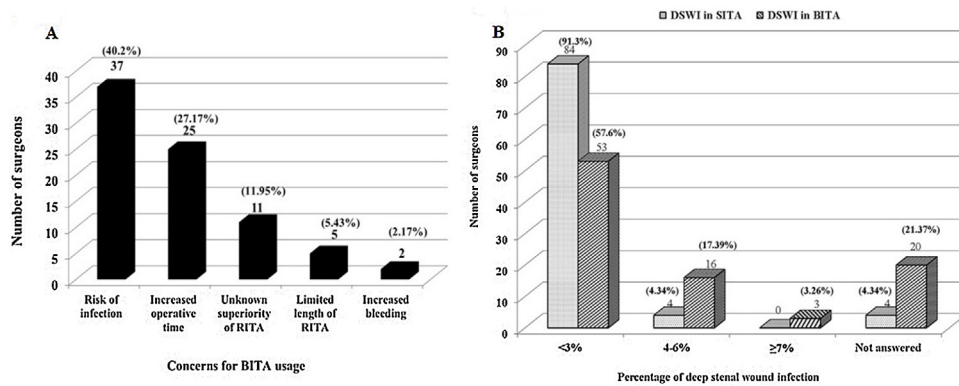


Fig. 2. (A) Concerns of BITA usage. BITA – Bilateral internal thoracic artery. RITA – Right internal thoracic artery. (B) Incidence of DSWI in SITA and BITA grafting strategies. DSWI – deep sternal wound infection. LITA – left internal thoracic artery. BITA – bilateral internal thoracic artery.

What is already known?

Best available data suggests that bilateral internal thoracic artery (BITA) grafting improves long-term survival after coronary artery bypass graft surgery and this strategy remains grossly underutilized worldwide.

What this study adds?

This survey reports the prevalence of BITA grafting strategy, concerns, harvesting techniques, graft configurations and incidence of deep sternal wound infection in Indian population.

Conflict of interest

None declared

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at <http://dx.doi.org/10.1016/j.ihj.2017.03.001>.

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