



Artículo de Revisión

Bilateral internal mammary artery grafting in South America

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ABSTRACT

Coronary artery bypass using bilateral internal thoracic artery (BITA) has been related to survival benefits in patients with coronary artery disease, but data is not conclusive. In South America, several centers reported their own experience with good results in survival, minimal postoperative cardiovascular events, and a low degree of mediastinal infection, however, the number of cases is low, and the absence of publications in several countries is a matter of concern. We review the leading publications on BITA grafting in our region, assessing how far we have advanced in coronary surgery.

Keywords: Internal Mammary-Coronary Artery Anastomosis; Cardiac Surgery; South America (source: MeSH NLM)

RESUMEN

Revascularización quirúrgica utilizando dos arterias torácicas internas en Sudamérica

La derivación de la arteria coronaria utilizando la arteria torácica interna bilateral se ha relacionado con beneficios de supervivencia en pacientes con enfermedad arterial coronaria, pero los datos no son concluyentes. En Sudamérica, varios centros reportaron su propia experiencia con buenos resultados en supervivencia, mínimos eventos cardiovasculares postoperatorios y un bajo grado de infección mediastínica, sin embargo, el número de casos es bajo y la ausencia de publicaciones en varios países es preocupante. Revisamos las principales publicaciones sobre el injerto de arteria torácica interna bilateral en nuestra región, evaluando cuánto hemos avanzado en la cirugía coronaria.

Palabras clave: Anastomosis Interna Mamario-Coronaria; Cirugía Cardíaca; América del Sur (fuente: DeCS Bireme)

Introduction

Coronary artery bypass using multiple arterial grafts has been hypothesized to improve outcomes compared with venous grafts ⁽¹⁾. Several studies have supported this concept with favorable results throughout history ⁽²⁾.

In 1986, Loop ⁽³⁾ published a landmark study demonstrating the superiority of the left internal thoracic artery (LITA) anastomosis to the left anterior descending artery (LAD) versus saphenous vein grafts (SVG). The primary outcomes were reduction in mortality, postoperative major adverse events, and the need for subsequent revascularization. This finding made the LITA-LAD anastomosis “the cornerstone of coronary surgery.” Nowadays, it is a quality standard in every coronary surgery program.

In 1999, Lytle ⁽⁴⁾ published the first long observational study using bilateral internal thoracic artery (BITA), evidencing survival benefits and lower need for reintervention than the single internal thoracic artery (ITA) grafting patients. The ART trial ⁽⁵⁾, the only randomized protocol that confronted single versus bilateral ITA grafting, was published in 2019. This study found no benefit in adding a second ITA conduit in CABG, but this conclusion was not robust secondary to methodological bias. However, subsequent analysis of the ART data and other observational studies shows mortality reduction in patients favoring BITA ^(6,7).

Despite the growing evidence favoring this strategy, many surgeons worldwide still avoid its utilization because of not well-funded factors (technical complexity, fear of subsequent mediastinal infection, co-morbid status, elderly, Etc.), leaving patients without the maximal benefit of CABG surgery.

This review described the principal papers published from South American countries on BITA utilization, giving a perspective of our regional experience in modern CABG and the use of arterial conduits.

Methods

We did our research in Pub Med, BIREME, and SciELO databases. The terms employed were (“bilateral”[All Fields] OR “bilaterally”[All Fields] OR “bilaterals”[All Fields]) AND (“mammary arteries”[MeSH Terms] OR (“mammary”[All Fields] AND “arteries”[All Fields]) OR “mammary arteries”[All Fields] OR (“internal”[All Fields] AND “mammary”[All Fields] AND “artery”[All Fields]) OR “internal mammary artery”[All Fields]). We include all the results from Latin America in Spanish, English, or Portuguese in the last 20 years.

Results

Peru

Bracamonte ⁽⁸⁾ *et al.* published excellent results of BITA grafting in 2001. They showed the surgical results in 50 consecutive patients. Thirty-day mortality was 0%. Two patients were submitted to redo surgery for bleeding (4.5%), 01 patient had a myocardial infarction (2.2%), and no patient had mediastinitis. The nine-year follow-up of 42 patients (84%) showed survival of 100% without cardiologic events in 92.8% of operated patients. Complete revascularization was achieved in 48 patients (98%). The average number of distal anastomosis per patient was 4.3, from which it can be deduced that part of the revascularization was completed with veins.

In 2018, Ríos ⁽⁹⁾ *et al.* published the short-term results in CABG with BITA in The National Cardiovascular Institute, EsSalud. A retrospective study was conducted on CABG surgeries with BITA from January 2012 to December 2015. In 36 patients (diabetes 33%), the 30-day mortality was 0%, major cardiovascular events occurred in 5.56% of patients (Stroke 0%, postoperative myocardial infarction 5.56%, need of new coronary intervention 0%). The incidence of mediastinitis or sternal reconstruction was 0%. Superficial wound infection was observed in 7 patients, with no significant difference between diabetics and non-diabetics (25% vs. 16.66%, OR = 3.3, $p = 0.88$), or between patients with or without overweight (19.23% vs. 20%, respectively, OR = 0.95; 95% CI, $p = 0.68$). Twelve patients (33%) were submitted to complete myocardial revascularization with BITA. The group concluded that CABG surgery with BITA is a safe procedure, with low mortality rates and major cardiovascular events in the short term. The same group published in 2020 the results of a 30-month follow-up using BITA for CABG ⁽¹⁰⁾. 121 patients (26% with diabetes) were operated with BITA; 59 patients (48.8%) were submitted to total myocardial revascularization with BITA (radial artery graft was also grafted in 17 patients). All patients underwent dissection of ITA with a skeletonized technique. Most of the CABG surgeries were performed using the AMID as a free graft and then anastomosed to the AMII, thus creating an “inverted Y” compound graft. There was one in-hospital death due to mediastinitis. Major adverse cardiovascular events occurred in 5.8% of patients (death 0.8%, stroke 0%, perioperative myocardial infarction 1.6%, need for new coronary intervention 3.3%). The incidence of mediastinitis or sternal reconstruction was 0.8%.

Chile

Seguel ⁽¹¹⁾ *et al.* in 2012 published a paper where they described the technique using only BITA grafts for complete myocardial revascularization. They supported that using the BITA grafts will

reduce mortality and major adverse events. In the same paper, they mention that 35 patients had already been treated with this technique in the Cardiovascular Center of Grant Bevaente, with no mortality, stroke or mediastinitis.

In 2015, the same group published their experience using the BITA "Y" configuration technique for total myocardial revascularization in short-term outcomes⁽¹²⁾. The prospective study included patients treated between December 2010 and May 2014. 67 patients were treated with an average of 3.8 anastomosis/patient. All cases had complete revascularization using BITA grafts. There was no surgical mortality nor reoperations for bleeding. Patients have been followed for an average of 39.2 ± 12.1 months. Four patients died, and 2 needed coronary angiography because of symptoms. Four years after publishing their first experience using the BITA "Y" configuration technique, the same group published their experience at 5 years, being this the first national case series in the country⁽¹³⁾. Their goal was to describe the operative results, survival, and major adverse events at 5 years. Their cohort consists of 73 cases between December 2010 and April 2017; the follow-up period was completed until June 2018 (media of 64.6 months/patient). Their operative results demonstrate a median of $3,75 \pm 0,6$ total bypass/patient; the median of mechanical ventilation was $1,4 \pm 5,3$ hours. The bleeding rate between the first 24 hours was $671,4 \pm 309$ ml, 11 patients (15.9%) required blood cell transfusion. There were 8 medical and 7 surgical complications, 1 patient (1,5%) died because of mediastinitis. The overall survival rate at 5 years was 90.4% (9 patients died in the follow-up period). Their major adverse events rate was zero (defined as acute myocardial infarct, stroke, or reintervention).

Argentina

One of the first mentions in this country of revascularization using BITA was made for Weinschelbaum⁽¹⁴⁾ *et al.* in 2000. They presented 4 years of follow-up results of 1023 patients treated with total arterial revascularization, where BITA was used in 225 patients (22%). No reports of conduit failure or major cardiovascular complications were described in BITA cases.

Navia and colleagues from the Cardiovascular Institute of Buenos Aires had several studies on off-pump CABG with the utilization of BITA: In 2008, they made a retrospective review of 569 patients with multivessel disease who underwent off-pump CABG using BITA as exclusive conduits⁽¹⁵⁾. The principal configuration of grafts deployment was a T shape, with sequential anastomosis to circumflex and posterior descending coronary artery. Thirty-day mortality was 0.88%, and the cumulative patient survival at 4 years was 93.3%. The composite of major complications (preoperative myocardial infraction, redo bleeding, stroke, low cardiac output)

was observed in 4.92%. Complete revascularization was achieved in 100% of patients, with an average of 3.18 distal anastomoses per patient.

In 2014, they reported a propensity score-matched follow-up study comparing the performance of the radial artery as a second conduit versus the right internal thoracic artery⁽¹⁶⁾. At 7 years of follow-up, postoperative survival was 88% in the BITA group and 83% in the LITA-RA group; however, it did not reach statistical significance (long-rank: $p = 0.65$). In the same period of follow up, post-operative reintervention/readmission-free survival at 7 years was superior in patients receiving BITA than RA (97% vs. 81%, long-rank: $p = 0.31$), as well the composite of mortality plus reintervention/readmission (80% vs. 66%, long-rank: $p = 0.38$). Another technical aspect was that completeness of arterial revascularization was higher in the BITA group than in the RITA-RA, with a mean number of anastomoses of 3.0.

In 2016, they compared long-term survival using BITA in T configuration vs. single internal thoracic artery (SITA) grafting in patients with multivessel disease⁽¹⁷⁾. Among 22 years, 2098 patients had BITA as exclusive grafts, and 1659 had SITA plus another type of conduits. In the BITA group, patients evidenced reduced unadjusted mortality at 30 days (1.2% versus 4.4% in SITA group; $p < 0.00001$). The 10 years unadjusted survival was superior in the BITA group ($82.6\% \pm 1.8\%$ versus $76.1\% \pm 1.3\%$ in the SITA groups) and was maintained in the propensity-score-adjusted analysis (BITA $81\% \pm 4.1\%$ versus SITA, $71.8\% \pm 2.5\%$; $p = 0.039$).

Vranic⁽¹⁸⁾ *et al.* in 2017 performed a case-control study to assess the risk of developing mediastinitis in patients with BITA vs. SITA grafting. 2533 patients were included, and a propensity-matched score was also calculated in 520 patients. Most of the patients treated with BITA had off-pump coronary surgery and "T" graft configuration of BITA. In the non-matched results, in-hospital mortality was 40 patients (1.6%), 11 developed stroke (0.4%), and 47 (1.9%) had a mediastinal infection. The adjusted analysis showed no difference between the risk of mediastinitis in both groups ($p = 0.18$).

In 2019, the same group published a retrospective review of their database to assess if sex was a risk factor affecting survival in BITA patients⁽¹⁹⁾. They realize a Cox proportional hazard model to investigate predictors of late mortality in 2979 patients who are underweight to BITA CABG. They observed that women had similar 10-year survival compared with men.

The latest study reported from this group in 2020 was a propensity score-matched study to compare survival in patients aged 70 years or greater who underweight BITA vs. SITA grafting⁽²⁰⁾. 1300 patients were analyzed, 968 in BITA

group versus 322 in SITA group. They found higher mortality in the SITA (32.5%) group compared with BITA (14.8%) in the propensity score-matched analysis ($p < 0.001$) at 10 years. No differences were evidenced in postoperative morbidity.

Brazil

The oldest article found is one published by Marcelo B. Jatene⁽²¹⁾, who did a review with satisfactory results of 442 cases recruited between 1984 and 1989 at the Heart Institute of the Hospital de las Clínicas of the University of Sao Paulo; the mean age was 52.7 years, and 90% were male, 30 of them had saphenectomized or had invalidated the use of the saphenous vein, 32 had already undergone previous myocardial revascularization. 819 in situ ITA grafts were used, 440 with the LITA and 379 with the RITA; 65 free grafts were used, 63 being from the RITA and two from the LITA, 5 patients received sequential grafts with the ITA, the mean was 3.17 grafts per patient. Regarding the harvesting technique, the article only mentions opening the pleurae; 5% of the operations were emergencies. Hospital mortality was 4.9% and was more related to older age and previous ventricular dysfunction, the leading causes of death were multiorgan failure and myocardial failure. Among the specific complications of the procedure, the most relevant were pulmonary atelectasis (5.6%), pleural effusion (4.5%), acute myocardial infarction (3.6%), reoperation due to postoperative bleeding (1.3%), and infection of the sternum in 9 patients (2.0%). They were not related to any death. These results, compared with international results of the time, are very similar in terms of increased mortality. They justify it because there were patients with high surgical risk factors, such as older age and low function, which compared with their patients without these risk factors demonstrated significantly lower mortality. The author proposes to improve mortality by the possible use of two ITA in these patients, as for the patency of the ITA grafts, he reports more than 90% for the LITA in a follow-up of 2 to 60 months and almost 70% for the RITA; Regarding the complications related to the technique, the degree of sternal infection was twice as high compared to its global statistic, possibly related to the devascularization of the sternum when using both ITA. However, it should be mentioned that the article did not specify whether the ITA were dissected skeletally or not. The history of diabetes in the patients was not evaluated. In summary, this presentation is a good review of cases with the use of two ITA grafts, revealing good patency and the need to identify the patients who would benefit most from the use of BITA grafts according to risk factors. It is important to indicate that although the study does not specify, it is understood that all the surgeries were performed with extracorporeal circulation because the technique without extracorporeal circulation is a technique that has only been implemented in the last 20 years.

Martins⁽²²⁾ *et al.* published in 2007 a paper that compares results from two groups: diabetic patients undergoing myocardial revascularization using BITA and non-diabetic patients undergoing myocardial revascularization surgery using BITA. Between January 1995 and August 2005, he recruited 700 patients divided into two groups, DM carriers (group I, with 148 patients) and non-DM carriers (group II, 552 patients). The selection of patients was based on the anatomical characteristics of the coronary arteries (good distal coronary beds) and quality of the sternum during its cut (sternum without osteoporosis) in the intraoperative; When both factors were considered favorable, both ITA were dissected, regardless of whether the patient is a carrier of DM or not. During the dissection of the arterial grafts, care is taken to keep the pleural cavities closed; the anastomoses were performed with intermittent clamping of the aorta. Although diabetic patients had a higher incidence of congestive heart failure with a significant difference in terms of functional class and left ventricular contractility dysfunction; there was slight variation between patient groups concerning morbidity and mortality; regarding surgical wound infection, despite presenting more in diabetic patients, there was no significant difference between the two groups; thus recommended in patients with DM the use of both MI arteries, with little increased risk when their application is adequately indicated. In the discussion, he recommends using skeletonized dissection to harvest the ITA and the use of continuous intravenous insulin to reduce the risk of infection and dehiscence of the sternum, despite not specifying whether these recommendations were followed in cases where studied.

Leão *et al.*⁽²³⁾ published a paper in 2014, where they analyzed the experience of 4 cardiovascular surgery centers IMIP ($n = 13$), RHP ($n = 14$), UNICORDIS ($n = 2$), and UNIMED ($n = 1$) about CABG with the use of a double ITA; carried out a descriptive cross-sectional study, with a sample of 30 patients who underwent myocardial revascularization with the use of a BITA, between August 2013 and July 2014. Of the individuals studied, 86.7% were male. The mean age was 60.5, 16% had a left coronary artery lesion and had the most frequent comorbidities hypertension (90%), dyslipidemia (70%), diabetes (33%), smoking (23%); About 97% of the surgeries were performed with the use of extracorporeal circulation, in 8 cases the non-skeletonized or pedicled ITA was dissected, and 5 of these were diabetic. Only one had any complications (renal failure). At least one postoperative complication occurred in 13 patients (43.3%), with no deaths in the hospital period, the most frequent complications were mechanical ventilation for more than 24 hours (10%), pneumothorax (7%), and respiratory infection (6.7%), only one patient had a sternal wound infection, and he was not diabetic. They concluded that the use of BITA in revascularization proved to be a safe and effective technique, even in patients considered at risk, such as people with diabetes. However, due to the small

number of patients evaluated, this study deserves to be repeated in larger samples.

Discussion

The pioneer publication of BITA in South America was done in Brazil for Jatene ⁽²¹⁾ in 1990. He reported a significant number of cases superior to Lyle ⁽⁴⁾ publication in the 80s with good results. Both studies preferred the in-situ configuration of revascularization, probably because it is more feasible to realize due to low technical complexity. Most groups in several countries, except Argentina, have started BITA grafting, adopting this “friendly” configuration.

It’s well known that the preoccupation of performing prolonged patency to the LAD territory and the question about if RITA is safe to LAD have been motives of debate. Current evidence supports similar patency rates of LITA versus RITA to LAD ⁽²⁴⁾ anastomosis supporting the in-situ configuration,

where sometimes RITA is anastomosed to LAD because LITA is more prone to reach the non-LAD territories. A randomized trial realized by Glineur ⁽²⁵⁾ compared in-situ LITA-LAD plus RITA non-LAD configuration versus LITA-LAD plus Y configuration for RITA to non-LAD territories. No significant differences in-hospital mortality or morbidity or in late survival, myocardial infarction, or stroke was found between groups, but more need for repeat revascularization occurred in the in-situ group. A possible explanation for these results could be the feasibility of performing complete revascularization that is more prone to occur in composite grafts where free RITA can reach more territories ⁽²⁶⁾.

Another primary concern about arterial revascularization is its underutilization. In a recent publication, Zhu *et al.* ⁽⁶⁾ evidence a 2.1% of BITA development in patients underweight to surgical revascularization in the US in the latest years. As evidenced in our research, only five countries have been reported to use BITA in a few cases in the past 30 years (see table 1). Most of the time, they analyze a single registry for publications. A precise determination of BITA use is far away from assessment because lack of data.

Table 1. Principal studies of BIMA in South America.

Author (Country, year)	Poblacion (age range)	Type of surgery	Grafts configuration: n(%)	Short-term results in BITA: n(%)	Follow up (n), surviellence
Bracamonte (Perú, 2001)	50 patients (41 -71 years)	On pump	In Situ: LITA - LAD + RITA - RC: 15 (30%) RITA - LAD + LIMA - Dg/Mg: 7 (14%) RITA ass free graft: LITA - LAD + RITA - Dg/Mg: 23 (46%) LITA - LAD + RITA - PD: 5 (10%)	Intraoperative Mortality: 0 (0%) Perioperative myocardial infraction: 1 (2.2%) Stroke: 1 (2.2%) Need for revascularization in 30 days: 0 (0%) Mediastinal infection: 0 (0%) Superficial wound infection: 3 (6%)	9 years (42): Globar surviellence 100%.
Rios (Perú, 2018)	36 patients (47 - 65 years)	On pump	Composite “Y” graft: LITA - LAD + RITA - Mg: 13 (36.1%) LITA - LAD + RITA - Dg: 2 (5.6%) BIMA In Situ: LITA - LAD + RITA - RC: 3 (8.3%) RITA - LAD + LITA - Mg: 18 (50%)	Intraoperative Mortality: 0 (0%) Perioperative myocardial infraction: 2 (5.5%) Stroke: 0 (0%) Need for revascularization in 30 days: 0 (0%) Mediastinal infection: 0 (0%) Superficial wound infection: 7 (20%)	30 days (36): Globar surviellence 100%.
Castillo (Perú, 2020)	121 patients (49 - 67 years)	On pump	Composite “Y” graft: LITA - LAD + RITA - Mg: 45 (37.2%) LITA - LAD + RITA - Dg: 27 (22.3%) BIMA In Situ: LITA - LAD + RITA - RC: 11 (9%) RITA - LAD + LITA - Mg: 38 (31.4%)	Intraoperative Mortality: 0 (0%) Perioperative myocardial infraction: 2 (1.6%) Stroke: 0 (0%) Need for revascularization in 30 days: 4 (3.3%) Mediastinal infection: 1 (0.8%) Superficial wound infection: 9 (7.4%)	2.5 years (121): Globar surviellence 99.2%
Seguel (Chile, 2015)	67 pacients (50 - 66 years)	On pump	Composite “Y” graft: LITA - Dg - LAD (secuential) + RITA - Mg - PD (secuential)	Intraoperative Mortality: 0 (0%) Perioperative myocardial infraction: 1 (1.5%) Stroke: 0 (0%) Need for revascularization in 30 days: 0 (0%) Mediastinal infection: 0 (0%) Superficial wound infection: 5 (7.4%)	5 years (73): Globar surviellence 90.4%
Jatene (Brasil, 1990)	442 pacients (30 - 78 years)	On pump	In situ: LITA - LAD + RITA - Cx, Mg, Dg: 232 (52.4%) LITA - LAD + RITA - RC, PD, PV: 135 (30.5%) RITA ass a free graft: 65 (14.7%) LITA - Mg + RITA - LAD, Dg: 48 (10.8%) Miscellany: 27 (6.1%)	Intraoperative Mortality: 22 (4.97%) Perioperative myocardial infraction: 16 (3.7%) Stroke: 12 (2.7%) Mediastinitis: 15 (3.3%)	4.8 years (442): Globar surviellence 94.3%

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(Continuation)

Author (Country, year)	Poblation (age range)	Type of surgery	Grafts configuration: n(%)	Short-term results in BITA: n(%)	Follow up (n), surviellence
Giublin (Brasil, 1996)	60 pacients (36 - 76 years)	On pump	In situ: LITA - LAD + RITA - Mg, Dg: 13 (21.7%) LITA - LAD + RITA - RC: 5 (8.3%) RITA - LAD + LITA - Mg, Dg: 36 (60%) LITA - Mg + RITA - Dg: 3 (5%) Miscellany: 3 (5%)	Intraoperative Mortality: 0 (%) Perioperative myocardial infraction: 1 (1.7%) Stroke: 0 (0%) Need for revascularization in 30 days: 0 (0%) Mediastinal infection: 1 (1.7%) Superficial wound infection: 5 (7.4%)	30 days (60): Global surviellence 95%.
Martins (Brasil, 2007)	700 patients (52 - 72 years) 148 with diabetes 552 with out diabetes	On pump	No description of the technique. RITA for the lateral wall.	Intraoperative Mortality: 3 (2%) DM vs 2 (0.7%) without DM (p = 0.9) patients. In hospital complications of DM vs non-DM patients: Hemostasis redo surgery: 3 (2%) vs 9 (1.6%) Reoperation for sternal stabilization: 2 (1.4%) vs 5 (0.9%)	-
Milan (Brasil, 2007)	70 pacients (38 - 75 years) with diabetes	Off pump	In situ: LITA as a pedicle: LITA: LAD (16, 45.7%), Cx (13, 37.1%), Dg (6, 17.1%) RITA: LAD (18, 51.4%), Mg (8, 22.8%), Dg (1, 2.8%), RC (8, 22.8%) LITA skeletonized: LITA: LAD (25, 71.4%), Mg (9, 25.7%), Dg (1, 2.8%) RITA: LAD (9, 25.7%), Mg (13, 37.1%), Dg (1, 2.8%), RC (12, 34.2%)	Mediastinal infection: AMI as a pedicle: 3 AMI skeletonized: 0	-
Leão (Brasil, 2014)	30 pacients (31 - 75 years)	On pump	No description of the technique: LITA: Mg (14, 46.7%), LAD (10, 33.3%), Cx (5, 16.7%) RITA: LAD (20, 66.7%), Dg (6, 20%)	Intraoperative Mortality: 0 (%) Perioperative myocardial infraction: 0 (0%) Stroke: 2 (6.6%) Need for revascularization in 30 days: 0 (0%) Mediastinal infection: 0 (0%) Superficial wound infection: 1 (3.3%)	-
Navia (Argentina, 2008)	569 pacients (55 - 73 years)	Off pump	Composite "T" graft: LITA - LAD + RITA - Mg y DP (most of the cases)	Intraoperative Mortality 0 (%) 30 days mortality: 5 (0.88%) Perioperative myocardial infraction: 7 (1.23%) Stroke: 4 (0.7%) Need for revascularization in 30 days: 0 (0%) Mediastinal infection: 10 (1.76%)	4 years (544): Global surviellence 93.3%.
Navia (Argentina, 2016)	2098 pacients (54 - 72 years)	Off pump	Composite "T" graft: LITA - LAD + RITA - Mg y DP (most of the cases)	30 days mortality: (1.2%) Perioperative myocardial infraction: (1.0%) Stroke: (0.5%) Mediastinal infection: (1.9%)	10 years (1963): Global surviellence 82.6%.
Vranic (Argentina, 2017)	2533 BITA vs 585 + SITA patients 520 propensity score matched	Off pump	Composite "T" graft: LITA - LAD + RITA - Mg y DP (most of the cases)	Unadjusted: In hospital mortality: 40 (1.6%) Stroke: 11 (0.4%) Mediastinal infection: 47 (1.9%) Propensity score matched: Mediastinal infection: No difference between groups (p = 0.18)	-
Vranic (Argentina, 2019)	2979 BITA patients (55 - 75 years) 229 women 2680 men	Off pump	Composite "T" graft: LITA - LAD + RITA - Mg y DP (most of the cases)	Unadjusted: In hospital mortality: 36 (1.2%) Stroke: 12 (0.4%) Mediastinal infection: 40 (1.5%)	Long-term adjusted by sex at 5.1 years: Equivalent survival in women than men (p = 0.784).
Navia (Argentina, 2020)	1300 pacients (71 - 79 years) 968 BITA 332 SITA	Off pump	Composite "T" graft: LITA - LAD + RITA - Mg y DP (most of the cases)	Unadjusted: In hospital mortality: 15 (4.3%) SITA vs 22 (2.3%) BITA; p < 0.001. Stroke: 4 (1.2%) SITA vs 3 (0.3) BITA Mediastinal infection: 4 (1.2) SITA vs 20 (2.1%) BITA Perioperative myocardial infraction: 9 (2.7%) SITA vs 6 (0.6%) BITA propensity score matched: (243 patients) In hospital mortality: 10 (4.3%) SITA vs 7 (2.9%) BITA; p = 0.06. Stroke: 2 (0.8%) SITA vs 0 (0.0%) BITA Mediastinal infection: 3 (1.2) SITA vs 6 (2.4%) BITA Perioperative myocardial infraction: 3 (1.2%) SITA vs 2 (0.8%) BITA	10 years (1263): Mortality in unadjusted patients: 103 (20%) SITA vs 149 (15.7%) BITA; p < 0.001. Mortality in propensity scored matched patients: 82 (35.2%) SITA vs 35 (14.8%) BITA; p < 0.001.

LAD: Left anterior descending artery. LITA: Left internal thoracic artery. RITA: Right internal thoracic artery. Mg: Marginal. Dg: Diagonal. Cx: Circumflex. PD: Posterior descending. BITA: Bilateral internal thoracic artery. SITA: Single internal thoracic artery.

Nowadays, several studies support the use of multiple arterial grafts⁽²⁷⁾, and the no reports of its deployment in our region must be a motive of alarm.

When we examine surveillance in patients to South American reports, we evidence good results like other studies around the world^(2,3,6). Four studies evidence a mid-term survivor superior to 90%^(10,11,15,21), and at long-term follow-up, three studies reported over 80% surveillance^(8,17,20). It's interesting to note the study of Navia *et al.*⁽²⁰⁾ where patients who went to BITA revascularization were over 70 years, evidencing a significant benefit in surveillance. This group of patients sometimes assume that they do not qualify for BITA grafting.

Mediastinal complications, a high motive of resistance to this surgery, have been decreased over time. Utilizing the skeletonized LITA harvesting technique was demonstrated to preserve a better degree of sternal circulation with more minor cases of deep wound infections. Most of the studies that we

evaluate obtain a skeletonized LIMA with low rates of mediastinal infection (below 1.5% of cases). Navia⁽²⁰⁾ reported a single study where a high trend of mediastinitis was found in patients older than 70 years, but these results were not statistical significative.

In conclusion, besides good results reported in our regional data, the utilization of BITA grafting has low reports. We want to assume that is secondary to the low grade of publications, especially in the surgical group. However, it may also reflex a low quantity of multi arterial coronary surgery development. We have a long road to equilibrate our countries to the requirement of actual evidence and what our patients require of us.

Author's contribution

PR: Data recompilation, assessment, redaction, discussion elaboration, final review.

JS, RZ, JR: Data recompilation, assessment, redaction.

References

- Torregrossa G, Amabile A, Williams EE, Fonceva A, Hosseinian L, Balkhy HH. Multi-arterial and total-arterial coronary revascularization: Past, present, and future perspective. *J Card Surg.* 2020;35(5):1072-1081. doi:10.1111/jocs.14537.
- Rocha RV, Tam DY, Karkhanis R, Nedadur R, Fang J, Gaudino M, *et al.* Multiple arterial grafting is associated with better outcomes for coronary artery bypass grafting patients. *Circulation.* 2018;138(19):2081-2090. doi:10.1161/CIRCULATIONAHA.118.034464.
- Loop FD, Lytle BW, Cosgrove DM, Stewart RW, Goormastic M, Williams GW, *et al.* Influence of the internal-mammary-artery graft on 10-year survival and other cardiac events. *N Engl J Med.* 1986;314(1):1-6. doi:10.1056/NEJM198601023140101.
- Lytle BW, Cosgrove DM, Saltus GL, Taylor PC, Loop FD. Multivessel coronary revascularization without saphenous vein: long-term results of bilateral internal mammary artery grafting. *Ann Thorac Surg.* 1983;36(5):540-547. doi:10.1016/s0003-4975(10)60684-4.
- Taggart DP, Benedetto U, Gerry S, Altman DG, Gray AM, Lees B, *et al.* Bilateral versus single internal-thoracic-artery grafts at 10 years. *N Engl J Med.* 2019;380(5):437-446. doi:10.1056/NEJMoa1808783.
- Zhu Y, Lingala B, Wang H, Woo YJ. Bilateral vs single internal mammary artery grafts for coronary artery bypass in the united states. *Ann Thorac Surg.* 2021;111(2):629-635. doi:10.1016/j.athoracsur.2020.05.049.
- Taggart DP, Gaudino MF, Gerry S, Gray A, Lees B, Dimagli A, *et al.* Effect of total arterial grafting in the Arterial Revascularization Trial. *J Thorac Cardiovasc Surg.* 2022;163(3):1002-1009.e6. doi:10.1016/j.jtcvs.2020.03.013.
- Bracamonte L, Alcantara C, Aste H, Malpartida B, Talledo O, Bassino M, *et al.* La mamaria interna en la revascularización miocárdica: A propósito de 486 casos [Internet]. Lima: Vascor; March 1, 2016 [accessed March 8, 2022]. Available in: <https://vascor.pe/publicaciones/la-mamaria-interna-en-la-revascularizacion-miocardica-a-proposito-de-486-casos/>.
- Ríos JC, Castañeda P, Talledo L, Soplopucio F, Aranda N, Pérez Y, *et al.* Cirugía de revascularización de miocardio usando arteria mamaria interna bilateral. Resultados a corto plazo. *Arch Cardiol Mex.* 2018;88(1):9-15. doi:10.1016/j.acmx.2016.12.003.
- Castillo J, Ríos J. Cirugía de revascularización de miocardio usando arteria mamaria interna bilateral. Resultados a mediano plazo. *Archivos Peruanos de Cardiología y Cirugía Cardiovascular.* 2020;1(1):37-42. doi:10.47487/apcyccv.v1i1.11.
- Seguel SE, González LR, Stockins LA, Alarcón CE, Cárdenas MP. Revascularización miocárdica completa con dos mamarias. *Revista chilena de cirugía.* 2012;64(2):201-214. doi:10.4067/S0718-40262012000200017.
- Seguel E, Stockins A, Figueroa L, González R, Alarcón E, Quiñones C. Cirugía coronaria exclusiva con dos mamarias en "Y": resultados a corto plazo. *Revista chilena de cardiología.* 2015;34(3):182-189. doi:10.4067/S0718-85602015000300003.
- Seguel E, Stockins A, González R, Vera-Calzaretta A, González-Burboa A, Hidalgo A. Resultados a 5 años de la revascularización exclusiva con dos arterias mamarias en pacientes con enfermedad coronaria multivaso. *Revista médica de Chile.* 2019;147(6):718-726. doi:10.4067/S0034-98872019000600718.
- Weinschelbaum EE, Macchia A, Caramutti VM, Machain HA, Raffaelli HA, Favaloro MR, *et al.* Cirugía de revascularización coronaria con conductos arteriales. Técnica, resultados y seguimiento a cuatro años en 1.023 pacientes consecutivos. *Rev Esp Cardiol (Ed. impr.).* 2000;53(2):179-188.
- Navia D, Vrancic M, Vaccarino G, Piccinini F, Raich H, Florit S, *et al.* Total arterial off-pump coronary revascularization using bilateral internal thoracic arteries in triple-vessel disease: surgical technique and clinical outcomes. *Ann Thorac Surg.* 2008;86(2):524-530. doi:10.1016/j.athoracsur.2008.04.069.
- Navia D, Vrancic M, Piccinini F, Thierer J, Gil C, Benzadon M, *et al.* Is the second internal thoracic artery better than the radial artery in total arterial off-pump coronary artery bypass grafting? A propensity score-matched follow-up study. *J Thorac Cardiovasc Surg.* 2014;147(2):632-638. doi:10.1016/j.jtcvs.2013.02.012.
- Navia DO, Vrancic M, Piccinini F, Camporrotondo M, Dorsa A, Espinoza J, *et al.* Myocardial revascularization exclusively with bilateral internal

- thoracic arteries in t-graft configuration: effects on late survival. *The Annals of Thoracic Surgery*. 2016;101(5):1775-1781. doi:10.1016/j.athoracsur.2015.10.074.
18. Vrancic JM, Piccinini F, Camporrotondo M, Espinoza JC, Camou JI, Nacinovich F, *et al.* Bilateral internal thoracic artery grafting increases mediastinitis: myth or fact? *Ann Thorac Surg*. 2017;103(3):834-839. doi:10.1016/j.athoracsur.2016.06.080.
 19. Vrancic JM, Navia DO, Espinoza JC, Piccinini F, Camporrotondo M, Benzadon M, *et al.* Is sex a risk factor for death in patients with bilateral internal thoracic artery grafts? *J Thorac Cardiovasc Surg*. 2019;158(5):1345-1353.e1. doi:10.1016/j.jtcvs.2019.01.025.
 20. Navia D, Espinoza J, Vrancic M, Piccinini F, Camporrotondo M, Dorsa A, *et al.* Bilateral internal thoracic artery grafting in elderly patients: Any benefit in survival? *J Thorac Cardiovasc Surg*. 2020;S0022-5223(20)32705-7. doi:10.1016/j.jtcvs.2020.09.101.
 21. Jatene MB, Puig LB, Jatene FB, Ramires AF, Oliveira S, Dallan LA, *et al.* Revascularização direta do miocárdio com as duas artérias mamárias internas: análise de 442 casos. *Braz J Cardiovasc Surg*. 1990;5:71-78. doi:10.1590/S0102-76381990000200002.
 22. Martins SK, Arrais dos Santos M, Ponce FH, Martins FC, Malat HF, Jatene AD, *et al.* Revascularização do miocárdio com emprego de ambas artérias mamárias internas em pacientes com diabetes mellitus. *Rev Bras Cir Cardiovasc*. 2007;22(3):291-296. doi:10.1590/S0102-76382007000300004.
 23. Falcao de Souza G, Souza AG, Lacerda HR, Figueira CH, Carvalho F, Filho S, *et al.* Uso da dupla mamária na cirurgia de revascularização do miocárdio. Use of double breast in coronary artery bypass grafting. Recife: IMIP; 2014 [accessed March 8, 2022]. Available in: <http://tcc.fps.edu.br:80/jspui/handle/fpsrepo/1220>.
 24. Bakaeen FG, Ghandour H, Ravichandren K, Zhen-Yu M, Soltesz EG, Johnston DR, *et al.* Right internal thoracic artery patency is affected more by target choice than conduit configuration. *Ann Thorac Surg*. 2021;S003-4975(21)01725-2. doi:10.1016/j.athoracsur.2021.09.015.
 25. Glineur D, Boodhwani M, Hanet C, Laurent de Kerchove, Navarra E, Astarci P, *et al.* Bilateral internal thoracic artery configuration for coronary artery bypass surgery. *Circulation: Cardiovascular Interventions*. 2016;9(7):e003518. doi:10.1161/CIRCINTERVENTIONS.115.003518.
 26. Head SJ, Milojevic M, Taggart DP, Puskas JD. Current practice of state-of-the-art surgical coronary revascularization. *Circulation*. 2017;136(14):1331-1345. doi:10.1161/CIRCULATIONAHA.116.022572.
 27. Thuijs DJ, Davierwala P, Milojevic M, Deo SV, Noack T, Kappetein AP, *et al.* Long-term survival after coronary bypass surgery with multiple versus single arterial grafts. *Eur J Cardiothorac Surg*. 2022;61(4):925-933. doi:10.1093/ejcts/ezab392.