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Coronary artery bypass grafting using the radial artery: influence of proximal anastomosis site in mid-term and long-term graft patency

Revascularização miocárdica com artéria radial: influência da anastomose proximal na oclusão a médio e longo prazo

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Abstract

Objective: **To determine whether the proximal anastomosis interferes or not in mid- and long-term patency of these grafts.**

Methods: **One hundred twenty-three out of 481 patients who had undergone surgery using radial artery (RA) were restudied. The mean age was 58.8 ± 10.4 years. In 96 (78.05%) patients the cardiopulmonary bypass (CPB) was used. Considering all surgical grafts, 382 coronary branches were grafted (mean, 3.1 ± 0.8 arteries per patient). 150 of them used radial artery (RA), and the left marginal branches (LOM) were the most prevalent (48.67%). The proximal anastomosis was performed in the aorta in 50 (40.65%) patients and as an artificial "Y" composite graft with the left or right internal thoracic artery (LIMA/RITA) in 73 (59.35%). Postoperatively, coronary angiography studies were performed within a mean period of 5.36 ± 3.21 years. The obtained data was divided into two categories: proximal anastomosis (aorta/composite) and patency (occluded/patent). A chi-square test was used to compare both proportions, within a 95% confidence interval (CI).**

Results: **From the 50 aorta-anastomosed grafts, 42 (84%) were patent and eight (16%) occluded. Regarding the 73 "Y" composite grafts, 59 (80.82%) were patent and 14 (19.18%) occluded. Comparing these proportions in both techniques, there was no statistically significant difference between them (*P*=0.651, CI=95%).**

Conclusion: **The site of proximal anastomosis of the RA coronary grafts does not interfere in mid- and long-term graft occlusion and patency.**

Descriptors: **Myocardial revascularization/methods. Radial artery. Anastomosis, surgical. Treatment outcome.**

Resumo

Objetivo: **Determinar se o local da anastomose proximal apresenta influência ou não na perviedade a médio e longo prazo destes enxertos.**

Métodos: **Foram reestudados 123 pacientes, de um total**

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This study was carried out at Heart Institute of Clinics Hospital of Faculty of Medicine – University of São Paulo (InCor-HCFMUSP) – São Paulo, SP, Brazil.

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de 481 operados com artéria radial (AR). A média de idade era de 58,8 ± 10,4 anos. Noventa e seis (78,05%) pacientes foram operados com circulação extracorpórea (CEC). Considerando-se todos os enxertos, foram revascularizados 382 ramos coronários, média de 3,1 ± 0,8 artérias por paciente. Desse total, 150 artérias foram revascularizadas com AR, sendo os ramos marginais esquerdos (ME) os mais prevalentes (48,67%). A anastomose proximal foi realizada na aorta em 50 pacientes (40,65%) e em "Y" com a artéria torácica interna esquerda (ATIE) ou direita (ATID) nos demais 73 (59,35%). No pós-operatório, os reestudos angiográficos tiveram período médio de 5,36 ± 3,21 anos. Os dados foram divididos em duas categorias: anastomose proximal (aorta/"Y") e perviedade (enxerto ocluído/pérvio). Foi utilizado teste qui-quadrado para duas proporções, com intervalo de confiança (IC) de 95%.

Resultados: **Dos 50 enxertos com anastomose na aorta, 42 (84%) apresentaram-se pérvios, contra oito (16%) ocluídos. Dos 73 enxertos em "Y", 59 (80,82%) apresentaram-se pérvios, contra 14 (19,18%) ocluídos. Comparando-se enxertos ocluídos e pérvios de ambas as técnicas, observou-se não haver diferença estatisticamente significativa entre as proporções (*P*=0,651, IC=95%).**

Conclusão: **Conclui-se que, na utilização da AR como enxerto coronário, o local da anastomose proximal não interfere na obstrução e no fluxo do enxerto, a médio e longo prazo.**

Descritores: **Revascularização miocárdica/ métodos. Artéria radial. Anastomose cirúrgica. Resultado de tratamento.**

INTRODUCTION

Even nowadays, the radial artery (RA) graft is a controversial alternative, but with wide use in coronary artery bypass grafting. Since the first publications in the 1970s [1], with disappointing short-term results [2-4], until its "resurgence" in the 1990s [5], the results indicated by numerous series of patients founded well established concepts about this graft. It is known, for example, about the effect of the degree of obstructive lesion of the target coronary on evolution of its flow [6,7]. However, only recently, other aspects of RA have been studied such as, for example, the different techniques for graft dissection or the site of proximal anastomosis [6,8-10].

The aim of this study is to determine whether the site of proximal anastomosis influences on patency in mid- and long-term of RA grafts.

METHODS

Between 1994 and 2006, 481 patients underwent CABG at the Heart Institute of Clinics Hospital of Faculty of Medicine, University of São Paulo (InCor / FMUSP), operated by the same surgical team (surgeon and first assistant). In all surgeries, was used at least one RA graft. Of these patients, 123 (25.57%) underwent coronariography restudy in the postoperative period, according recommended by the Clinics of Coronary Disease of the institution. The data - including the coronariography exams performed and their reports - were obtained by evaluating the records, with approval of the Ethics Committee for Analysis of Research Projects (CAPPesq) of InCor/FMUSP.

Of the 123 patients restudied, 99 (80.48%) were male and 24 (19.52%) were female, with mean age of 58.8 + 10.4 years. Ninety-six (78.05%) of them had undergone off-pump surgery. It totalized - considering all grafts used - 382 grafted coronary branches, with mean of 3.1 ± 0.8 arteries per patient.

Of this total, 150 arteries were grafted with RA by means of single end-to-side or side-to-side anastomosis (sequential) in more than one coronary branches. The RA dissection in all cases was the same, using single incision through the ventral side of the forearm selected, from the distal portion of the vessel, with manual dissection and ligation of branches, thus preserving adjacent tissues and extending up to the junction of the interosseous branch. The left marginal branches (LMB) - or equivalent from the same territory - were the most prevalent (48.67%). The other coronary branches, in decreasing order of use of RA, were diagonal (DB) (30.67%), right coronary artery (RCA) (15.33%) and anterior interventricular branch (AIB) (5.33%) (Figure 1).

In this group of patients, the proximal anastomosis of RA was performed directly in the aorta in 50 (40.65%) patients, through traditional end-to-side technique and using 7-0 polypropylene thread. In the remaining 73 (59.35%) patients, the RA was used as composed graft, through end-to-side Y-shaped anastomosis to the left internal thoracic artery (LITA) and right internal thoracic artery (RITA), using 7-0 polypropylene thread. There were no complications during the postoperative period and all patients were discharged from hospital with maintenance of outpatient follow-up.

Coronary angiography was performed in 123 patients studied, within a mean period of 5.36 ± 3.21 years, also with injection in aorto-coronary grafts and LITA and/or RITA, if present.

The data were divided into two categories, as the proximal anastomosis (aorta/ composed graft) and the graft patency (occluded/pervious). For comparison among variables, we used chi-square test for two proportions (or linear trend chi-square for comparison among more than two proportions), with confidence interval (CI) of 95%.

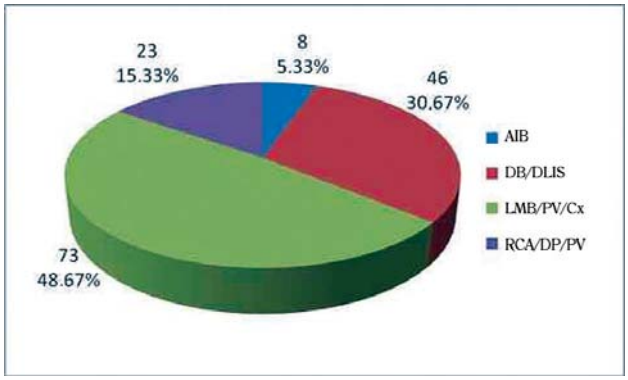

Fig. 1 – Grafted coronary arteries using RA (n=150, in 123 patients)

RESULTS

Considering the evolution of the RA grafts, irrespective of the proximal anastomosis, we noted a patency rate of 82.11%. The grafts with total obstructive lesion in anastomoses (distal/proximal) and/or on the graft were considered as "occluded" (17.89%).

There was no statistically significant difference in distribution of obstructive lesions of grafted coronaries between the two groups of proximal anastomosis, and the most prevalent obstructions were between 90% and 99% (Figure 2).

Of the 50 grafts with proximal anastomoses in the aorta, 42 (84%) were pervious, and eight (16%) occluded. As the 73 RA composed grafts, Y-shaped anastomosis using LITA or RITA, 59 (80.82%) were pervious, and 14 (19.18%) occluded. Comparing the occluded and pervious grafts of both techniques (Figure 3), there was no statistically significant difference between the proportions (*P*=0.651).

We noted a predominance of graft patency in the most severe obstructive lesions, particularly in groups with obstructions of 90% or more (*P*=0.0003) (Figure 4). This behavior could be observed similarly in both groups of proximal anastomoses, with statistical significance only in the Y-shaped proximal anastomosis (*P*=0.0031) (Figures 5 and 6).

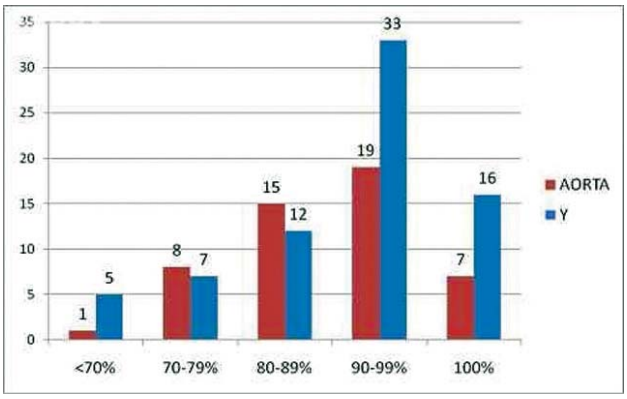

Fig. 2 – Distribution of different degrees of obstructive lesion in both groups of proximal anastomosis

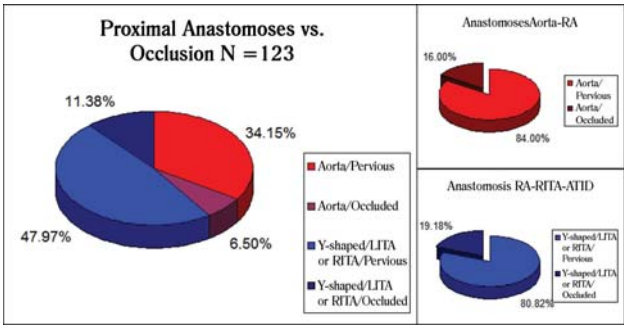

Fig.3 – Evolution of RA patency, according proximal anastomosis

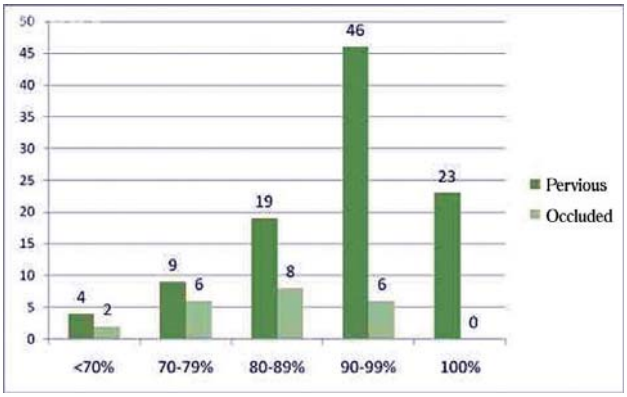

Fig. 4 – Evolution of RA grafts patency as the obstructive lesion of the grafted coronary (n=123)

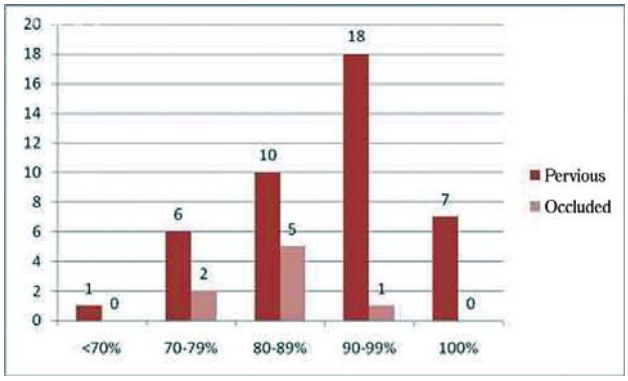

Fig. 5 – Evolution of RA grafts patency as the obstructive lesion of the grafted coronay – group proximal anastomosis in the aorta (n=50)

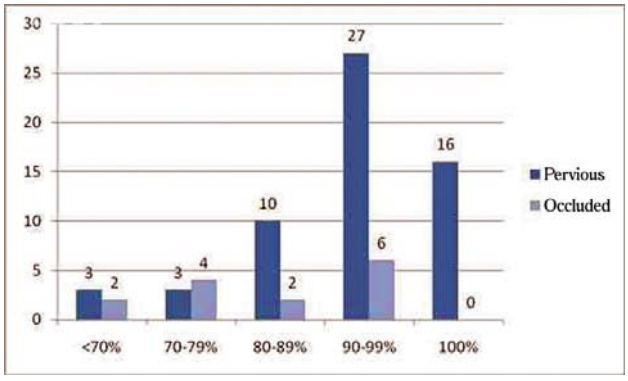

Fig. 6 - Evolution of RA grafts patency as the obstructive lesion of the grafted coronay – group "Y-shaped" anastomosis (n=73)

DISCUSSION

It is known the historical evolution of the use of RA in CABG. Since the pioneering proposal and comments of Carpentier et al. [1] in 1973, investigations were made in various aspects, aiming to evaluate its effectiveness. The first studies, even in the 1970s, showed unfavorable results [2,3], which raised interesting in different studies to determine possible factors - perhaps at the histopathological level - that may justify the behavior of early occlusion of RA [4, 11,12]. In the early 1990s, numerous technical and pharmacological advances [6.8] raised again the interest in this graft [5,13,14]. With this new approach, there were very satisfactory results, but always in series of patients restudied early or in short-term [5], between 14 and 18 months [6,10,13,15].

From this time and since then there has been preference for Y-shaped proximal anastomosis, usually involving the LITA or RITA [7,15-18]. This trend was based on the favorable adaptation shown by *in situ* internal thoracic arteries by appropriate supplying of blood for Y-shaped composed grafts [7.19]. Furthermore, some authors have shown good results with RA, using the proximal anastomosis in the aorta, by always considering the short-term restudies [9,20,21].

Good results have also been showed in recent series – of which the follow-up time reaches 6 years [22.23]. In these studies, there is no evidence that the proximal anastomosis affects RA patency at mid-term [24]. Currently, the site of proximal anastomosis is recommended, considering, for example, the less or even no manipulation of the ascending aorta [21]. It is also considered that the topography of the target coronary could interfere with the RA patency [25] - data that have not yet been shown by other authors.

The degree of preoperative obstructive lesion interferes with the development of RA patency. The possibility of competition between the flow and the graft is described, especially when the obstructive lesion of the target-coronary is not subocclusive [22].

In a series of 54 patients restudied with one year of postoperative, there was also apparent vulnerability of the RA grafts under situations of "theft of flow." The authors describe 50% of graft occlusion for preoperative obstructions less than 60% [26]. In postoperative angiographic restudy (mean 32 months) of 123 patients undergone surgery using ITA and RA grafts was observed patency of 99.2% and 92% respectively. The highest patency rates of RA were recorded in the "target coronary" with obstructions of 90% or more (98%) in relation to the less obstructive lesions (83.3%, $P<0.05$) [27]. Similar results were shown in retrospective assessment of 600 patients, where 93 (15.5%) were restudied, with 92.5% of RA grafts patency rate, and all occluded grafts were related to the coronary arteries with less severe obstructions, 56. 3% + 15.4 ($P<0.001$) [28].

It should be considered further, the progress of the RAPCO study (Radial Artery Patency and Clinical Outcome), that compares the RA grafts with free RITA and saphenous vein graft (SVG). Preliminary results of this study include mean time of follow-up of 3.5 years. The authors note that although with tendency to be better than PVS, the free arterial graft does not maintain patency comparable to *in situ* LITA or RITA. Clear differences on the influence of the proximal anastomosis in the results were not shown [29].

The number of patients we studied who had undergone CABG using RA, presents midterm evolution compatible with the data available in recent literature.

Still, considering the time of follow-up of these patients

and time of restudy, it is noted that the favorable results described herein extend from mid- to long-term.

CONCLUSION

It is concluded that the site of proximal anastomosis (aorta/ "Y-shaped" with *in situ* LITA or RITA) did not interfere with the mid- and long-term patency of the RA grafts.

The degree of obstructive lesion interferes with the patency of RA grafts with a higher number of pervious grafts in obstruction of 90% or more.

REFERENCES

1. Carpentier A, Guermonprez JL, Deloche A, Frechette C, DuBost C. The aorta-to-coronary radial artery bypass graft. A technique avoiding pathological changes in grafts. Ann Thorac Surg. 1973;16(2):111-21.

2. Curtis JJ, Stoney WS, Alford WC Jr, Burrus GR, Thomas CS Jr. Intimal hyperplasia. A cause of radial artery aortocoronary bypass graft failure. Ann Thorac Surg. 1975;20(6):628-35.

3. Fisk RL, Brooks CH, Callaghan JC, Dvorkin J. Experience with the radial artery graft for coronary artery bypass. Ann Thorac Surg. 1976;21(6):513-8.

4. Chiu CJ. Why do radial artery grafts for aortocoronary bypass fail? A reappraisal. Ann Thorac Surg. 1976;22(6):520-3.

5. Acar C, Jebara VA, Portoghese M, Beyssen B, Pagny JY, Grare P, et al. Revival of the radial artery for coronary artery bypass grafting. Ann Thorac Surg. 1992;54(4):652-9.

6. Dietl CA, Benoit CH. Radial artery graft for coronary revascularization: technical considerations. Ann Thorac Surg. 1995;60(1):102-9.

7. Royse AG, Royse CF, Groves KL, Bus B, Yu G. Blood flow in composite arterial grafts and effect on native coronary flow. Ann Thorac Surg. 1999;68(5):1619-22.

8. Reyes AT, Frame R, Brodman RF. Technique for harvesting the radial artery as a coronary bypass graft. Ann Thorac Surg. 1995;59(1):118-26.

9. Fremes SE, Christakis GT, Del Rizzo DF, Musiani A, Mallidi H, Goldman BS. The technique of radial artery bypass grafting and early clinical results. J Card Surg. 1995;10(5):537-44.

10. Dallan LAO, Oliveira SA, Jatene FB, Corso RC, Iglézias JCR, Prates N, et al. Artéria radial na ampliação do uso de enxertos arteriais para revascularização do miocárdio: considerações anatômicas e tática cirúrgica. Rev Bras Cir Cardiovasc. 1996;11(2):75-81.

11. Spray TL, Roberts WC. Morphologic observations in biologic conduits between aorta and coronary artery. Cardiovasc Clin. 1977;8(2):11-40.

12. van Son JA, Smedts F, Vincent JG, van Lier HJ, Kubat K. Comparative anatomic studies of various arterial conduits for myocardial revascularization. J Thorac Cardiovasc Surg. 1990;99(4):703-7.

13. Calafiore AM, Di Giammarco G, Teodori G, D'Annunzio E, Vittola G, Fino C, et al. Radial artery and inferior epigastric artery in composite grafts: Improved midterm angiographic results. Ann Thorac Surg. 1995;60(3):517-23.

14. Dallan LAO, Oliveira SA, Corso RC, Pereira NA, Iglézias JCR, Verginelli G, et al. Revascularização do miocárdio com a artéria radial. Rev Bras Cir Cardiovasc. 1995;10(2):77-83.

15. Barner HB. Defining the role of the radial artery. Semin Thorac Cardiovasc Surg. 1996;8(1):3-9.

16. Ikeda M, Ohashi H, Tsutsumi Y, Hige K, Kawai T, Ohnaka M. Angiographic evaluation of the luminal changes in the radial artery graft in coronary artery bypass surgery: a concern over the long-term patency. Eur J Cardiothorac Surg. 2002;21(5):800-3.

17. Uchikawa S, Nishida H, Endo M, Chikazawa G, Ozawa H, Yamazaki K, et al. Kyobu Geka. 2002;55(12):1006-10.

18. Dallan LAO, Oliveira SA, Lisboa LAF, Platania F, Jatene FB, Iglézias JCR, et al. Revascularização completa do miocárdio com uso exclusivo de enxertos arteriais. Rev Bras Cir Cardiovasc. 1998;13(3):187-93.

19. Tagusari O, Kobayashi J, Bando K, Niwaya K, Nakajima H, Ishida M, et al. Early adaptation of the left internal thoracic artery as a blood source of y-composite radial artery grafts in off-pump coronary artery bypass grafting. Heart Surg Forum. 2003;6(6):E93-8.

20. Yilmaz AT, Ozal E, Barindik N, Günay C, Tatar H. The results of radial artery Y-graft for complete arterial revascularization. Eur J Cardiothorac Surg. 2002;21(5):794-9.

21. Maniar HS, Barner HB, Bailey MS, Prasad SM, Moon MR, Pasque MK, et al. Radial artery patency: are aortocoronary conduits superior to composite grafting? Ann Thorac Surg. 2003;76(5):1498-503.

22. Gaudino M, Alessandrini F, Pragliola C, Cellini C, Glieca F, Luciani N, et al. Effect of target artery location and severity of stenosis on mid-term patency of aorta-anastomosed vs. internal thoracic artery-anastomosed radial artery grafts. Eur J Cardiothorac Surg. 2004;25(3):424-8.

23. Berreklouw E, Pompei E, Ferrari E, Ozdemir HI, ter Woorst J. Hospital outcome after aorta-radial versus internal thoracic artery-radial artery grafts. J Card Surg. 2004;19(6):520-7.

24. Iacó AL, Teodori G, Di Giammarco G, Di Mauro M, Storto L, Mazzei V, et al. Radial artery for myocardial revascularization: long-term clinical and angiographic results. Ann Thorac Surg. 2001;72(2):464-8.

25. Sajja LR, Mannam G, Pantula NR, Sompalli S. Role of radial artery graft in coronary artery bypass grafting. Ann Thorac Surg. 2005;79(6):2180-8.

26. Joung B, Park S, Choi D, Choi BW, Ko YG, Yoo KJ, et al. The impact of the preoperative severity of target-vessel stenosis on the short-term patency of radial artery grafts. Yonsei Med J. 2004;45(4):635-42.

27. Yie K, Na CY, Oh SS, Kim JH, Shinn SH, Seo HJ. Angiographic results of the radial artery graft patency according to the degree of native coronary stenosis. Eur J Cardiothorac Surg. 2008;33(3):341-8.

28. Al-Ruzzeh S, Modine T, Athanasiou T, Mazrani W, Azeem F, Nakamura K, et al. Can the use of the radial artery be expanded to all patients with different surgical grafting techniques? Early clinical and angiographic results in 600 patients. J Card Surg. 2005;20(1):1-7.

29. Hayward PA, Buxton BF. Contemporary coronary graft patency: 5-year observational data from a randomized trial of conduits. Ann Thorac Surg. 2007;84(3):795-9.