



Revista Brasileira de Cirurgia  
Cardiovascular/Brazilian Journal of  
Cardiovascular Surgery

ISSN: 0102-7638

revista@sbccv.org.br

Sociedade Brasileira de Cirurgia  
Cardiovascular

Lorenção de Almeida, Bruno; Massamitsu Kambara, Antonio; Rossi, Fabio Henrique;  
Martins Moreira, Samuel; Silva Jordao de Oliveira, Eduardo; de Carvalho Linhares Filho,  
Frederico Augusto; Bastos Metzger, Patrick; Zampieri Passalacqua, Aldo  
Left subclavian artery stenting: an option for the treatment of the coronary-subclavian  
steal syndrome

Revista Brasileira de Cirurgia Cardiovascular/Brazilian Journal of Cardiovascular Surgery,  
vol. 29, núm. 2, abril-junio, 2014, pp. 236-240  
Sociedade Brasileira de Cirurgia Cardiovascular  
São José do Rio Preto, Brasil

Available in: <http://www.redalyc.org/articulo.oa?id=398941893018>

- How to cite
- Complete issue
- More information about this article
- Journal's homepage in redalyc.org

redalyc.org

Scientific Information System

Network of Scientific Journals from Latin America, the Caribbean, Spain and Portugal

Non-profit academic project, developed under the open access initiative

# Left subclavian artery stenting: an option for the treatment of the coronary-subclavian steal syndrome

*Angioplastia com stent de artéria subclávia esquerda: uma opção no tratamento da síndrome do roubo coronário-subclávio*

Bruno Lorenção de Almeida<sup>1</sup>, MD; Antonio Massamitsu Kambara<sup>1</sup>, MD; Fabio Henrique Rossi<sup>1</sup>, MD; Samuel Martins Moreira<sup>1</sup>, MD; Eduardo Silva Jordao de Oliveira<sup>1</sup>, MD; Frederico Augusto de Carvalho Linhares Filho<sup>1</sup>, MD; Patrick Bastos Metzger<sup>1</sup>, MD; Aldo Zampieri Passalacqua<sup>1</sup>, MD

DOI: 10.5935/1678-9741.20140031

RBCCV 44205-1545

## Abstract

**Introduction:** The subclavian steal syndrome is characterized by the vertebral artery flow inversion, due to a stenotic lesion in the origin of the subclavian artery. The Coronary-subclavian Steal Syndrome is a variation of the Subclavian Steal Syndrome and is characterized by inversion of flow in the Internal Thoracic artery that has been used as conduct in a myocardial revascularization. Its diagnosis must be suspected in patients with difference in pulse and arterial pressure in the upper limbs, that present with angina pectoris and that have done a myocardial revascularization. Its treatment must be a surgical bypass or a transluminal angioplasty.

**Objective:** The objective is to show the left subclavian artery stenting as a safe and effective method to treat the coronary-subclavian steal syndrome.

**Methods:** Historical prospective, non-randomized trial, through revision of the hospital records of the patients treated with the stenting of the left subclavian artery, from January 2006 to September 2012.

**Results:** In the mentioned period, 4.291 myocardial revascularizations were performed with the use of the left mammary artery, and 16 patients were identified to have the Coronary-subclavian steal syndrome. All of them were submitted to endovascular treat-

ment. The success rate was 100%; two patients experienced minor complications; none of them presented with major complications. Eleven of the 16 patients had ultrasonographic documentation of patent stent for at least one year; two patients lost follow up and other two died.

**Conclusion:** The stenting of the left subclavian artery is a good option for the treatment of the Coronary-subclavian Steal Syndrome, with high level of technical and clinical success.

**Descriptors:** Angioplasty. Peripheral Arterial Disease. Coronary Disease. Subclavian Artery. Coronary-Subclavian Steal Syndrome.

## Resumo

**Introdução:** A síndrome do roubo de subclávia caracteriza-se por inversão de fluxo na artéria vertebral, decorrente de lesão estenótica na origem da artéria subclávia. A síndrome do roubo coronário-subclávio é uma variante da síndrome do roubo de subclávia e caracteriza-se por inversão de fluxo na artéria torácica interna que foi usada como conduto na revascularização do miocárdio. Seu diagnóstico deve ser suspeitado em pacientes com diferença de pulso ou pressão em membros superiores que

<sup>1</sup>Instituto Dante Pazzanese de Cardiologia (IDPC), São Paulo, SP, Brazil.

Work carried out at the Instituto Dante Pazzanese de Cardiologia (IDPC), São Paulo, SP, Brazil.

No financial support.

Correspondence address:  
Bruno Lorenção de Almeida

Instituto Dante Pazzanese de Cardiologia  
Av. Dr. Dante Pazzanese, 500 - Vila Mariana - São Paulo, SP, Brazil -  
Zip code: 04012-180  
E-mail: brunolorencao@gmail.com

Article received on May 5<sup>th</sup>, 2013  
Article accepted on August 19<sup>th</sup>, 2013

#### Abbreviations, acronyms & symbols

ASA	acetylsalicylic acid
CSSS	Coronary-subclavian steal syndrome
SSS	Subclavian Steal Syndrome

apresentem quadro anginoso e com histórico de revascularização miocárdica. Seu tratamento pode ser realizado através de bypass cirúrgico ou por meio de angioplastia transluminal percutânea.

**Objetivo:** O objetivo deste artigo é mostrar a angioplastia com stent da artéria subclávia esquerda como um tratamento efetivo e seguro da síndrome do roubo coronário-subclávio.

**Métodos:** Estudo prospectivo histórico, não randomizado, através da revisão de prontuários dos pacientes submetidos a angioplastia de artéria subclávia, no período de Janeiro de 2006 a Setembro de 2012.

## INTRODUCTION

The subclavian steal syndrome (SSS) is characterized by the vertebral artery flow inversion, due to a stenotic lesion in the origin of the subclavian artery. The Coronary-subclavian Steal Syndrome is a variation of the SSS and is characterized by inversion of flow in the Internal Mammary artery that has been used as conduct in a myocardial revascularization, leading to myocardial infarction.

Its diagnosis must be suspected in patients with difference in pulse and arterial pressure in the upper limbs, that present with angina pectoris and that have done a myocardial revascularization.

Its treatment must be a surgical bypass or, after the rise of the minimal invasive techniques, a transluminal angioplasty.

### Objective

The objective of this article is to show the left subclavian artery stenting as a safe and effective method to treat the Coronary-subclavian Steal Syndrome.

## METHODS

Retrospective, non-randomized trial, through revision of the hospital records of the patients treated with the stenting of the left subclavian artery, from January 2006 to September 2012. Epidemiological and clinical data were assessed, as well as technique and materials used in the procedure. The study was approved by the ethics commission.

The procedures were performed after local anesthesia and positioning of a valvulated sheath in the common right femoral artery and in the left brachial artery, by the Seldinger technique. After systemic heparin, the lesion was crossed with a 0.035" hydrophilic guidewire, and then it was exchanged by a stiff

**Resultados:** Foram realizadas neste período, 4.291 revascularizações miocárdicas com uso de torácica interna esquerda, sendo identificados 16 pacientes portadores da síndrome do roubo coronário-subclávio. Todos foram submetidos a tratamento endovascular. O índice de sucesso terapêutico foi de 100%; dois pacientes experimentaram complicações menores; nenhum apresentou complicações maiores. Do total, 11 pacientes apresentavam documentação ultrassonográfica de stent pervingo por pelo menos um ano; dois pacientes perderam seguimento e outros dois foram a óbito.

**Conclusão:** A angioplastia com stent da artéria subclávia esquerda é uma boa opção para o tratamento da Síndrome do roubo coronário-subclávio, com altas taxas de sucesso técnico.

**Descritores:** Angioplastia. Doença Arterial Periférica. Doença das Coronárias. Artéria Subclávia. Síndrome do Roubo Coronário-Subclávio.

wire of the same diameter, to give support to the stent (Figure 1). This approach allows several attempts of recanalization, whether proximal or distal to the lesion and appropriate angiographic control (Figure 2).

Balloon expandable stents were used in the majority of the cases; only one selfexpandable stent was used. The sizes varied from 7 to 10 mm in diameter and 25 to 60 mm in length. The material selection was made by visual angiographic analysis and was based on the nominal diameter of the target vessel, diameter proximal and distal to the lesion and the extension of it (Figure 3). Only one of the four cases of occlusion demanded pre dilatation (Figure 4), due to the difficulty of moving the balloon expandable stent through the lesion.

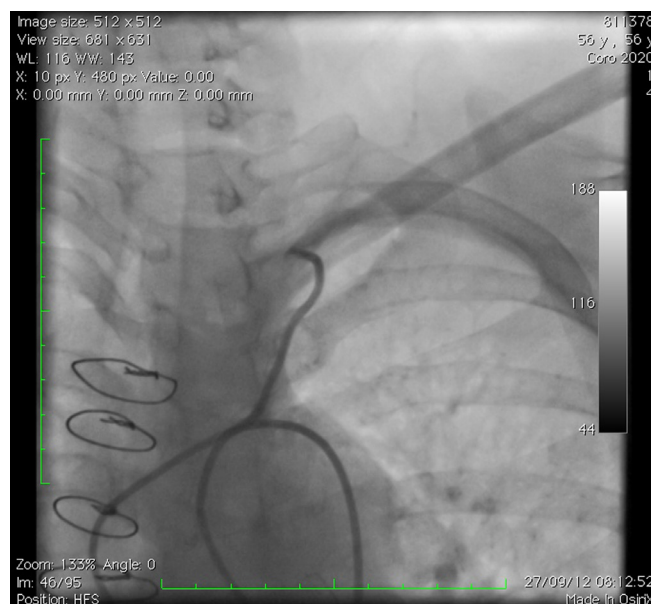


Fig. 1 - Filling of the left subclavian artery by retrograde flow of the left internal mammary artery

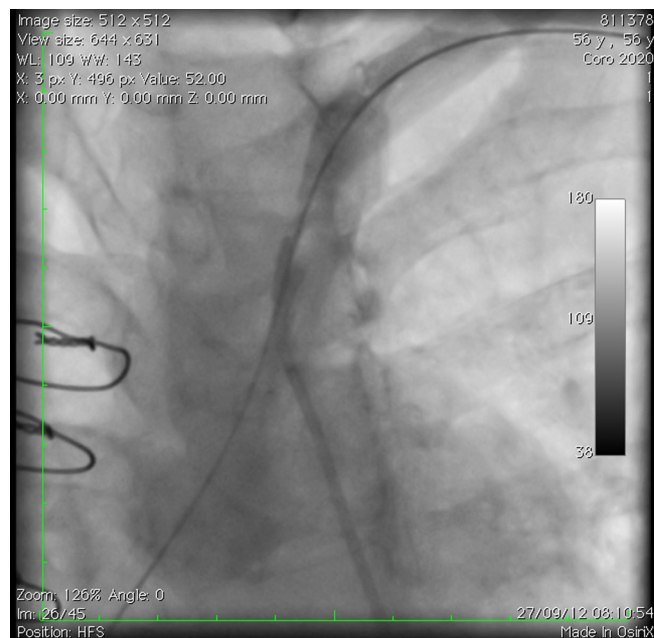


Fig. 2 - Proximal and distal access to the lesion access and facilitating overtaking angiographic control

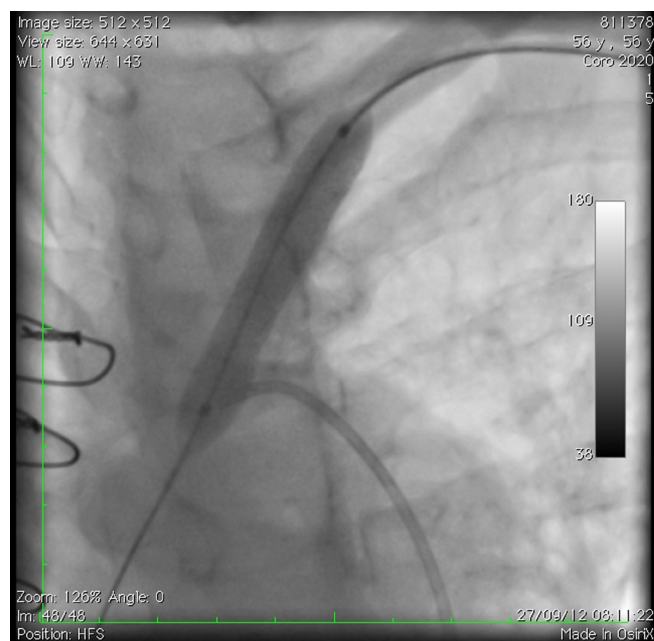


Fig. 3 - Balloon Expandable stent being released by brachial access

All patients were receiving antiplatelet therapy with acetylsalicylic acid (ASA) at the time of diagnosis, in doses ranging from 75 to 325 mg/day. In addition, Clopidogrel was started 75 mg/day orally, or 300 mg loading dose in the morning of the procedure, maintaining the dual antiplatelet therapy for 30 days.

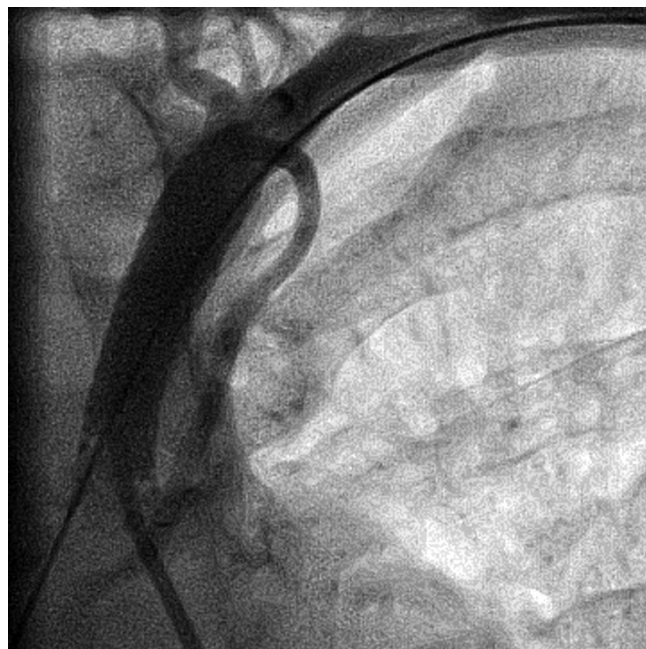


Fig. 4 - Filling antegrade left subclavian artery and the proximal third of the left internal thoracic artery

The monitoring was carried out on an outpatient basis and by performing ultrasound duplex color of the left subclavian artery. Routinely the patient returned to the Endovascular clinic in a week for initial evaluation of pulse and pressure measurement in the upper limbs. Then we continued monitoring in the sector of origin.

## RESULTS

Four thousand two hundred and ninety one coronary artery bypasses were performed in this period with the use of the left internal mammary artery angioplasty and 69 angioplasties of the subclavian artery in this Institute, identifying 16 patients with the Coronary-subclavian steal syndrome (CSSS). All of them underwent endovascular treatment.

The mean age of patients was 67.2 (53-81 years), seven-females and nine males. Table 1 shows the distribution of risk factors among patients treated. The clinical presentation leading to diagnosis of CSSS varied, and three patients presented with acute myocardial ischemia and in the other 12, the diagnosis was made by coronary angiography after provocative test positive for ischemia. In only one case the diagnosis was made after coronary angiography prior to percutaneous valve replacement (Table 2). Of the 16 patients included, 13 had stenoses and three had occlusions, in all cases in the proximal left subclavian artery.

The therapeutic success rate was 100%, with the criterion of antegrade flow in the internal mammary through digital angiography. Two patients experienced minor complications, being a minor hematoma and pseudoaneurysm that did not require



surgical correction. No patient had major complications. Upon examination of the medical records, 11 patients had sonographic documentation of stent patency for at least one year; two patients lost follow-up and two died. One of infection and sepsis in diabetic foot and other unknown cause. In all cases there was clinical improvement of symptoms after the procedure.

Table 1. Demographical Characteristics of the analyzed patients.

n	16
Age	67.2 (53-83 years)
Male	9 (56.2%)
Female	7 (43.7%)
Systemic Hypertension	16 (100%)
Diabetes Mellitus	7 (43.7%)
Dyslipidemia	13 (81.2%)
Smoking	5 (31.2%)
• Former smokers	7 (43.7%)
Chronic Renal Insufficiency*	1 (6.2%)

\*Non dialysis chronic renal insufficiency patient, being treated after adequate renal preparation

Table 2. Clinical characteristics of the patients.

Acute Myocardial Infarction	3 (18.7%)
Angina/Positive provocative test	12 (75%)
Others*	1 (6.2%)

\*Asymptomatic patient; diagnosis in the coronary angiography previous to valve replacement surgery

## DISCUSSION

With an incidence between 0.5% and 2% of patients undergoing coronary artery bypass grafting<sup>[1]</sup>, the CSSS was initially described by Hargola / Valle and Tyras / Barner in the 70s, concurrently with the beginning of the use of the internal mammary artery as a conduit artery<sup>[2]</sup>. The use of this artery is widely accepted because of its high long-term patency rate and low atherosclerosis, being used in most Coronary artery bypasses<sup>[3-6]</sup>. The incidence of this syndrome was 0.3% in our study, being equivalent to that found in the literature. All cases diagnosed underwent endovascular treatment.

The left subclavian artery is the branch of the aortic arch most affected by atherosclerosis<sup>[7]</sup>, which is the main cause of the syndrome. This also explains why the vast majority of cases in the literature CSSS occur on the left side, not being different in the cases presented. Other causes include Takayasu arteritis, actinic arteritis and giant cell arteritis<sup>[1]</sup>. The occlusion of the proximal subclavian artery causes flow reversal in arteries downstream (vertebral and internal mammary), leading to several vertebral- basilar symptoms (dizziness, nystagmus, nausea) and myocardial ischemia<sup>[2]</sup>.

Conventional surgical revascularization procedures have good long-term patency<sup>[7]</sup>, but contain a risk of morbidity of 4-11% and a mortality rate of up to 5%. Options include subcla-

vian-subclavian, carotid-subclavian, axillary- axillary grafts, subclavian- carotid transposition or even transposition of the internal mammary artery. Potential complications include fistula of the thoracic duct, Horner's syndrome, supraclavicular nerve injury (eg N. Phrenic and recurrent laryngeal) and decompensation of preexisting atherosclerotic disease in the supra-aortic trunks, thereby leading to ischemic or neurological symptoms<sup>[7,8]</sup>.

In the cases presented, there were two minor complications and no major complications, besides the therapeutic and clinical success of 100%. The technical literature reports success of more than 80%, with rates of complications from 3 to 6% and high patency up to ten years of follow-up<sup>[5,7,9,10]</sup>. None of the patients experienced vertebrobasilar acute neurological symptoms due to reverse flow in vertebral artery, which protects cerebral circulation leading to embolic events fragments plate to the upper member. The forward flow is restored gradually from 20 seconds to 30 minutes, probably due systems of cerebral selfregulation by decreasing vascular resistance<sup>[3,8]</sup>. There are reports in the literature of internal mammary artery blockage and aspiration of blood through the brachial catheter during the procedure, to avoid potential embolization to coronary territory, especially when it is noted an antegrade flow in the internal mammary - a variant of the CSSS<sup>[3,10]</sup>. However, in the patients presented, this technique was not used, without any harm to the result.

The choice of balloon expandable stents rather than self-expandable in most cases is due to its greater radial strength and greater accuracy in delivery. However, in very tight lesions or occlusions when it perceives a certain resistance in the positioning of the stent, may be necessary pre-dilatation to facilitate their passage and to prevent it from deforming over the balloon. In the cases presented, only one required a pre-dilatation.

One should remember that the label of the balloon- expandable stents available on the market today does not include its use in the supra -aortic area. The use of these stents in this region is due to the excellent results in case series.

In most services is not routine an angiographic study of aortic arch and supra-aortic trunks prior to Coronary artery bypass<sup>[7,11]</sup>. Thus, the physical examination of the upper limbs is necessary, so you can detect any change in pulse/pressure or supraclavicular souffle before surgery<sup>[5,12]</sup>. In contrast, in revascularized patients presenting with acute or insidious myocardial ischemia, we must always remember the CSSS as a possible etiology. In fact, the development of this syndrome in less than a year after myocardial revascularization suggests the presence of subclavian steal syndrome not diagnosed by the time of surgery<sup>[5]</sup>.

## CONCLUSION

Angioplasty and stenting of the left subclavian artery is a good option for the treatment of coronary subclavian steal

syndrome, with high rates of technical and clinical success. Besides, does not preclude surgical treatment, in the case of more than one unsuccessful endovascular attempt.

Authors' roles & responsibilities	
BLA	Author
AMK	Coauthor, scientific reviewer
FHR	Coauthor, scientific reviewer
SMM	Coauthor, scientific reviewer
ESJO	Coauthor, data collection
FACLF	Coauthor, data collection
PBM	Coauthor, statistical analysis
AZP	Coauthor, statistical analysis

## REFERENCES

1. Tariq S, Tuladhar S, Wingfield E, Poblete H. Coronary subclavian steal syndrome unamenable to angioplasty successfully managed with subclavian-subclavian bypass. *Case Report Vasc Med*. 2012;2012:784231.
2. Chokyu I, Terada T, Matsuda Y, Okumura H, Shintani A, Nakamura Y, et al. Stenting for left subclavian artery stenosis before and after coronary artery bypass grafting using the internal mammary artery: a report of three cases. *Interv Neuroradiol*. 2008;14(2):209-14.
3. Kneale BJ, Irvine AT, Coltart DJ. Coronary subclavian steal syndrome following coronary bypass surgery. *Postgrad Med J*. 1996;72(848):358-60.
4. Miiller JC, Candemil PC, Loures JMGR, Zucco FM, Belz WE, Loures NGR, et al. Síndrome do roubo coronário-subclávio: relato de caso e revisão de literatura. *J Vasc Bras*. 2012;11(2):166-70.
5. Westerband A, Rodriguez JA, Ramaiah VG, Dietrich EB. Endovascular therapy in prevention and management of coronary-subclavian steal. *J Vasc Surg*. 2003;38(4):699-704.
6. Dinkhuysen JJ, Souza LCB, Fichino MZS, Chacur P, Arnoni AS, Piegas LS, et al. Anastomose mamária-coronária: análise de 2923 casos. *Rev Bras Cir Cardiovasc*. 1987;2(1):7-21.
7. Costa SM, Fitzsimmons PJ, Terry E, Scott RC. Coronary-subclavian steal: case series and review of diagnostic and therapeutic strategies: three case reports. *Angiology*. 2007;58(2):242-8.
8. Martinez R, Rodriguez-Lopez J Torruella L, Ray L, Lopez-Galarza L, Diethrich EB. Stenting for occlusion of the subclavian arteries. Technical aspects and follow-up results. *Tex Heart Inst J*. 1997;24(1):23-7.
9. Van Noord BA, Lin AH, Cavendish JJ. Rates of symptom reoccurrence after endovascular therapy in subclavian artery stenosis and prevalence of subclavian artery stenosis prior to coronary artery bypass grafting. *Vascular Health Risk Manag*. 2007;3(5):759-62.
10. Nishio A, Takami T, Ichinose T, Masamura S, Hara M, Shimada K, et al. Percutaneous transluminal angioplasty and stent placement for subclavian steal syndrome with concomitant antegrade flow in the left internal mammary artery graft for coronary artery bypass. *Neurol Med Chir (Tokyo)*. 2003;43(10):488-92.
11. Fergus T, Pacanowski JP Jr, Fasseas P, Nanjundappa A, Habeeb Ahmed M, Dieter RS. Coronary-subclavian steal: presentation and management: Two case reports. *Angiology*. 2007;58(3):372-5.
12. Munk PS, Larsen AI, Fjetland L, Nilsen DWT. Acute occlusion of the left subclavian artery causing a non-ST-elevation myocardial infarction with subacute lung edema due to a coronary subclavian steal syndrome--a case report. *Int J Cardiol*. 2006;108(1):139-41.