Steal coronary-subclavian syndrome: case report and literature review

Síndrome do roubo coronário-subclávio: relato de caso e revisão da literatura

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Abstract

The phenomenon of coronary-subclavian steal is defined as the reversed blood flow in a coronary artery, through internal mammary artery graft towards medial-distal subclavian artery, which happens due to severe stenosis or total occlusion of the proximal portion of the latter. It is a rare but significant cause of cardiac ischemia after coronary artery bypass surgery and it can cause a syndrome of the same name and with typical manifestations. We have reported the case of a patient with this disease, who underwent percutaneous angioplasty with stent implantation, and we also reviewed the literature on the subject.

Keywords: subclavian artery; subclavian steal syndrome; coronary-subclavian steal syndrome.

Resumo

O fenômeno do roubo coronário-subclávio é definido como o fluxo sanguíneo invertido de uma artéria coronária, por meio de enxerto de artéria mamária interna em direção à subclávia médio-distal, e ocorre devido à estenose significativa ou oclusão total da porção proximal desta última. É uma causa rara, mas significante, de isquemia cardíaca após cirurgia de revascularização miocárdica e pode originar uma síndrome de mesmo nome e com manifestações típicas. Relatou-se o caso de um paciente com esta enfermidade, que foi submetido à angioplastia percutânea com implante de stent. Também revisou-se a literatura a respeito.

Palavras-chave: artéria subclávia; síndrome do roubo subclávio; síndrome do roubo coronário-subclávio.

Introduction

Advances in Interventional Cardiology have turned angioplasty with stenting into an increasingly attractive option for patients with coronary atherosclerotic disease[1]. Thus, patients that are referred to myocardial revascularization (MR) usually have more severe coronary disease, frequently associated with atherosclerosis in other vascular territories[2].

The phenomenon of coronary-subclavian steal is defined as reverse blood flow in a coronary artery through an internal mammary artery graft (IMAG), towards the distal subclavian artery, and it happens in patients with severe stenosis or total occlusion of the proximal portion of the latter[1]. Despite being rare[2], its morbidity is significant, with possible complications[3] that can lead to the coronary-subclavian steal syndrome (CSSS). It should be in patients after MR using the internal mammary artery graft as bypass, who develop recurrent chest pain, especially when triggered by physical effort[2].

Case report

A 68-year-old male patient, with hypertension and dyslipidemia had a history of MR using IMAG 12 years earlier. He presented with pain in the left hemithorax at moderate

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effort, especially in activities involving the upper limbs, suggestive of *angina pectoris*, associated with mild dyspnea and sweating. He denied limb claudication, dizziness or syncope. He did not present with murmurs, and had wide and symmetrical pulses in the upper and lower limbs. Blood pressure was 150/75 mmHg in the right upper limb, and 80/50 mmHg in the left upper limb.

At first, he underwent myocardial radionuclide imaging, which pointed to an ischemic area on the anterior wall. He then underwent percutaneous coronary angioplasty that showed the reverse blood flow in an anterior descending artery (Figure 1), even at rest. The reverse blood flow fed the IMAG and reached the distal left subclavian artery (LSA), which presented proximal occlusion (Figures 2 and 3). Color Doppler ultrasonography of the cervical arteries showed left subclavian artery steal.

Despite the occlusion, it was decided to perform percutaneous angioplasty with stenting of the left subclavian artery, through retrograde puncture of the right common femoral artery and the left brachial artery, by the Seldinger technique. After the procedure, patency of the occluded segment was observed (Figure 4). The patient's symptoms disappeared in the postoperative period. Control radionuclide myocardial imaging showed improvement of the ischemic pattern.

Discussion

The internal mammary artery, or internal thoracic artery, was first used as MR bypass in 1970[4], and it is currently the graft of choice, used in about 90% of the patients submitted to this procedure[2]. It has several advantages described in literature, such as: to provide higher patency rates in comparison to saphenous vein graft[5]; to rarely be involved by atherosclerotic disease[5] – even in these cases, high rates of success with angioplasty are reported[6] –; and rarely present occlusion, that usually happens in the distal anastomosis with the coronary artery by a local proliferative reaction[7].

The prevalence of left subclavian artery (LSA) stenosis, mostly found in the proximal segment (85% of the cases)[7], ranges from 0.5 to 6.8%[2] in the general population; 3.5 to 5.3% in potentially surgical coronary patients, and from 11.8 to 18.7% in individuals with peripheral arterial disease (PAD). Thus, the latter has the highest predictive value for LSA stenosis[3,8].

CSSS was first described in the 1970s, by Tyras and Barner[5], and it is considered an unusual complication of MR[9], with incidence of 0.5 to 2% of the total number of

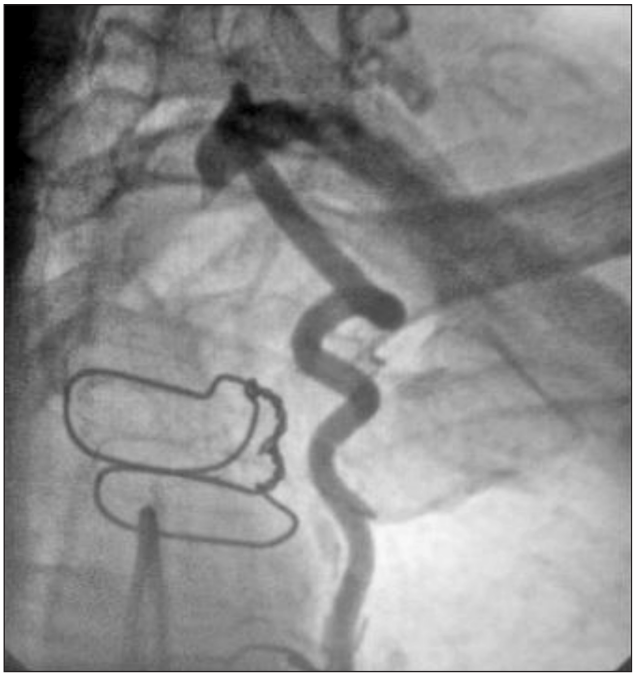

Figure 1. Coronarography showing retrograde flow in the internal mammary artery with filling of the left distal and axillary subclavian arteries.

Figure 2. Angiography shows the obstruction of the left subclavian artery with distal recanalization by the reverse flow of the vertebral and internal mammary arteries.

Figure 3. Angiography in the aortic arch showing obstruction in the left subclavian artery.

Figure 4. Angiography of post-angioplasty control with stent implant showing good patency of the left subclavian artery and maintenance of the vertebral and internal mammary arteries.

operated patients[4]. However, its incidence is supposedly increasing, because the age of patients submitted to coronary bypass has been increasing, and the risk factors for coronary disease are the same for LSA stenosis[10].

The etiology of CSSS is almost invariably atherosclerotic, even though cases of patients with Takayasu's arteritis[10] or IMAG malformations, such as the presence of arteriovenous fistula, have been described[11].

The physiopathology is similar to the Subclavian Steal Syndrome (SSS), described in 1961 by Reivich[12], in which the vertebral artery presents reverse flow towards the subclavian artery in the presence of stenosis of the proximal LSA. It can be aggravated by the peripheral vasodilation produced by the physical exercise of the affected limb. Symptoms are upper limb claudication and vertebrobasilar symptoms (dizziness, vertigo, ataxia and syncope)[13]. In CSSS, besides the left vertebral artery, there may be a decrease or even flow reversal in IMAG[12].

Since the IMAG supplies blood flow to the coronary artery after MR, flow inversion through the IMAG leads to myocardial ischemia, resulting in ischemic symptoms and even leading to myocardial infarction[10]. Patients can be asymptomatic[14], however, the diagnosis should be taken into consideration in those submitted to MR using IMAG who present with cardiac symptoms such as chest pain and arrhythmia[1]; and non-cardiac symptoms, such as dizziness, vertigo, ataxia and upper limb claudication. The symptoms are usually triggered or aggravated by physical effort[9,12]. The onset of the syndrome may occur from 2 to 31 years after MR (mean of 14 years)[14], which shows that LSA occlusive lesions developed late after the operation. The onset of CSSS up to one year after MRS suggests that LSA stenosis was not observed at the moment of cardiac surgery[9].

Physical examination should search for supraclavicular murmurs, pulse asymmetry, and especially the arterial blood pressure difference between the upper limbs >20 mmHg, which is the most significant finding[1]. Color Doppler ultrasonography is a valid method to detect hemodynamically significant stenosis in the subclavian area, and the images of computed angiotomography and magnetic angioresonance can be diagnostic. However, digital subtraction angiography is still the gold standard for this

diagnosis[10]. After contrast injection in the anterior descending artery, reverse flow of IMAG towards the subclavian bed is observed[12]. Besides, during the procedure, direct measurement of the pressure gradient can be obtained, along with the demonstration of flow inversion[10].

Different types of treatment for CSSS have been described. The most common procedures in the 1970s and the 1980s were prosthetic or autologous subclavian-subclavian, aorta-subclavian or, most commonly, carotid-subclavian bypass[10,12]. The latter is contraindicated in cases of critical stenosis of the carotid segment[5].

Alternatively, the proximal third of the IMAG can be transferred to another donor artery, such as the aorta[11]. Dacron prosthesis or polytetrafluoroethylene (PTFE) are used as preferential bypasses for open surgery. Autogenous veins, like the saphenous magna, are not a good option due to the high probability of axial torsion and rotation with the movements of the neck, and due to the great difference between the calibers of both vessels[4]. The supraclavicular approach for anastomosis with subclavian artery graft is not free of difficulties and potential complications, due to the proximity to lymphatic channels and local nervous tissues. The infraclavicular approach is simpler, and avoids some of these potential risks[14]. The improvement of CSSS symptoms after bypass surgery reached 75% in a series of 168 patients[5]. Possible complications are: stroke, cervical lymphatic fistula, phrenic nerve paralysis and Horner syndrome[5]. The medium and long term patency rate demonstrated in studies is 96% after four years, and 83% after eight years of follow-up[5,14]. The morbidity rate is approximately 25%, and mortality ranges from 1 to 2%[7,13].

Another option for open surgery is the transposition of the subclavian artery to the carotid, which was first described in 1964 by Parrot[4]. It is considered to be an excellent method to treat stenosis and proximal LSA occlusions due to the lack of synthetic material and the performance of a single anastomosis, with higher long term patency rates than the carotid-subclavian bypass[4]. However, the transposition requires the temporary LSA constriction, which ceases the flow in the IMAG. This can lead to transitory myocardial ischemia and cause complications[13].

Since the 1990s, percutaneous transluminal angioplasty is considered to be an effective method to treat for LSA stenosis[9]. Followed by the stent placement, the technique provides more anatomical and physiological results when compared to open surgery[7,12], and it associated with low morbidity, zero mortality and short hospital stay[2,3,7]. The short term technical success is >90%[3] and five-year patency rates higher than 90%[2,3] have been reported.

Some factors may be obstacles for angioplasty, such as cases of densely calcified chronic plaques[14], significant stenosis or LSA occlusion[4,9,12]. De Vries et al. reported 100% success rate for stenosis, and only 65% for occlusions[15]. Besides, when the stenosis is too close to the origin of the vertebral artery, the stent may occlude it[14].

Postangioplasty thrombosis is rare[2]; however, long term in-stent stenosis was described as frequent by Schilliner et al., reaching 40.7% in five years[14-16]. Even then, the effectiveness of angioplasty with stent and open surgery is comparable[3], with less complications in the angioplasty group, which leads to the conclusion that this should be considered as the primary choice of therapy[3,9].

In cases of urgent MR with known LSA stenosis, cardiac surgery can be combined with the carotid-subclavian bypass[14], or the right internal thoracic artery can be used to supply the coronary artery[2]. Angioplasty is the method of choice[2] on elective patients and those with LSA stenosis.

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