

# Atherosclerosis – apropos of a subclavian steal phenomenon

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### Abstract

Atherosclerosis as a multi-systemic pathology affecting people all around the world, it is the main death cause in developed countries, through its acute clinical manifestations. The authors report a clinical case of a 52 year-old man, with a prior medical history of hypertension and dyslipidaemia, with a detected high blood pressure only in the right arm in a medical appointment. We studied the different vascular territories which are more frequently affected by the atherosclerotic disease, it was diagnosed left subclavian artery stenosis (related with the observed subclavian steal phenomenon), bilateral carotid occlusion, bilateral aorto-iliac

lesions and left popliteal artery occlusion. The authors would like to emphasize the fact that despite the extension of the atherosclerotic disease, the patient had never had an acute vascular event, until now. They want also to emphasize the relevance of adequate and careful medical history and physical examination. That is why the internal medicine doctors must have a permanent alert attitude and consequently an active role in primary and secondary prevention of cardiovascular diseases.

Key words: subclavian steal phenomenon, atherosclerosis, cardiovascular diseases.

### INTRODUCTION

The subclavian steal phenomenon is a relatively rare condition, which was first described through the angiography technique in 1960, by Cantorni. Among Europeans, this phenomenon, recorded by Doppler ultrasound and without any associated symptoms, is described to having a prevalence of around 1.3%.<sup>1</sup> The stenotic-occlusive involvement of the subclavian artery, proximal to the origin of the vertebral artery, leads to the occurrence of retrograde flow in the latter. Subclavian steal syndrome may be totally asymptomatic, or it may cause symptoms related to transient cerebral ischemia, caused solely by the chronic nature of this phenomenon or secondary to vigorous exercise of the neck and/or ipsilateral upper limb. The risk of stroke is, nevertheless, low. Its most common etiology, among Caucasian men, is atherosclerosis.<sup>2</sup>

In recent decades, due to the economic development of populations, cardiovascular diseases have been gradually replacing infectious diseases as causes

of global mortality, giving rise to a new “epidemic”, according to some authors. Atherosclerosis, a *sine qua non* condition for the development of these cardiovascular diseases, is now regarded as the leading cause of death in the so-called “developed” world.<sup>3,4</sup> In certain parts of the globe, such as Central and South America, Africa and Asia, atherosclerosis is less frequent.<sup>3</sup> According to the latest figures from the Instituto Nacional de Estatística (INE – National Portuguese Statistics Institute), more than 100,000 individuals, of both sexes, died in Portugal in 2005 due to circulatory diseases. In 2006, the mortality rate due to circulatory diseases was 3.1% in mainland Portugal and 2.8% in the Autonomous Region of Madeira.<sup>5</sup>

Given the magnitude of the problem, there is a need for prompt and appropriate intervention. In addition to hygienic and dietary measures, and drugs that should be prescribed according to the individual, public health measures, like regulating the amount of salt used in the baking industry, or anti-smoking campaigns, and campaigns to promote physical activity and encourage the adoption of a Mediterranean diet, are fundamental policies.<sup>6</sup>

Bearing in mind the current and future panorama, it is imperative to take aggressive action against the risk factors for atherosclerotic disease, which primarily affects the brain and heart regions, among others, so that, through a permanent attitude of prevention and alert, we can reduce the occurrence of acute events correlated with significant morbidity and mortality.<sup>3,6</sup>

Internal Medicine Service of Hospital Central do Funchal  
Received for publication on the 15<sup>th</sup> October 2009  
Accepted for publication on 22<sup>nd</sup> July 2010

According to the latest guidelines of the American College of Cardiology, intensive control of risk factors not only increases survival rates, but also reduces the number of recurrences of acute events and invasive medical interventions, significantly improving the quality of life of patients.<sup>7</sup>

### CLINICAL CASE

Male patient, aged 52 years, referred by the Assistant Doctor to the Clinic for the Prevention of Atherosclerosis and Dyslipidaemias of the Hospital Central do Funchal in 2002, due to the existence of multiple cardiovascular risk

factors which were difficult to control. The patient had personal history of mixed dyslipidaemia, high blood pressure, intermittent left claudication, sedentary lifestyle and alcohol and smoking habits, which the patient stopped in 1999. At the time of the consultation, the patient had been taking Amlodipine 10 (1+0+0), Indapamide 2.5 mg (1+0+0), Simvastatin 20 mg (0+0+1), Gemfibrozil 600 (0+0+1) and Buflomedil 300 (1+0+1). Family history included a brother who died suddenly (SIC) at the age of 60, and a brother who had one of his legs amputated at the age of 62.

On objective examination, the first observation revealed the existence of high blood pressure in the right upper limb (156/71 mmHg) and normal blood pressure in the left (110/53 mmHg). The patient had a body mass index (BMI) of 24.56 kg/m<sup>2</sup> and a waist circumference of 104 cm. Cardiopulmonary auscultation was normal and carotid auscultation revealed bilateral murmurs. The most relevant laboratory results were: total cholesterol of 301 mg/dL, HDL of 41 mg/dL, LDL of 175 mg/dL and triglycerides of 413 mg/dL.

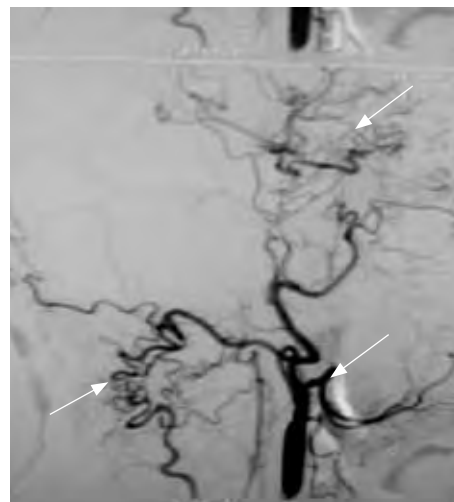
Given the suspicion of subclavian steal phenomenon, and taking into account the coexistence of multiple risk factors of atherosclerosis, we investigated the vascular regions most affected by the atherosclerosis, obtaining the following results:

- Electrocardiogram and echocardiogram - normal;
- Computed tomography of the brain (CT-CE) - “are-



The aortic arch and its branches (vertebro-carotid angiography).

FIG. 1



Left internal carotid artery (vertebro-carotid angiography).

FIG. 2

as of chronic ischemia in the parietal regions”;

- Vertebral and carotid Doppler ultrasound - “less than 50% asymptomatic stenosis of the distal common carotid artery and initial portion of the left internal carotid artery”;
- Vertebral and carotid angiography - “stenosis of the left subclavian artery” (Fig.1); “stenosis of the left internal carotid artery associated with exuberant collateral circulation” (Fig.2); “stenosis of the right internal carotid artery and extensive collateral circulation”;
- Abdominal CT scan - “aortic arch and abdominal aorta with calcified atherosclerotic plaques”; “unconventional thrombus in the left external iliac artery” (Fig. 3);
- Aorto-iliac angiography - “abdominal aortic stenosis; collateral blood flow (Fig.4);
- Peripheral Angiography - “right left popliteal artery occluded” (Fig.5).

We made some adjustments to the patient’s therapy and recommended changes tailored to the patient’s lifestyle. The severity of the condition, and the need to adhere to the therapy, were explained to the patient. The patient was referred to the Nutritional Clinic at our hospital, for nutritional advice. He was also referred to a Carotid Surgery Assessment Clinic (performed by Neurology in collaboration with Vascular Surgery). Two other investigations of the neck vessels were conducted by Doppler ultrasound, which

revealed, in 2004, “50-70% stenosis of the left internal carotid artery; occlusion of the right artery” and, in 2007, “bilateral carotid occlusion”. It was considered that there was no need to conduct endarterectomy in the different assessments of the patient. A multidisciplinary and conservative approach was opted for, enabling adequate control of the risk factors through the administration of medication and changes to the patient’s lifestyle.

The patient is currently asymptomatic and stabilized, from a clinical and laboratory perspective (Table 1), and is undergoing treatment with Simvastatin 20 mg, Ezetimibe 10 mg, Fenofibrate 267 mg, Lisinopril 5 mg, Aspirin 150 mg and Pentoxifylline 400 mg. Patient is in three-monthly follow-up by Internal Medicine (Atherosclerosis and Dyslipidaemia Prevention) and annual follow-up by the Carotid Surgery and Vascular Surgery Assessment clinics.

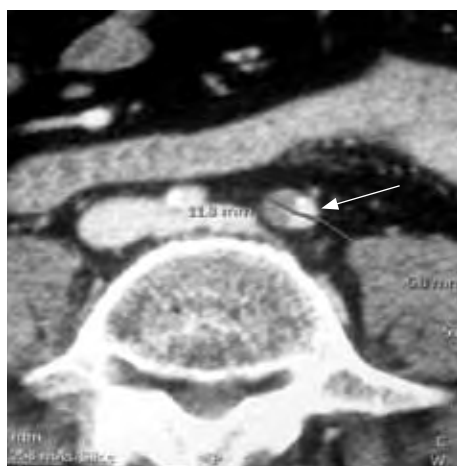
**DISCUSSION**

Atherosclerosis has a multifactorial etiopathogenesis, which involves genetic, environmental and behavioral factors. Smoking, a sedentary lifestyle, pre-existing hypertension, dyslipidaemia or diabetes mellitus, pro-inflammatory conditions, a reduction in circulating estrogen levels and high serum homocysteine levels are factors that favor the development of atherosclerosis over a period of years. These factors can result in endothelial dysfunction which, through different mechanisms, leads to accelerated progression of the atherosclerotic plaques, resulting in their instability

and culminating in an acute vascular event.<sup>8</sup>

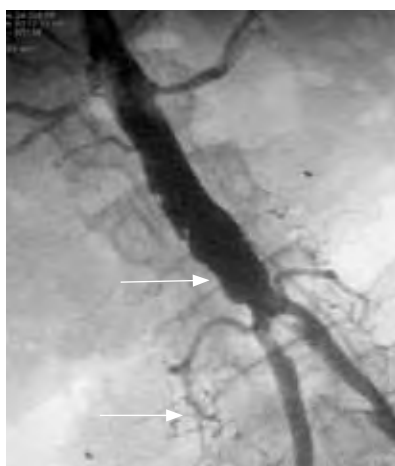
The fact that the coexistence of several risk factors has a potentiating effect is well documented in the literature.<sup>7</sup> However, this clinical entity has a very varied behavior. Although it is a multisystemic disease, it almost electively affects certain vascular regions in which the blood flow is more turbulent, namely, the abdominal aorta, coronary arteries, popliteal arteries, descending thoracic aorta, internal carotid and Willis polygon.<sup>8</sup> Besides this pathophysiology characteristic, the disease also has unpredictable behavior in relation to its clinical signs and symptoms. Certain patients have chronic manifestations, such as stable angina pectoris or intermittent claudication, which reflect the existence of stable atherosclerotic disease. In other individuals, the first sign of the disease is an atherothrombotic event, such as acute myocardial infarction or stroke, caused by the rupture of an unstable atherosclerotic plaque. Other patients may have atherosclerosis that evolves silently, and is only diagnosed *post mortem*.<sup>6,9</sup> We know that atherosclerosis evolves by periods of activity alternating with periods of stabilization. But how can we extend the latter and minimize the former? This is a question for which there is no clear, unequivocal answer, although some drugs, such as statins, can be of help.<sup>9,10</sup>

Our patient had multiple cardiovascular risk factors (high blood pressure, mixed dyslipidaemia, obesity and a history of smoking) which, coupled with poor adherence to the therapy, put him at a high overall risk of suffering an atherothrombotic event.



Left external iliac artery (abdominal CT scan).

FIG. 3



Iliac arteries (aorto-iliac angiography).

FIG. 4



Right popliteal artery (peripheral angiography).

FIG. 5

TABLE I

## Analytical Evolution

Date	12/01/1999	08/05/2002	31/03/2003	11/10/2004	06/01/2006	12/02/2007
<b>Analyses</b>						
Total Cholesterol (mg/dL)	301	221	206	187	244	165
LDL Cholesterol (mg/dL)	175	126	57	58	112	60
HDL Cholesterol (mg/dL)	41	42	52	56	41	53
Triglyceride (mg/dL)	413	421	485	264	279	106

However, despite the involvement of multiple arteries, as revealed by angiography, the patient remained clinically stable, thanks to the development, probably over many years, of an extensive collateral circulation network. The patient complained only of intermittent left claudication, despite the involvement of internal carotids, abdominal aorta and left external iliac, in addition to the left popliteal artery. The patient showed no clinical signs of vertebrobasilar insufficiency, despite the existence of areas of chronic ischemia in the parietal regions. Regarding the cardiac region, we did not perform the stress test due to the increased risk of provoking myocardial ischemia. We requested myocardial scintigraphy, which was refused by the patient because it would have meant traveling mainland Portugal, since we do not have nuclear medicine at our hospital.

The subclavian steal phenomenon more commonly affects the left arteries. One explanation for this is the anatomical existence of a more acute angle on the left, leading to a greater turbulence in this area. It is more common in men aged over 50 years. In Caucasians, this phenomenon is most frequently secondary to atherosclerotic disease, but other possible etiologies are Takayasu's arteritis, giant cell arteritis, tumor invasion, trauma or previous local surgical instrumentation.<sup>2</sup>

The main sign observed on objective examination,

which causes us to believe that this phenomenon is a differential in blood pressure higher or equal to 20 mmHg measured in the upper limb, compared with the lower limb. Other possible signs are a decreased radial or cubital pulse or absent pulse on palpation, auscultation of a murmur in the subclavian artery corresponding to the lesion, and positive subclavian steal test (reactive hyperemia in the arm, provoked by applying pressure to the cuff while taking the patient's blood pressure). The diagnosis can be revealed by color Doppler ultrasound or CT angiography, but the gold standard is still coronary angiography. The difference between the terms subclavian "syndrome" and "steal" lies in the presence or absence, respectively, of vertebrobasilar insufficiency symptoms. The therapeutic approach is directed at treating the underlying etiology. In the event of dizziness or disabling changes in vision, surgical therapy is indicated, using biological or synthetic prostheses or carotid-subclavian arterial bypass.<sup>1,2</sup>

In our case, the suspicion was based on the finding of an asymmetry of about 40 mmHg in blood pressure in the upper limbs. The patient showed no neurological symptoms related to this phenomenon. The diagnosis was confirmed by angiography in the vertebral carotid region. In relation to the therapeutic approach, we must also mention that the option not to perform endarterectomy in a patient with this extent

of atherosclerotic plaques in the carotid arteries was controversial. However, this was the attitude taken, since there were no neurological symptoms or history of acute vascular events, indicating that the disease was stable. Moreover, the procedure would carry a risk of cerebral embolization. Because the patient was asymptomatic, insertion of a subclavian stent was not indicated. The treatment mainly involved controlling the risk factors for atherosclerosis, with intensive clinical and analytical monitoring (*Table I*), resulting in LDL cholesterol below 70 mg/dL, as currently recommended by the American College of Cardiology.<sup>7</sup>

## CONCLUSION

The authors wish to draw attention to the subclavian steal phenomenon, since it is an uncommon condition, and to the peculiarity of this case study, given the extent of atherosclerotic lesions and the non-occurrence, to date, of any acute vascular event. One is tempted to draw an analogy with a “time bomb”, since, according to what was presented, we expect that an atherothrombotic event could occur at any time. We can say that the images speak for themselves and clearly demonstrate the extent and severity of the atherosclerotic disease in this patient. Therefore, this gradual evolution that provided the patient with an adaptation due to the development of an extensive collateral circulation network is intriguing; it has allowed the patient to live virtually in conditions of normal health, with only symptoms of peripheral arterial disease. The completion of a clinical history and a thorough objective examination was the key point for the diagnostic suspicion of subclavian steal phenomenon, which initially led to the investigation of the vascular regions most frequently affected by atherosclerosis, allowing a better characterization of the clinical situation and guidance for the patient.

It is once again the Internist’s role to have an alert and preventive attitude, for which aggressive control of the major risk factors of atherosclerosis is essential, in order to reduce the occurrence of acute events.<sup>7</sup> ■

## Acknowledgements

Our thanks to Dr. Lucília Nóbrega and Dr. José França, from the Department of Vascular Surgery of the HCF, for providing the angiography images and for their indispensable assistance in interpreting the results.

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