

SUBCLAVIAN STEAL SYNDROME IN A PATIENT WITH DIZZINESS, LEFT UPPER ARM PARESTHESIA, AND EXERCISE- RELATED SYNCOPE – A CASE REPORT

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ABSTRACT

Background: Dizziness, numbness, and paresthesia of upper limbs are common symptoms in patients who undergo physiotherapy. Most of the symptoms are caused by neurological and skeletomuscular diseases. Subclavian steal syndrome is a rare case of such symptoms.

Aim of the study: This study aimed to analyze how to proceed with symptomatic patients suspected of subclavian steal syndrome.

Material and methods: Medical documentation was used.

Case report: A 69-year-old patient, long term cigarette smoker, with the anamnesis of spine surgery due to discopathy, atherosclerosis of the lower extremities, and hypertension was referred to our hospital due to exacerbation of coronary artery disease. During his stay in the cardiac department, after smoking a cigarette, he felt pain and numbness in his left arm. He began intense movement of this hand, and then lost consciousness. A difference in pulse filling and blood pressure between the upper extremities was noted. In a duplex Doppler study, reversal flow in the left vertebral artery due to stenosis of the left subclavian artery was found. Angio-CT of the head vessels confirmed a significant stenosis of the proximal left subclavian artery. The patient was referred for further treatment to a Vascular Surgery Clinic.

Conclusions: The subclavian steal syndrome is a rare cause of dizziness and paresthesia of the upper extremities. Physiotherapy procedures on the affected limb can exacerbate neurological symptoms. It is easy to identify the disease based on differences in pulse amplitude and blood pressure between upper limbs. Diagnosis should be established before proceeding with physiotherapy, due to the fact that some procedures can worsen the patient's condition.

KEYWORDS: subclavian steal syndrome, dizziness, paresthesia

BACKGROUND

Subclavian steal syndrome (SSS) is a phenomenon causing retrograde flow in an ipsilateral vertebral artery due to stenosis or occlusion of the subclavian artery, proximal to the origin of the ver-

tebral artery. The term was introduced by Fisher in 1961 in his commentary to Reivich's article, who first connected symptoms of transient ischemic attack with retrograde blood flow through vertebral artery [1,2].

If the subclavian stenosis exists proximal to the vertebral artery branch, there is a chance of reverse blood flow from the brain circulation (Circle of Willis) and a stealing phenomenon can occur [3]. Due to retrograde flow from the contralateral vertebral and basilar arteries into the low-pressure ipsilateral upper extremity artery, vertebro-basilar insufficiency symptoms appear. Exercises of the upper limbs increase the blood flow to the muscles and steal it from the brain. Therefore, during upper extremity exertions, symptoms of arm fatigue, cerebral ischemia, and reduced blood flow in the occipital cortex can occur. A left subclavian stenosis may also provoke angina symptoms in patients after a successful coronary artery bypass grafting (CABG) with the left internal mammary artery (LIMA) [4].

Despite the subclavian stenosis, most patients are asymptomatic, and the SSS is an incidental finding or a differential diagnosis in patients with a pulse deficit or a systolic blood pressure difference of greater than 20 mmHg between the arms [5]. If there is isolated stenosis, the likelihood of symptoms is less than in other vascular beds. Most common symptoms are arm claudication, consisting of exercise induced arm pain, paresthesia or fatigue [6]. Only 5.3 % of patients experience neurological symptoms [7]. Vertebrobasilar hypoperfusion can result in visual disturbances, dizziness, ataxia, vertigo, dysarthria, or syncope.

The most common etiology of SSS is an atherosclerotic plaque, mostly in patients with multiple comorbidities. SSS symptoms may indicate a very high cardiovascular risk for atherosclerotic complications, such as myocardial infarction and brain stroke [8]. In other cases, the subclavian stenosis or occlusion may be caused by arteritis, inflammation due to radiation exposure, compression syndrome, fibromuscular dysplasia, or less often, aortic dissection, Takayasu's disease, giant cell arteritis, or thoracic outlet syndrome [9]. An anomalous connection of the left subclavian artery to the pulmonary artery in d-transposition of the great arteries was also described as a rare case of SSS [10]. The prevalence of SSS is approximately 0.6 to 6.0%, mostly in older patients. Males are more affected compared to females by a ratio of about 2 to 1 [11]. The left subclavian artery is more likely to be affected than the right [3].

Due to advances in medical science, people live longer, resulting in increased medical and rehabilitation needs. The risk associated with pharmacotherapy is high, hence attention is being given to a wider application of physical therapy methods [12]. For many patients, rehabilitation is a chance to return to normal activity and an optimum quality of life. The largest group referred for rehabilitation are patients with root pain, and spine disorders [13]. Patients with cervical radiculopathy often present with complaints that include pain, numbness, and paresthesia of upper limbs. SSS should merit consideration as one of the differentials in the evaluation of a patients with such symptoms.

Medical diagnostic classifications focus on identification of disease are determined by physicians. Rec-

ognition of risk factors for certain medical conditions impacts the physical therapy interventions. The physical therapist, before embarking upon a therapy plan, must determine whether the patient's condition is appropriate to start exercises. Therefore, in some cases of SSS, the patient should be immediately referred for other medical investigation and treatment, prior to any physical therapy.

AIM OF THE STUDY

This study aimed to analyze how to proceed with symptomatic patients suspected of subclavian steal syndrome.

MATERIAL AND METHODS

The medical documentation of a patient hospitalized in December 2019 in the Department of Cardiology at Saint Elisabeth Hospital in Biala was used. The patient's consent to publication was obtained.

CASE REPORT

A 69-year-old patient, with familial anamnesis of atherosclerosis, a long-term cigarette smoker, osteoarthritis of the spine, atherosclerosis of the lower extremities for twenty years (Fontaine IIB), hypertension for fifteen years, and a five-year history of coronary artery disease, was admitted to the Cardiac Department due to episodes of exercise induced angina (Canadian Cardiovascular Society class II) to undergo diagnostic tests. There was no history of stroke or myocardial infarction. On admission, the patient reported episodes of fainting and dizziness (lasting for few minutes), as well as numbness in the left arm, worsening after exercise, especially during arm rising. These symptoms began four months prior to admission, worsening over that period.

In the physical examination he was hemodynamically stable, with an increased arterial blood pressure of 153/96 mmHg; a 20 mmHg difference in blood pressure between both upper extremities, and weak pulse in the left radial artery, was noted. The results of the laboratory tests (morphology, fasting blood sugar level, creatinine, electrolytes, TSH) were within normal values; the elevated cholesterol and LDL level indicated a high cardiac risk. The resting ECG did not show any abnormalities. The Bruce exercise treadmill test (XScribe 6.25, Trackmaster) was aborted in the third minute due to angina, there were no ST-T wave abnormalities noted.

During his stay in hospital, after smoking a cigarette, the patient began to feel numbness and pain in the left hand. He started shaking this hand intensely and making rotational movements in the ipsilateral shoulder joint, losing consciousness as a result.

Duplex Doppler examination of the major arteries of the neck was performed (Arietta V70, Aloka, Hitach, Japan). It revealed 80% narrowing of the lumen in the right internal carotid artery, retrograde flow in the left

vertebral artery, and a difference in the flow spectrum between radial arteries (Fig. 1). The angio-CT of the cranial vessels (Brightspeed S, General Electrics, USA) confirmed a high-grade atherosclerotic stenosis (up to 75% of the surface area) of the proximal left subclavian artery before the vertebral artery departed (Fig. 2). The right internal carotid artery was also obstructed to 65% of the surface area.

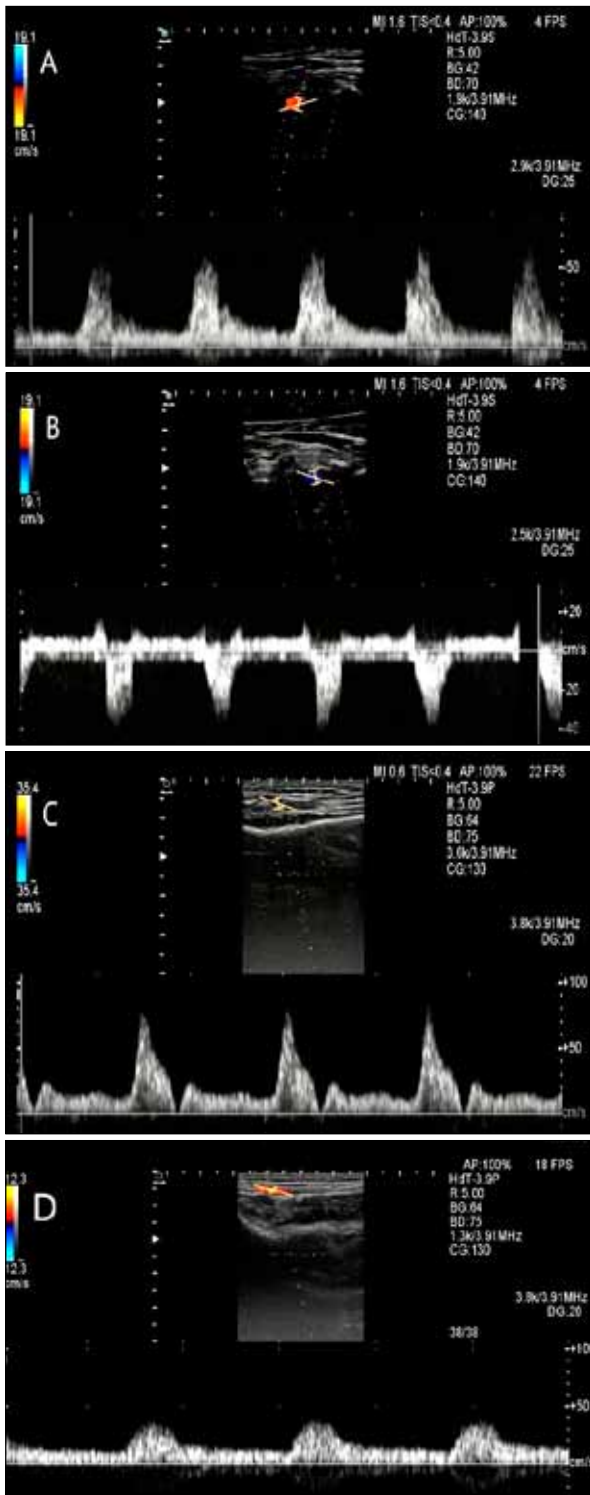


Figure 1. Doppler flow spectrum in radial and vertebral arteries. A – Right vertebral artery. B – Retrograde flow in the left vertebral artery. C – Right radial artery. D – Reduced flow in the left radial artery.

Source: the author.

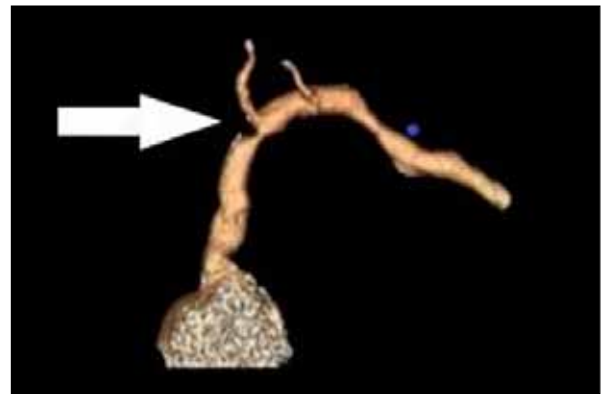


Figure 2. A high-grade proximal stenosis in the left subclavian artery (arrow).

Source: the author.

DISCUSSION

Patients suffering with SSS are found among those referred for rehabilitation with spine and limb symptoms. The disease may occur when a significant stenosis in the subclavian artery compromises distal perfusion to the vertebral, axillar, or internal mammary artery. The result is a pressure gradient favoring reversal blood flow (retrograde flow) in the vertebral artery distal and ipsilateral to the subclavian stenosis [1]. Arm claudication is the most common complaint, coexisting with exercise induced arm pain and fatigue [14]. The real prevalence of the disease is still unknown, but it has been estimated between 0.6-6% [7]. Physiotherapy procedures on the upper limb, by reducing arterial resistance and increasing blood flow to the arm muscles, can exacerbate neurological symptoms. In rare circumstances reverse flow of vertebral artery may cause vertebrobasal ischemic attack [9]. The diagnosis in such cases is of utmost importance, since the character of the pathological process determines the treatment policy.

One-sided pain in the upper limb accompanied by numbness and weakness, intensifying especially after exercise, should raise the suspicion of SSS. A difference in amplitude of pulses and in systolic blood pressure of more than 20 mmHg between arms is a simple and cost-efficient diagnostic screening test. Doppler ultrasound of the extracranial arteries is the test of choice for SSS confirmation. Visualization of stenosis, or more often, reversal flow in the vertebral artery at rest or arm exercise, facilitates accurate diagnosis [15]. Angio-CT or angio-MR finally confirm the narrowing of the subclavian artery, and often show the coexisting narrowing of the carotid arteries [7]. Subclavian artery angiography remains the gold standard to confirm the diagnosis. These tests are necessary before planning surgical treatment.

Dizziness, numbness, and paresthesia of upper limbs are common in patients who undergo physiotherapy. Physical therapy of a patient with missed diagnosis or misdiagnosis of SSS may provoke symptoms, and can cause deterioration of their condition. Therefore,

amplitude of pulse on both radial arteries, and blood pressure on both upper extremities, should be carefully observed before qualifying patients with neurological symptoms for physiotherapy.

The implementation of appropriate treatment is important because, in many cases, atherosclerotic lesions in patients with symptomatic SSS also affect other vascular areas, such as coronary and cerebral circulation. Therefore, SSS can be a marker of cardiovascular risk in a population that will benefit from aggressive secondary prevention. According to the recommendations of the European Society of Cardiology, every patient requires pharmacotherapy, antiplatelet therapy, aggressive lipid management, and lifestyle modifications [8]. Incidental subclavian stenosis, in the absence of symptoms, even if reversal flow in the vertebral artery is demonstrated, rarely requires revascularization. In patients with symptomatic SSS, subclavian artery endovascular angioplasty with stenting gives the best clinical results, with low surgical risk [16]. In other cases, the traditional surgical approach can be used. Technical success of the percutaneous approach can be achieved in 90% of cases, with five-year patency rates of 85% [17,18]. Longer or more complex occlusions

in the subclavian artery are usually qualified for surgical treatment to by-pass the stenosis or occlusion of the subclavian artery.

In our case, subclavian steal syndrome of the left subclavian artery, accompanied by stenosis of the right internal carotid artery, was diagnosed. The patient has been scheduled for optimal medical treatment. Acetylsalicylic acid, a statin, and antihypertensive drugs were prescribed. He was advised to stop smoking immediately. He was also qualified for further treatment and follow-up in the Department of Vascular Surgery.

CONCLUSIONS

Dizziness, numbness, and paresthesia of upper extremities occur in subclavian steal syndrome. Physical exercise of the upper limbs may provoke symptoms, or even induce a stroke. The difference in pulse amplitude and blood pressure between upper limbs is a simple test which should be performed on patients who are being qualified for physiotherapy. Diagnosis must be established before proceeding with physiotherapy, due to the fact that some procedures may worsen the patient's condition.

REFERENCES

1. Reivich M, Holling HE, Roberts E, Tool JF. Reversal of blood flow through the vertebral artery and its effect on cerebral circulation. *N Engl J Med* 1961; 265: 878–885.
2. Fisher CM. A new vascular syndrome: "The subclavian steal". *N Engl J Med* 1961; 265: 912–913.
3. Potter BJ, Pinto DS. Subclavian steal syndrome. *Circulation* 2014; 129: 2320–2323.
4. Takach TJ, Reul GJ, Cooley DA, Cooley DA, Livesay JJ, Ott DA, et al. Myocardial thievery: the coronary-subclavian steal syndrome. *Ann Thorac Surg* 2006; 81: 386–392.
5. Tan TY, Schminke U, Lien LM, Tegeler CH. Subclavian steal syndrome: can the blood pressure difference between arms predict the severity of steal? *J Neuroimaging* 2002; 12: 131–135.
6. Caesar-Peterson S, Qaja E, Quaja E. Subclavian Artery Stenosis. [Updated 2020 Jan 29]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2020 Jan- [online] [cit. 19.03.2020]. Available from URL: <https://www.ncbi.nlm.nih.gov/books/NBK470221/>.
7. Osiro S, Zurada A, Gielecki J, Shoja MM, Thubs SR, Loukas M. A review of subclavian steal syndrome with clinical correlation. *Med Sci Monit* 2012; 18(5): RA57–RA63.
8. Aboyans V, Ricco JB, Bartelink MEL, Björck M, Brodmann M, Cohnert T, et al. 2017 ESC Guidelines on the Diagnosis and Treatment of Peripheral Arterial Diseases, in collaboration with the European Society for Vascular Surgery (ESVS). *Eur Heart J* 2018; 39(9): 763–816.
9. Ochoa VM, Yeghiazarians Y. Subclavian artery stenosis: a review for the vascular medicine practitioner. *Vasc Med* 2011; 16: 29–34.
10. McMahon CJ, Thompson KS, Kearney DL, Nihill MR. Subclavian steal syndrome in anomalous connection of the left subclavian artery to the pulmonary artery in d-transposition of the great arteries. *Pediatr Cardiol* 2001; 22(1): 60–62.
11. Shankar Kikkeri N, Nagalli S. Subclavian Steal Syndrome. [Updated 2020 Jul 5]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2020 Jan- [online] [cit. 19.03.2020]. Available from URL: <https://www.ncbi.nlm.nih.gov/books/NBK554599/>.
12. Jesus TS, Landry MD, Hoening H. Global need for physical rehabilitation: systematic analysis from the Global Burden of Disease Study 2017. *Int J Environ Res Public Health* 2019; 16(6): 980.
13. Bartyzel-Lechforowicz H, Idzikowski M, Martowicz B. Zapotrzebowanie na zabiegi rehabilitacyjne w wybranych gabinetach na terenie Rzeszowa. *Med Og Nauk Zdr* 2011; 17(4): 185–188. (In Polish).
14. Alcocer F, David M, Goodman R, Jain SK, David S. A forgotten vascular disease with important clinical implications. Subclavian steal syndrome. *Am J Case Rep* 2013; 14: 58–62.
15. Vecera J, Vojtisek P, Varvarovský I, Lojik M, Másová K, Kvasnicka J. Non-invasive diagnosis of coronary-subclavian steal: role of the Doppler ultrasound. *Eur J Echocardiogr* 2010; 11(9): E34.
16. Sojka M, Sojka A, Jargiełło T, Pyra K, Drelich-Zbroja A, Miazga M, et al. Leczenie zespołu podkradania tętnicy podobojczykowej na drodze wewnątrznaczyniowej – doświadczenia własne. *Post Nauk Med* 2015; 2: 129–134. (In Polish).
17. Labropoulos N, Nandivada P, Bekelis K. Prevalence and impact of the subclavian steal syndrome. *Ann Surg* 2010; 252(1): 166–170.
18. Mleczo SZ, Wrotniak L, Kablak-Ziembicka A, Odrowąż-Pieniążek P, Badacz R, Przewłocki T. Zwężenie tętnicy podobojczykowej i pnia ramiennie-głowowego: obrazowanie, wskazania do leczenia interwencyjnego oraz wyniki bezpośrednie i odległe zabiegów. *Kardiol Dypl* 2014; 13: 31–44. (In Polish).

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