The Subclavian Steal Syndrome Disclosed Significant Generalized Atherosclerosis: A Case Report

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***Key Words**: subclavian steal syndrome, generalized atherosclerosis, multisite vascular disease, atherosclerotic lesions, vascular imaging, case report.*

***Summary.** We present an illustrative case report of the symptomatic subclavian steal syndrome which disclosed significant multisite vascular disease. This case report reviews symptoms, diagnostic aspects, treatment and nursing care aspects which exist for subclavian steal syndrome. Most of the patients with a hemodynamic subclavian steal have few or no clinical symptoms and should be treated conservatively. When symptoms interfere with the patient's quality of life, endovascular or surgical treatment should be considered.*

Introduction

Subclavian steal syndrome (SSS) is a fascinating rare vascular phenomenon in which proximal subclavian artery severe stenosis or total occlusion determinates retrograde flow in the vertebral artery. This flow redirectioning causes vertebrobasilar insufficiency and manifests as a variety of neurological and vascular insufficiency signs and symptoms. However, in many cases this phenomenon is diagnosed as an accidental finding in an asymptomatic patient (1).

Multisite artery disease is diagnosed when clinically significant atherosclerotic lesions are present in at least two major circulatory areas (2). Multivascular disease is a common challenge in clinical practice, related to increased risk for both vascular and coronary surgery. Some case reports represent promising results of percutaneous treatment as an option for patients with multisite artery disease (2, 3).

This paper presents an illustrative case of symptomatic subclavian steal syndrome which disclosed significant multisite vascular disease. This case report reviews symptoms, diagnostic aspects, treatment and nursing care aspects which exist for subclavian steal syndrome.

Case Report

A 66-year-old man with a medical history significant for hypertension and dyslipidaemia presented to the cardiologist complaining of weakness and dizziness or blurred vision, and reclined head. The patient also felt pain in his lower extremities with exercise. His physical examination was remarkable for a bruit over the left subclavian artery and a higher systolic blood pressure (difference of 118 mmHg) in the left arm than in the right arm (the blood pressure was 198/120 mmHg in the left arm and 80/50 mmHg in the right arm). The pulse was absent in the right arm. The left arm pulse was easily palpable. Moreover, dorsalis pedis and posterior tibial arteries pulses were not palpable. The patient's physical examination was otherwise unremarkable.

An arch aortography was performed for the assessment of subclavian, brachiocephalic and left common carotid arteries. It demonstrated total occlusion of the right subclavian, brachiocephalic and left common carotid arteries (Fig. 1); furthermore, the left vertebral artery had a significant stenosis of approximately 75–80% (Fig. 2A). His left vertebral artery was the main source of blood supply to the right side of the head and the right arm (Fig. 3). Moreover, the aortography showed collateral circulation through arteries of the shoulder and the left external carotid artery up to the left common carotid artery.

Coronary angiography showed a 90% stenosis of the proximal right coronary artery (RCA) and a 50% stenosis of the distal RCA (Fig. 4A). The aortography was performed because of absent bilateral common femoral arteries pulses. It showed total occlusion of the left external iliac artery and a 50% stenosis of the right external iliac artery.

Brachiocephalic and subclavian arteries can be affected by vasculitides like Takayasu arteritis and giant cell arteritis. Therefore, a carotid ultrasound and tests of antineutrophil cytoplasmic antibodies (ANCA) and erythrocyte sedimentation rate (ESR)

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were performed. The ANCA was negative. The ultrasound demonstrated carotid intima-media thickness; moreover, the ESR was elevated – 58 mm/h. Finally, positron-emission tomography images did not confirm vasculitides. In conclusion, it was significant generalized atherosclerosis.

How to Treat? Total occlusion of the right subclavian, brachiocephalic and left common carotid arteries is a rare but potentially devastating entity. Medical therapy alone or endarterectomy is associated with high rates of mortality and recurrent stroke.

Fig. 1. Aortography: total occlusion of the right subclavian, brachiocephalic and left common carotid arteries

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The optimal management of this disease remains poorly understood. So, a multidisciplinary vascular team made a decision to stent the right coronary artery and the left vertebral artery. The patient underwent successful stent placement of the RCA and the left vertebral artery which restored good blood flow (Figs. 2B and 4B).

Intermittent claudication was treated by the best medical therapy (smoking cessation, a healthy diet and physical activity, statin therapy to reduce LDL-C to < 1.8 mmol/L, antiplatelet therapy to lower blood pressure to < 140/90 mmHg). The patient was discharged to a rehabilitation centre on the fifth day of hospitalization.

How to Care for Patients with Subclavian Steal Syndrome? The role of nursing in the management of subclavian steal is diverse. In both outpatient and inpatient settings, nurses are involved not only in the triage of patients and the initial evaluation of their conditions, but also in the ongoing assessment and education of these patients (15).

Cardiac nurses have daily exposure to patients at risk for SSS (16). Assessing patients with symptoms of chest discomfort or other cardiac symptoms of angina, they can identify the person with potential SSS (17). Early detection and identification might prevent further myocardial injury, thus optimizing patient care and improving patient outcomes (16). Nurses who are knowledgeable of the criteria for subclavian steal syndrome play a key role in identifying these patients. By asking pertinent questions, a nurse can elicit information from the patient that will be helpful in the diagnosis of subclavian steal syndrome (15). Vital signs, routinely assessed by nurses, provide important information related to a

Fig. 2. Left vertebral artery 75–80% stenosis (A); angioplasty and stenting of the left vertebral artery (B)

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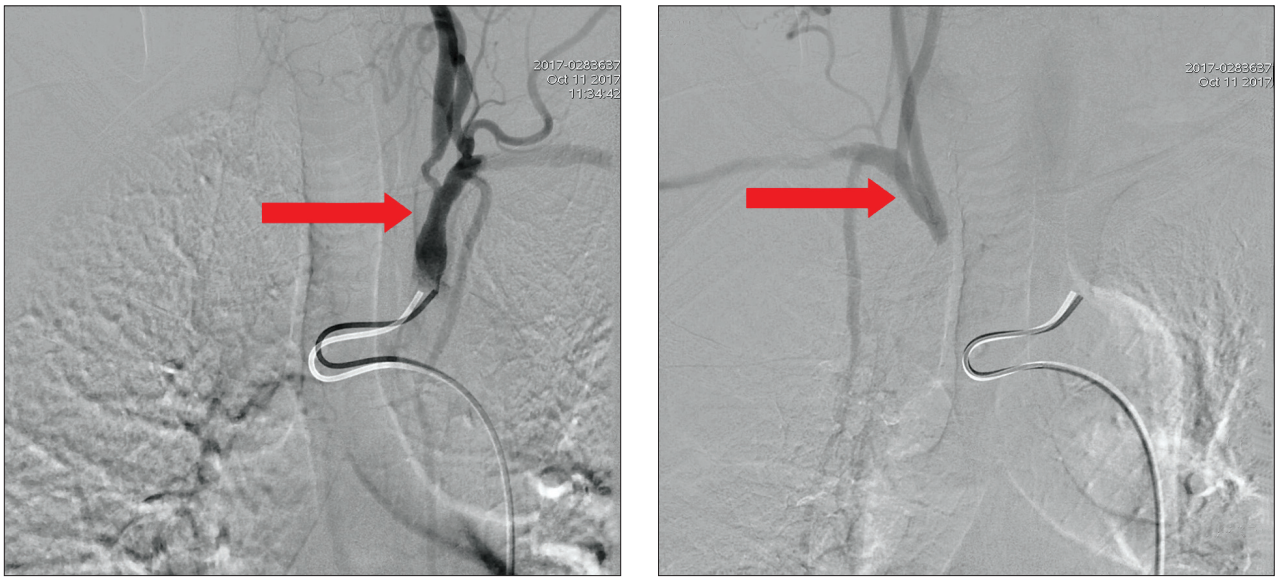

Fig. 3. Angiography: left vertebral artery the main source of blood supply to the right side of head and right arm Department of Cardiology, Medical Academy, Lithuanian University of Health Sciences, Lithuania.

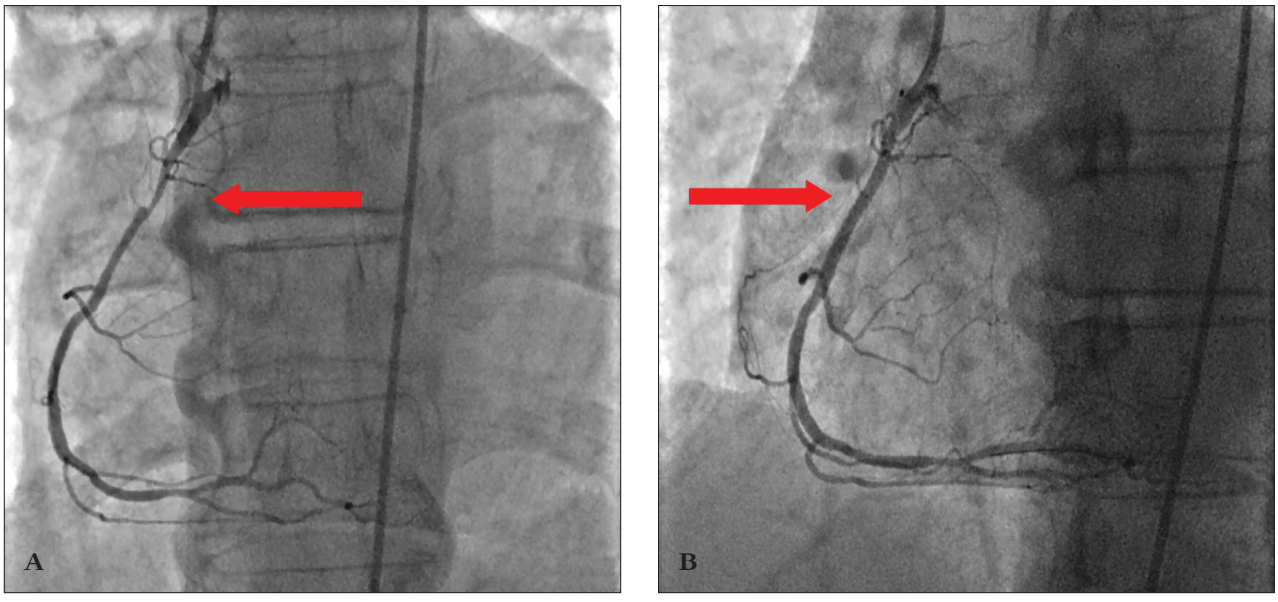

Fig. 4. Right coronary artery 90 % stenosis (A); angioplasty and stenting of the right coronary artery (B) Department of Cardiology, Medical Academy, Lithuanian University of Health Sciences, Lithuania.

person's general and baseline health status. Abnormalities in the vital signs are often the first clue that a patient has a subclavian steal. Nurses skilled in the assessment of bilateral blood pressure and pulse and their expected normal values can easily note discrepancies, irregularities, and unusually high or low values. Unusual findings warrant further investigation to confirm or rule out the diagnosis of a subclavian steal (15).

The most cost-conscientious and accessible subclavian artery stenosis (SAS) screening tools are those of physical examination including inspection of distal upper extremities for signs of hypoperfusion, palpation for delayed or decreased pulse amplitude on the affected side, auscultation of supraclavicular fossa to listen for bruits, and most importantly bilateral brachial blood pressure measurements to detect a systolic differential. A carotid bruit may be detectable on neck auscultation. The most important physical finding suggestive of SSS is a discrepancy in right and left arm blood pressure measurements, with a significantly lower blood pressure noted in

the left arm. Assessment of bilateral brachial artery blood pressure reveals a left arm pressure that is lower than that of the right by at least 20 mmHg (17, 18). Systolic blood pressure differentials of > 10 mmHg, 15 mmHg, and 20 mmHg are the most commonly used cut-offs for detecting the presence of a hemodynamically significant SSS (19, 20). Upper extremity blood pressure differences are usually due to atherosclerotic plaque, resulting in a reduction in blood pressure to one upper extremity, or less commonly, both upper extremities (21).

In cases of an asymptomatic subclavian steal, the nurse's primary role is in educating the patient. Information should be provided for patients so that they can understand the diagnosis (15). Indeed, the growing body of evidence confirms that in patients with atherosclerotic vascular disease, comprehensive risk factor management reduces the risk as assessed by a variety of outcomes, including improved survival, reduced recurrent events, the need for revascularization procedures, and improved quality of life (22). It is important to provide education about the recognition of the symptoms associated with a worsening subclavian steal and the implications of these symptoms. Patients will need to be reassured that in the majority of cases subclavian steal is essentially a benign problem, but that if it does progress, it is a treatable non-lifethreatening problem. In addition, patients should be educated about the atherosclerotic disease process and counselled on the modification of associated risk factors (15).

Smoking. Every tobacco user should be advised at every visit to quit and avoid exposure to environmental tobacco smoke at work, home, and public places. Their willingness to quit should be assessed at every visit (23).

Weight Management. All patients should be counselled regarding the need for lifestyle modification, including weight control, increased physical activity, alcohol moderation, sodium reduction, and emphasis on increased consumption of fresh fruits, vegetables, and low-fat dairy products. Dietary therapy for all patients should include reduced intake of saturated fats (to < 7% of total calories), trans fatty acids (to < 1% of total calories), and cholesterol (to < 200 mg/d). Body mass index and/or waist circumference should be assessed at every visit, and the clinician should consistently encourage weight maintenance/reduction through an appropriate balance of lifestyle physical activity, structured exercise, caloric intake, and formal behavioural programmes when indicated to maintain/achieve a body mass index between 18.5 and 24.9 kg/m^2 (23).

Blood Pressure Control. Patients with blood pressure > 140/90 mm/Hg should be treated, as tolerated, with blood pressure medication, treating initially with β-blockers and/or ACE inhibitors, with addition of other drugs as needed (23).

Physical Activity. For all patients, the clinician should encourage 30 to 60 minutes of moderate-intensity aerobic activity, such as brisk walking, at least 5 days and preferably 7 days per week, supplemented by an increase in daily lifestyle activities (e.g., walking breaks at work, gardening, household work) to improve cardiorespiratory fitness (23).

Indeed, the growing body of evidence confirms that in patients with atherosclerotic vascular disease, comprehensive risk factor management reduces the risk as assessed by a variety of outcomes, including improved survival, reduced recurrent events, the need for revascularization procedures, and improved quality of life. It is important not only that the healthcare provider implement these recommendations in appropriate patients but also that healthcare systems support this implementation to maximize the benefit to the patient (23).

Discussion

Atherosclerosis is often generalized. If atherosclerosis is diagnosed in one vascular area, multisite artery disease (MSAD) is common: from 10 to 15% frequency in patients with carotid artery disease (CAD) and from 60 to 70% with hemodynamically significant carotid stenosis or lower extremity artery disease (LEAD) (3).

Overall, the risk of a different location of peripheral arterial diseases (PADs) increases dramatically with age and is closely related to major cardiovascular (CV) risk factors, including smoking, hypertension, dyslipidaemia and diabetes.

When a vascular area is damaged by atherosclerosis, not only the particular organ is endangered, but also the risk of any CV event is generally increased. Any vascular territory diagnosed with atherosclerosis can be as a marker of a CV risk. It emphasizes the importance of general CV disease prevention beyond the management of the diseased area (3–5).

MSAD is associated with worse clinical outcomes; however, screening for asymptomatic atherosclerotic lesions in other vascular sites has not been proven to improve clinical outcomes, prognosis. Personal and family clinical history and physical examination are key steps in PADs diagnosis (family history of CAD, cerebrovascular disease, aortic aneurysm as well as LEAD). Evaluation of CV risk factors and comorbidities as well as a review of the symptoms related to different vascular territories should be included. Lifestyle habits, dietary patterns, walking performances, weight control and physical activity need to be systematically assessed and encouraged for the patients (3, 23).

Although physical examination alone is of relatively poor sensitivity and reproducibility, a sys-

tematic approach is mandatory. When carotid bruits are diagnosed, the risk of MI and CV death doubles (6). Inter-arm blood pressure (BP) asymmetry (⩾ 15 mmHg) and a femoral bruit is a sign of elevated risk of ischemic disease and death (7, 8).

Duplex ultrasound is a useful tool to detect subclinical artery disease (e.g., carotid plaque), as a CV risk predictor. Doppler assessment of subclavian arteries enables the detection of high-velocity flows indicating > 50% stenosis. Monophasic post-stenotic flow and altered flow in the ipsilateral vertebral artery can be found in more than 70% of the cases of when proximal subclavian stenosis. When SSS is suspected, flow in the ipsilateral vertebral artery should be measured. Reduced flow velocities are measured in the ipsilateral subclavian artery when severe stenosis or occlusion of the right brachiocephalic trunk is diagnosed. Abnormal or doubtful duplex ultrasound should be prompt to cardiac imaging (CTA or MRA). In the case of discrepancy between non-invasive imaging tools digital subtraction angiography (DSA) is being used as the standard reference in vascular imaging (3).

Usefulness of computed tomography angiography (CTA) is a non-invasive high-resolution fast investigation with 3D reformatting opportunity. Like a DSA and magnetic resonance angiography (MRA), CTA displays a 'roadmap' of the vascularization that is important for treatment strategies (lesion localization and severity). The drawbacks of CTA are insufficient functional and hemodynamic data, exposure to radiation and the use of iodinated contrast agents, which should be minimized in the case of CKD, also in case of allergies.

MRA is used for peripheral artery contrast imaging (i.e., gadolinium) and non-contrast techniques (i.e., phase contrast and time-of-flight sequences). These techniques have lesser resolution and are suceptible to artefacts that affects interpretation. It is possible to use them in patients with mild to moderate CKD. Compared with CTA, MRA does not demand iodine contrast and has better soft tissue resolution; however, motion artefacts are more frequent and contraindications include implantable devices (pacemakers, implantable cardioverter defibrillators, except conditional and MRI compatible pacemakers and leads), claustrophobia and severe CKD. In this case, the risk of nephrogenic systemic fibrosis following gadolinium administration should not be underestimated. Vascular calcifications, potentially affecting revascularization procedures, can be undervalued (3).

Positron emission tomography is suitable for the diagnosis of arteritis, but not for assessment of atherosclerotic lesions in clinical practice (3).

The therapeutic goal of patients with PADs includes the relation of specific symptoms of any localization to a specific lesion and evaluation of the PADs risk.

In addition, these patients have an increased risk of any CV event. General CV prevention is really important and management should be multidisciplinary. Best medical therapy (BMT) consists of management of CV risk factors, optimal pharmacological therapy, as well as lifestyle changes (healthy diet, weight loss and regular physical exercise) (11, 12). The pharmacological component of BMT includes antihypertensive, lipid-lowering and antithrombotic drugs. In patients with diabetes, optimal glucose level control is recommended (13).

All patients with PADs should lower their serum low-density lipoprotein cholesterol (LDL-C) to < 1.8 mmol/L (< 70 mg/dL) or decrease by ⩾ 50% if the initial LDL-C level is between 1.8 and 3.5 mmol/L (70 and 135 mg/dL) (3, 12).

In patients with symptomatic PADs, antiplatelet agents are recommended for secondary CV event prevention. In those who have an asymptomatic > 50% carotid artery stenosis, a long-term antiplatelet therapy (usually low-dose aspirin) should be considered when the bleeding risk is low (Class IIa level C). Antiplatelet therapy in patients with isolated asymptomatic LEAD is not routinely indicated because of the lack of proven benefit (Class III level A) (3).

Systolic blood pressure (SBP) control reduces the risk of CV events. According to the current ESC/European Society of Hypertension guidelines, a target BP < 140/90 mmHg is recommended, except diabetic patients, for whom a diastolic blood pressure ⩽ 85 mmHg is considered safe. In patients with PADs, healthy lifestyle and reduced daily salt intake (< 5–6 g/day) are recommended. Diuretics, beta-blockers, calcium antagonists, angiotensin-converting enzyme inhibitors and angiotensin receptor blockers are all suitable for antihypertensive treatment, as monotherapy or in different combinations. Beta-blockers are not contraindicated in patients with LEAD, because they do not alter walking capacity in patients with mild to moderate LEAD. An observational study showed that patients with LEAD and prior MI who were taking beta-blockers significantly decreased the risk of coronary events (53%) at 32 months. Nevertheless, beta-blockers should be carefully prescribed to patients with CLTI (3, 14).

Multisite artery disease is defined by the simultaneous presence of clinically relevant atherosclerotic lesions in at least two major vascular territories. Subclinical plaques are not discussed in this document. Patients with MSAD are regularly encountered in clinical practice, but there is a lack of robust data on the management of these patients. Clinical status and comorbidities should be considered for the management of patients with MSAD,

in addition to the lesion sites. Finally, the treatment strategy should be decided individually in a multidisciplinary team, first of all focusing on the symptomatic vascular site (3).

Conclusions and Future Work

In this clinical case, we demonstrate that angioplasty and stenting of the vertebral and right coronary arteries and optimal medical treatment of other damaged vascular beds may represent a safe potential option for the treatment of severe multisite vascular disease. In order to further reduce the risk of vascular stenosis, life changing habits such as diet, daily exercise, weight control, quitting smoking are mandatory. Future studies are necessary to better understand the natural history of this disease and to define the optimal therapy for this high-risk population.

References

1. Alcocer F, David M, Goodman R, Kumar Amruthlal Jain S, David S, et al. A forgotten vascular disease with important clinical implications. Subclavian steal syndrome. Am J Case Rep 2013;14:58-62.
2. Di Noi P, Brancati MF, Burzotta F, Trani C. Multisite artery disease: a common and challenging clinical condition calling for specific management. Future Cardiol 2014 May;10(3):395-407. doi: 10.2217/fca.14.25.
3. Aboyans V, Ricco J-B, Bartelink M-L, 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. Eur Heart J 2018;39:763-821.
4. Criqui MH, Aboyans V. Epidemiology of peripheral artery disease. Circ Res 2015;116:1509-26.
5. Lahoz C, Mostaza JM. Atherosclerosis as a systemic disease. Rev Esp Cardiol 2007 Feb;60(2):184-95.
6. Pickett CA, Jackson JL, Hemann BA, Atwood JE. Carotid bruits as a prognostic indicator of cardiovascular death and myocardial infarction: a meta-analysis. Lancet 2008; 371:1587-94.
7. Clark CE, Taylor RS, Shore AC, Ukoumunne OC, Campbell JL. Association of a difference in systolic blood pressure between arms with vascular disease and mortality: a systematic review and meta-analysis. Lancet 2012;379:905-14.
8. Cournot M, Taraszkiewicz D, Cambou JP, Galinier M, Boccalon H, Hanaire-Broutin H, et al. Additional prognostic value of physical examination, exercise testing, and arterial ultrasonography for coronary risk assessment in primary prevention. Am Heart J 2009;158:845-51.
9. Fowkes FG, Murray GD, Butcher I, Heald CL, Lee RJ, Chambless LE, et al. Ankle brachial index combined with Framingham Risk Score to predict cardiovascular events and mortality: a meta-analysis. JAMA 2008;300:197-208.
10. Criqui MH, McClelland RL, McDermott MM, Allison MA, Blumenthal RS, Aboyans V, et al. The ankle-brachial index and incident cardiovascular events in the MESA (Multi-Ethnic Study of Atherosclerosis). J Am Coll Cardiol 2010;56:1506-12.
11. Graham I, Atar D, Borch-Johnsen K, Boysen G, Burell G, Cifkova R, et al. European guidelines on cardiovascular disease prevention in clinical practice: executive summary: Fourth Joint Task Force of the European Society of Cardiology and Other Societies on Cardiovascular Disease Prevention in Clinical Practice (constituted by representatives of nine societies and by invited experts). Eur Heart J 2007;28:2375-414.
12. Piepoli MF, Hoes AW, Agewall S, Albus C, Brotons C, Catapano AL, et al. 2016 European Guidelines on cardiovascular disease prevention in clinical practice: the Sixth Joint Task Force of the European Society of Cardiology and Other Societies on Cardiovascular Disease Prevention in Clinical Practice (constituted by representatives of 10 societies and by invited experts). Developed with the special contribution of the European Association for Cardiovascular Prevention & Rehabilitation. Eur Heart J 2016;37:2315-81.
13. Ryden L, Grant PJ, Anker SD, Berne C, Cosentino F, Danchin N, et al. ESC Guidelines on diabetes, prediabetes, and cardiovascular diseases developed in collaboration with the EASD: the Task Force on diabetes, pre-diabetes, and cardiovascular diseases of the European Society of Cardiology (ESC) and developed in collaboration with the European Association for the Study of Diabetes (EASD). Eur Heart J 2013;34:3035-87.
14. Mancia G, Fagard R, Narkiewicz K, Redon J, Zanchetti A, Bohm M, et al. 2013 ESH/ESC Guidelines for the management of arterial hypertension: the Task Force for the management of arterial hypertension of the European Society of Hypertension and of the European Society of Cardiology. J Hypertens 2013;31:1281-357.
15. Lacey KO. Subclavian steal syndrome: a review. J Vasc Nurs 1996;14:1-7.
16. Ferrara LE, Ricci SA, Young EW. Coronary subclavian steal syndrome: implications for nursing care. Prog Cardiovasc Nurs 1998;13(4):24-9.
17. Herrera M, Forsyth M, Wolf E, Zack PM. Could it be coronary-subclavian steal syndrome? Med Surg Nursing 2012;21(3):167-78.
18. Morse KJ. Focusing on the surgical patient with cardiac problems. Nursing 2009;39(3):22-7.
19. Saha T, Naqvi TY, Ayah OA, McCormick A, Goldberg S. Subclavian artery disease: diagnosis and therapy. Am J Med 2017 Apr;130(4):409-16.
20. Cua B, Mamdani N, Halpin D, Jhamnani S, Jayasuriya S, Mena-Hurtado C. Review of coronary subclavian steal syndrome. J Cardiol 2017 Nov;70(5):432-7.
21. Shadman R, Criqui MH, Bundens WP, Fronek A, Denenberg JO, Gamst AC, et al. Subclavian artery stenosis: prevalence, risk factors, and association with cardiovascular diseases. J Am Coll Cardiol 2004 Aug 4;44(3):618-23.
22. Smith SC, Allen J, Blair SN, Bonow RO, Brass LM, Fonarow GC, et. al. AHA/ACC guidelines for secondary prevention for patients with coronary and other atherosclerotic vascular disease: 2006 update: [published correction appears in Circulation. 2006;113:e847]. Circulation 2006;113:2363-72.
23. Smith SC Jr, Benjamin EJ, Bonow RO, Braun LT, Creager MA, Franklin BA. AHA/ACCF Secondary Prevention and Risk Reduction Therapy for Patients With Coronary and other Atherosclerotic Vascular Disease: 2011 update: a guideline from the American Heart Association and American College of Cardiology Foundation. Circulation 2011;124:2458-73.

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