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İnnominat arter tıkanmasına bağlı subklavyen çalma-karotis geri kazanma fenomeni: Doppler ultrasonografi, dijital subtraksiyon anjiyografi bulguları ve damar içi yolla tedavisi

Subclavian steal-carotid recovery phenomenon due to innominate artery occlusion: Doppler ultrasound, digital subtraction angiography findings and endovascular treatment

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Özet– İnnominat arter oklüzyonu semptomsuz olabilmekle birlikte, ön serebral dolaşım, vertebrobaziller sistem ve üst ekstremite semptomlarına neden olabilen nadir görülen bir durumdur. Biz bu yazıda innominat arter oklüzyonuna bağlı, sağ subklavyen arter ve sağ ana karotis arterin aynı taraf vertebral arterden gelen ters yönlü akım ile dolduğunu Doppler ultrasonografi ve dijital subtraksiyon anjiyografi (DSA) ile göstererek, primer stentleme sonucu teknik ve klinik başarıyı tartışmayı planladık.

Summary– Innominate artery occlusion is a rare condition that may cause symptoms in the anterior cerebral circulation, vertebrobasilar system and upper extremity, while it can also be asymptomatic. We report Doppler ultrasound and digital subtraction angiography (DSA) findings of the right subclavian artery and right common carotid artery filling with retrograde flow from the ipsilateral vertebral artery due to innominate artery occlusion. We aimed to discuss the results of primary stenting together with its technical and clinical success.

Abbreviationsr:
DSA Digital subclavain angiography
US Ultrasound

Subclavian steal-carotid recovery phenomenon appears to be related to the occlusion of the innominate artery which is a rare cause of transient ischemic attacks reported only in a few case presentation in the literature. This definition was firstly made by Killen in 1965 based on angiographic evaluations.[1] It can be defined as because of very serious stenosis or occlusion of the innominate artery, filling of subclavian, and common carotid arteries with retrograde flow from ipsilateral vertebral artery. Retrograde flow both into the vertebral, and common carotid artery is termed as double steal syndrome.[1]

Although occlusion of the innominate artery can be asymptomatic, it can also induce cause anterior cerebral circulation symptoms (right amarosis fugax, right cerebral hemsiphere transient ischemic attack stroke) in 50% vertebrobasilar insufficiency symptoms oranın-(dizziness, loss of balance or both of them) in 40% of the cases. Besides, in 5-63.3% of the cases they can confront us with upper extremity symptoms as claudicatio, and embolization to fingers.[2] Atherosclerosis is the most frequent cause of innominate artery occlusions followed by Takayasu arteritis. Occlusive lesions of the innominate or subclavian artery are associated with coronary artery disease in 50%, peripheral vascular lesions in 27%, and carotid-vertebtal artery lesions in nearly 29% of the cases. Because of the comorbidities of all these diseases, the patients carry higher surgical risks.[2]

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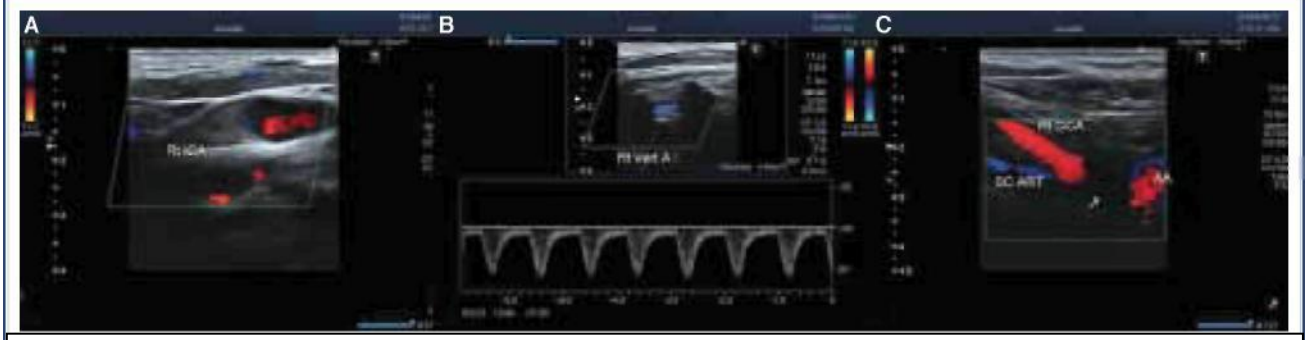

Figure 1 (A) Carotid Doppler ultrasound demonstrates decrease in the calibration of the right internal carotid artery which is occluded with soft, echoeic thrombus **(B)** Vertebral artery colour code, and spectral Doppler ultrasound reveal retrograde flow into the right vertebral artery **(C)** Suprasternal colour-Doppler ultrasound manifests occlusion of the innominate artery

CASE PRESENTATION

A 64-year-old male patient who had not any known history of hypertension, diabetes mellitus, and hypercholesterolemia consulted to our hospital with complaints of muscular weakness of his right hand, and occasional feelings of numbness persisting for a few months. Physical examination did not reveal any marked ischemic symptom, but upon detection of marked difference between systolic arterial pressures measured separately from two arms (nearly 40 mm Hg) Doppler ultrasonographic examination was performed. Bilateral carotid-vertebral Doppler US could not reveal any hemodynamically significant finding, while small caliber right common carotid artery was remarkable. Besides, lower right common carotid artery flow velocity (maximum systolic velocity /end-diastolic velocity: cm/sec), and midsystolic deceleration were observed. Diameter of the right internal carotid artery was decreased and external vibration of the artery was observed with arterial pulsation from its origin. Besides it was occluded with a soft echoeic thrombus. (Figure 1a). In colour mode, and spectral examination, retrograde flow into the right vertebral artery was seen (Figure 1b), and suprasternal examination could not reveal flow signal in the innominate artery (Figure 1c). As observed on Doppler US, right subclavian artery, and right common carotid artery filled with retrograde flow coming from vertebral artery characterized by prolonged acceleration time however cranially directed high-output flow (580 ml/min) was detected in the left vertebral artery, and a 50 % stenotic initial segment of the artery segment which increased maximum systolic blood flow velocity from 109 cm/sec up to 222 cm/sec was observed. Upon these findings the patient was referred to our Interventional Radiology Department for further examinations.

Under local anesthesia with the aid of a pigtail catheter inserted into right common femoral artery, and engaged in the aortic arch, aortography of the aortic arch was performed which demonstrated occlusion of the innominate artery from its origin. While initial segments of the left common carotid, and left subclavian arteries were within physiologic limits (Figure 2).

On selective left subclavian artery angiogram, a 50 % stenotic segment was seen at its exit site (Figure 3a). As observed on delayed contrast-enhanced angiograms, firstly right vertebral artery (Figure 3b), then right subclavian artery, and though weakly right common carotid (Figure 3c) were filled with retrograde blood flow. Right internal carotid artery was occluded from its initial segment, while normal blood flow was noted in external carotid artery (Figure 3d).

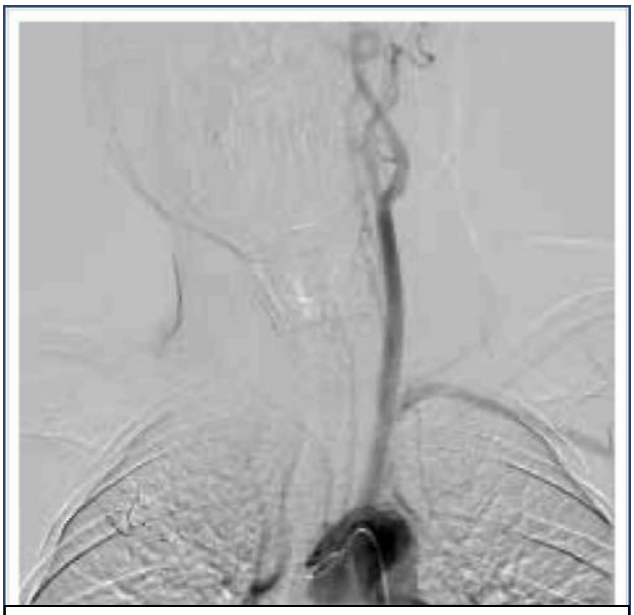

Figure 2. Arcus aortography demonstrating total occlusion of the innominate artery starting from its exit site

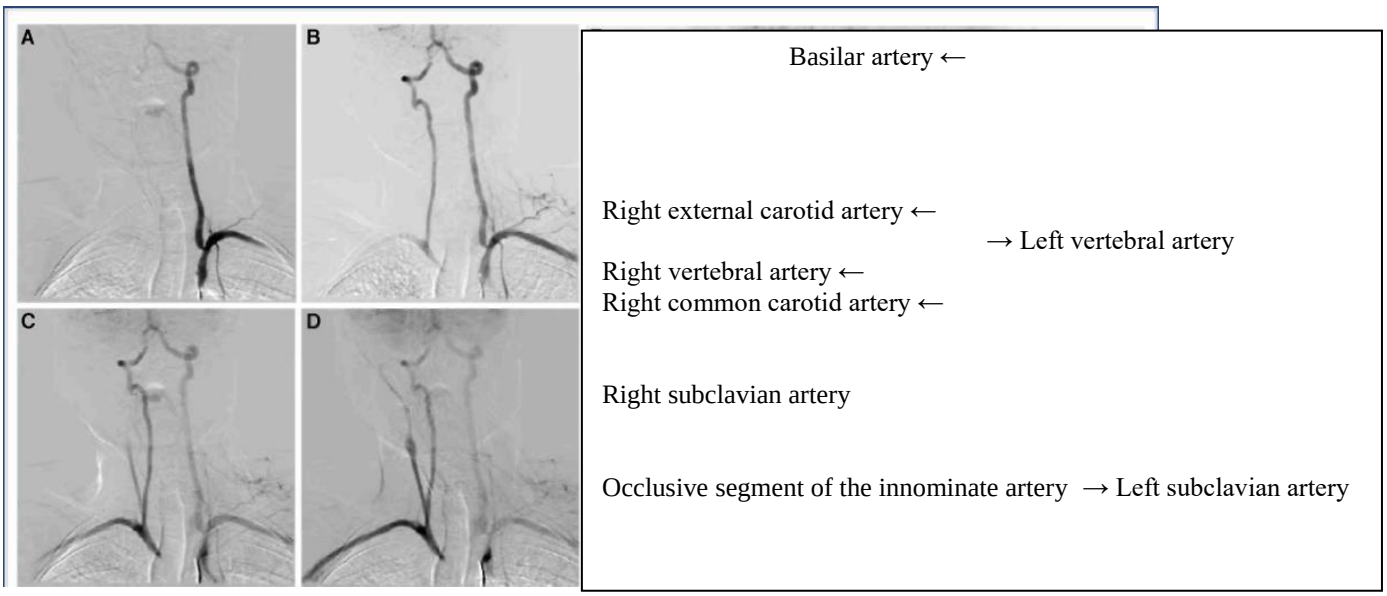

Figure 3. Angiogram of the left subclavian artery; **(A)** cranially directed blood flow in the left vertebral artery, and nearly 50% stenotic initial segment of the artery are seen **(B)** Retrograde blood flow into the right verteblal artery coming through basilar artery **(C)** When injection was continued firstly right subclavian artery, then right common carotic artery were filled with retrograde flow, **(D)** Then right external carotid artery is weakly filled, and internal carotid arter is occluded from starting from its exit. **(E)** previously described four succesive images were superimposed demonstrating all angiographic findings .

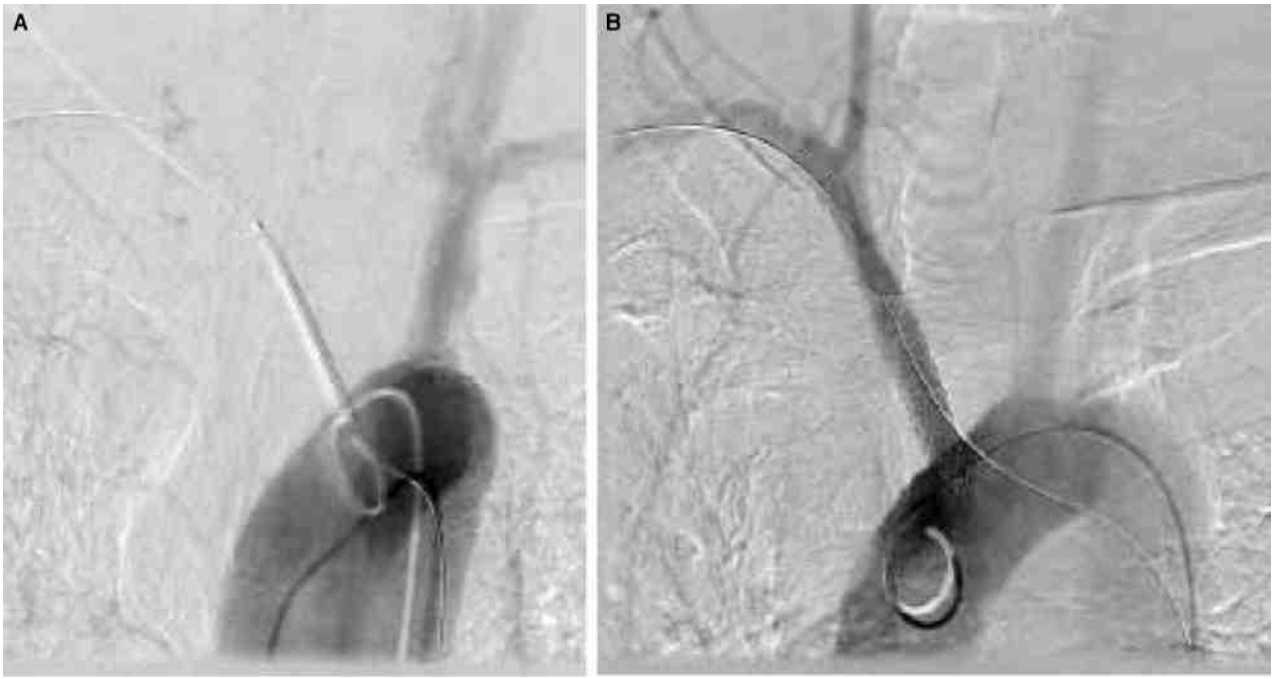

Figure 4. Images obtained during endovesical therapy; **(A)** following passage of the guidewire through right axillary artery beyond the stenotic segment, unopened stent is seen, **(B)** after the stent is opened, full patency of the occluded segment is seen.

However on cerebral angiograms right anterior, and posterior cerebral arteries were filled from the left side through the patent anterior communicating artery.

Following angiographic examination which supported Doppler US findings, subclavian steal-carotid recovery phenomenon due to the occlusion of the innominate artery was thought. Since surgical interventions including direct reconstruction. (aortic bypass graft, endarterectomy), and extraanatomic bypass have higher perioperative stroke, and mortality rates, priorly endovascular treatment was deemed to be appropriate. For the purpose of endovascular treatment, under local anesthesia short sheath introducers were inserted into the right common femoral artery (5F), and right axillar artery (6F) Completely occlusive short stenotic (category, 3; < 5 cm) proximal segment of innominate artery was negotiated with guidewire, and catheter advanced through right axillary artery, A 9 x 38 mm balloon catheter was advanced up to the occluded segment (Figure 4a), and placed from the distal part of the lesion up to the aortic arch (Figure 4b). Control angiograms obtained with the pigtail catheter engaged in the aortic arch, achievement of nearly complete patency, and recovery of the blood flow in the right vertebral artery to the cranial direction were observed (Figure 5). Because of potential risk of stent implantation procedure right upper extremity

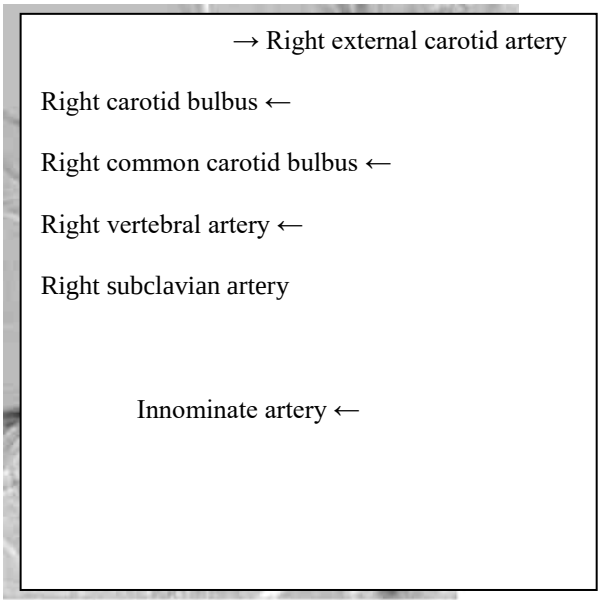

Figure 5. Poststenting control angiogram demonstrating cranially directed flow in the right vertebral artery

angiograms were obtained, and normal filling patterns were detected in the right brachial, ulnar, and radial arteries.

Since required patency of the innominate artery was achieved without development of any complication, the procedure was terminated. During the procedure the patient received 7500 IU unfractionated heparin, and the infusion was proceeded with 3 doses of 5000 IU unfractionated heparin given with the first 24 hours. During the first 6 months, clopidogrel (75 mg/d), and lifetime aspirin (100 mg/d) were prescribed for the patient. Control Doppler US performed one day later, revealed cranially directed blood flow in the right vertebral artery. The patient who had no complaints underwent, control Doppler US 3 months later which demonstrated cranially directed bilateral vertebral blood flow, patency of the stent implanted in subclavian arteries, and interestingly a weak recanalized blood flow was observed in the right internal carotid artery.

DISCUSSION

In our case, apart from right upper extremity symptoms, a 50 % stenosis of the initial segment of the left vertebral artery, and potentially risky posterior cerebral circulation which may be encountered in the future complicated the case, and necessitated implementation of the treatment. Although right internal carotid artery was occluded from its initial segment with a thrombus, since anterior communicating artery was patent, and right cerebral circulation was ensured through left internal carotid artery , the patient did not experience symptoms of cerebral ischemia Patients with occlusive lesions involving branches of aortic arch are under increased risks of hemodynamic, and embolic complications.[3] Therefore if patients with occlusive lesions of the innominate artery are symptomatic, then they should be treated to avoid potential morbidities. Patients usually manifest symptoms of anterior/posterior circulation dysfunction and/or upper extremity ischemia.[2] On physical examination, symptoms of upper extremity ischemia and difference between arterial blood pressure measurements taken from both arms are important diagnostic criteria. Doppler US is the first diagnostic step, and among US findings, complete or partial retrograde flow in the right vertebral artery, and reverse flow or midsystolic deceleration in one of three major segments of the carotid artery system (common carotid artery, internal, and external carotid artery) are remarkable findings. [4] DSA is a gold standard alternative both for diagnosis, and treatment. All data related to endovascular treatment were derived from the outcomes of retrospective studies, and any randomized study comparing angioplasty and stent implantation, and also angioplasty/stenting with surgery has not been conducted so far. Nowadays, with its minimal moridity, and mortality, in addition to its excellent technique, and clinical outcomes endovascular treatment is preferred.

Angioplasty balloons with a diameter of 8-12 mm usually ensure adequate patency. However, previously stenting had been applied following failed angioplasty. However, nowadays, on a routine basis, primary stent implantation, and especially for short-stenotic segments balloon stents are preferred. Especially in cases with rigid ostial stenosis or occlusions before stenting, optimal positioning of the stent, and predilaton with balloon catheters are advised so as to avoid stent/balloon detachment..[5] However in our case, since we couldn't implant a emboli protection filter inside the right vertebral artery, we thought it appropriate to perform directly stent implantation without predilation with balloon catheter to avoid complications of potential cerebral embolism. We simultaneously injected contrast material into the catheters we implanted in both aortic arch, and the right subclavian artery so as to appropriately adjust the position of the stent.

Technical success rates of endovascular treatment for stenotic lesions ranges between 91, and 100 % in different series, while extremely low success rates (25-83%) were detected for occlusive lesions in occlusive lesions Stroke rates following endovascular treatment were reported to vary between 0.9, and 1.4 % in various series, while major complication rate changed between 0, and 10 percent.[2] Though short-term patency rates of endovascular treatment are quiet satisfactory, lower long-term patency rates relative to surgical treatment – have been indicated in separate studies.[2] Unfortunately, as we mentioned above, comparative randomized studies on this issue have not been conducted yet.

In conclusion, although endovascular treatment modality is successful as for technical application, and clinical prospectives, long-term effectiveness of surgical, and endovascular treatment of occlusive lesions of innominate, and subclavian arteries should be investigated in randomized comparative studies.

Conflict of Interest : None declared

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Anahtar sözcükler: Anjiyografi, dijital çıkarma/yöntemleri; innominat arter; subklavyen arter/radyografi; subklavyen çalma sendromu; stent.

Key words: Angiography, digital subtraction/methods; innominate arteries; subclavian artery/radiography; subclavian steal syndrome; stents.