Simultaneous treatment of carotid artery stenosis and kinking with regional cervical block

İbrahim Erdinç1, Didem Melis Öztâş2, Çenk Eray Yıldız2, Murat Uğurlucan2

1Department of Cardiovascular Surgery, University of Health Sciences, Bozyaka Training and Research Hospital, İzmir, Turkey
2Department of Cardiovascular Surgery, Istanbul University Istanbul Faculty of Medicine, Istanbul, Turkey

ABSTRACT
Severe carotid artery stenosis is a pathology which is associated with increased morbidity and mortality. The rate of carotid artery kink increases together with the increasing aging population. There is a need for concomitant treatment of both pathologies, when they co-exist. In this report, we present the surgical treatment that we performed in a 76-year-old patient presenting with carotid artery stenosis and kinking.

Keywords: Carotid artery kinking; carotid artery stenosis; carotid endarterectomy.

Internal carotid artery (ICA) kinking is defined as angulation in one or more segments according to angiographic findings.[1] Prevalence in the general population is estimated to have increased from 10 to 16%.[2] Kinking is thought to increase with advanced age due to structural degeneration of the artery, but is actually fundamentally congenital.[1] In symptomatic patients with concurrent carotid artery stenosis and ICA kinking, simultaneous treatment of both pathologies is the generally accepted therapy model, ensuring completely secure revascularization.[3]

This case report presents the surgical treatment of a male patient with carotid artery stenosis as well as severe kinking.

CASE REPORT
A 76-year-old male patient was admitted to our clinic with symptoms of numbness of the right arm and dizziness. The patient was on medication for hypertension and had a 35 pack/year history of smoking. Laboratory tests revealed elevated levels of triglycerides and LDL.

Doppler ultrasound showed a plaque with more than 70% stenosis in the right ICA, upon which computed tomography angiography was performed. Right ICA stenosis was confirmed and kinking of the right proximal ICA was also detected (Figure 1). Surgery was planned in order to simultaneously treat carotid artery stenosis and kinking. The patient was appropriately informed and the procedure was planned after the patient provided consent.

The operation was performed under regional and infiltration anesthesia. The patient tolerated carotid clamping and use of shunt was unneeded. In the right proximal ICA segment with kinking (Figure 2), atheroma plaque was observed and resection of the narrowed segment and reimplantation of the ICA to the common carotid artery (CCA) was decided. Carotid endarterectomy together with primary repair was performed. The ICA was reimplanted to the CCA to correct its configuration (Figure 3). The patient was neurologically stable throughout the operation.

The patient’s postoperative period was unremarkable and the patient was discharged without issue on
postoperative day three. Doppler ultrasound taken three months after the operation showed normal configuration of the internal and external carotid arteries and no residual stenosis.

**DISCUSSION**

Elongation of the ICA with angulation of 90 degrees or less causes kinking. In patients with cerebrovascular symptoms or incidental carotid artery stenosis despite being asymptomatic, incidence of this pathology is between 5-25%.[3]

The exact incidence is unknown as it can be asymptomatic. Although there are publications that report rates of incidental detection as high as 16-34%, symptoms related to fibromuscular dysplasia are observed in at least half of these patients.[4,5] However, the literature does not provide data on incidence of concomitant carotid artery kinking and carotid artery atherosclerosis. Symptomatic patients show symptoms similar to those of carotid artery disease, including transient ischemic attacks, strokes, and transient loss of vision.[6] Most symptoms are due to turbulent flow caused by ulceration and embolism due to carotid artery kinking.[6] Carotid artery kinking has various causes. The pathology is thought to be associated with degenerative processes, especially in elderly patients. Greater elongation of the muscular layer compared to the adventitia establishes kinking of the artery.[1] These lesions are four times more common in women than men.[6] Chronic hypertension is thought to be one of the risk factors.[1] Carotid artery kinking is most commonly mistaken with ICA aneurysm. Ultrasonography easily distinguishes these lesions. Digital subtraction angiography (DSA) is the gold standard diagnostic method. Computed tomography angiography also provides good results.[6]

There are varying opinions on whether or not cerebrovascular hemodynamics are affected in the presence of kinking in the carotid artery without atherosclerotic plaque.[2] Kinking of the artery, unlike coiling, may cause neurologic symptoms such as paresthesia, weakness in the arms, or speech disorders without atherosclerotic plaque in 4-20% of patients.[1] Correction of the affected carotid artery segment as well as anatomical reconstruction is thought to reduce morbidity and mortality by preventing cerebrovascular symptoms.[7] There is no consensus on the surgical treatment of patients with carotid artery kinking without atheroma plaque. There are a few publications that state that isolated kinking of the artery occurs naturally and related neurologic symptoms rarely
justify surgical treatment.\textsuperscript{3,6} However, some publications argue that ICA kinking is a potentially harmful condition and that ICA revascularization achieves good results.\textsuperscript{7-11} However, according to the 2018 guidelines of the European Society for Vascular Surgery, surgical treatment of carotid artery kinking in asymptomatic patients is considered controversial and not recommended.\textsuperscript{12} In addition, in patients with no other risk factor for transient or irreparable stroke, surgical treatment is recommended according to the evaluation by a multidisciplinary team.\textsuperscript{12} In our patient, surgical treatment was performed due to carotid artery stenosis requiring intervention and ICA kinking was corrected to its anatomical position in the same session. Had the patient been asymptomatic or if severe carotid stenosis had not been detected, the patient would have been informed of the pathology and taken into a follow-up program in accordance with guidelines as planned.

Carotid artery stenosis is one of the major causes of ischemic stroke in elderly patients.\textsuperscript{13} The best treatment option is surgical approach in over 50% of patients with symptomatic carotid artery stenosis.\textsuperscript{13} When coexistence of kinking and carotid stenosis is observed, both pathologies must be simultaneously treated in order to ensure secure revascularization.\textsuperscript{3} In adults with symptoms due to cerebrovascular insufficiency, carotid artery kinking is usually associated with atheroma plaque in the bifurcation.\textsuperscript{3} Carotid endarterectomy is an effective method in the treatment of stenotic and symptomatic plaques.

There are various options in the surgical treatment of internal artery kinking. Internal carotid artery segment resection and end-to-end reanastomosis, shortening and reimplantation of the ICA to the CCA, and bypass grafting are among these techniques.\textsuperscript{3}

Carotid artery stenting, which is considered an alternative option, may complicate the procedure in arteries with severe kinking, but may be considered a safe and alternative treatment in patients who do not accept surgery or who cannot be operated due serious risk of morbidity and mortality.\textsuperscript{14}

Surgical method in treating symptomatic and asymptomatic patients with severe carotid artery kinking together with carotid artery stenosis is an effective and reliable form of treatment.\textsuperscript{15} Some publications have found eversion carotid endarterectomy, ICA resection, and reimplantation techniques to be superior to ICA resection with patch reconstruction and prosthetic repair after endarterectomy.\textsuperscript{16}

Our patient had severe carotid artery stenosis together with carotid artery kinking. In order to simultaneously treat both pathologies, the proximal ICA segment with atheroma plaque was resected and reimplanted to the CCA to correct ICA configuration. The main goals of treatment are to eliminate the possibilities of morbidity and mortality that may occur in patients with internal carotid artery stenosis together with kinking and ensure revascularization. Therefore, preferring techniques that will also eliminate kinking in the surgical treatment of atherosclerotic carotid artery stenosis is presented as a reliable therapy option, especially in the elderly population.

Declaration of conflicting interests
The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

Funding
The authors received no financial support for the research and/or authorship of this article.

REFERENCES
1. Hao JH, Zhang LY, Lin K, Liu WD, Zhang SG, Wang JY, et al. Surgical revascularization of symptomatic kinking of the internal carotid artery. Vasc Endovascular Surg 2016;50:470-474.
2. Poulias GE, Skoutas B, Doundoulakis N, Haddad H, Karkanias G, Lyberiadis D. Kinking and coiling of internal carotid artery with and without associated stenosis. Surgical considerations and long-term follow-up. Panminerva Med 1996;38:22-7.
3. Illuminati G, Caliò FG, Papasyropoulos V, Montesano G, D’Urso A. Revascularization of the internal carotid artery for isolated, stenotic, and symptomatic kinking. Arch Surg 2003;138:192-7.
4. Ballotta E, Thiene G, Baracchini C, Ermani M, Milletello C, Da Giau G, et al. Surgical vs medical treatment for isolated internal carotid artery elongation with coiling or kinking in symptomatic patients: a prospective randomized clinical study. J Vasc Surg 2005;42:838-46.
5. Coyle KA, Smith RB 3rd, Chapman RL, Salam AA, Dodson TF, Lumsden AB, et al. Carotid artery shortening: a safe adjunct to carotid endarterectomy. J Vasc Surg 1995;22:257-61.
6. Alpagut U, Ugurlucan M, Kafali E, Ali Sayin O, Demir T, Basaran M, et al. Aneurysm of the kinked extracranial internal carotid artery case report and review of the literature. Acta Chir Belg 2005;105:407-9.
7. Radonic V, Baric D, Giunio L, Buča A, Sapunar D, Marović A. Surgical treatment of kinked internal carotid artery. J Cardiovasc Surg (Torino) 1998;39:557-63.
8. Mascoli F, Mari C, Liboni A, Virgili T, Marcello D, Mari F, et al. The elongation of the internal carotid artery. Diagnosis and surgical treatment. J Cardiovasc Surg (Torino) 1987;28:9-11.
9. Kazakov YI, Pavlov EV, Federyakin DV, Ivanova OV, Vardak A. Peculiarities of diagnosis and surgical policy in elderly patients with pathological tortuosity of the internal carotid artery. Angiol Sosud Khir 2015;21:112-7. [Abstract]

10. Quattlebaum JK Jr, Wade JS, Whiddon CM. Stroke associated with elongation and kinking of the carotid artery: long-term follow-up. Ann Surg 1973;177:572-9.

11. Zanetti PP, Rosa G, Cavanenghi D, Sorisio V, Amerio GM, Stillo R, et al. Surgical treatment of carotid kinking. J Cardiovasc Surg (Torino) 1997;38:21-6.

12. Naylor AR, Ricco JB, de Borst GJ, Debus S, de Haro J, Halliday A, et al. Editor's Choice - Management of Atherosclerotic Carotid and Vertebral Artery Disease: 2017 Clinical Practice Guidelines of the European Society for Vascular Surgery (ESVS). Eur J Vasc Endovasc Surg 2018;55:3-81.

13. Déglise S, Dubuis C, Mosimann P, Saucy F, Engelberger S, Hirt L, et al. Management of the carotid artery stenosis. Rev Med Suisse 2013;9:1305-11. [Abstract]

14. Zhang Z, Liu Z, Tian Z, Tang W, Jiao J. Clinical analysis of carotid angioplasty stenting for high-grade extracranial carotid artery stenosis combined with severe tortuosity. Zhonghua Yi Xue Za Zhi 2015;95:1980-5. [Abstract]

15. Gavrilenko AV, Abramyan AV, Kuklin AV. An efficacy of carotid arteries repair for tortuosity combined with stenosis. Khirurgii (Mosk) 2018;26-32. [Abstract]

16. Gavrilenko AV, Kuklin AV, Khripkov AS, Abramian AV. Assessment of efficacy of reconstructive operations on carotid arteries in combination of stenosis and pathological tortuosity. Angiol Sosud Khir 2014;20:116-22. [Abstract]