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A Rare Cause in the Etiology of Patients who Underwent Mechanical Thrombectomy: Carotid Web

Mekanik Trombektomi Uyguladığımız Hastaların Etiyolojisinde Nadir Bir Neden: Karotid Web

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ABSTRACT

Background: The Carotid Web (CW) is located in the posterior wall at the orgin of the internal carotid artery or carotid bulb. It is a factor especially blamed in the etiology of young and cryptogenic stroke patients. It may be overlooked if contrast-enhanced vascular imaging is not carefully examined. In recent years, articles have been published about its involvement in large vessel occlusion. We present patients in whom we performed mechanical thrombectomy and found CW in the etiology.

Methods: Between 2020 January and 2023 December, patients who underwent mechanical thrombectomy due to anterior system large vessel occlusion and were diagnosed with carotid web in the etiology of stroke were included in the study. The diagnosis of carotid web was made by looking at the images taken from three different angles after the guiding catheter was placed distal to the common carotid artery during the mechanical thrombectomy procedure.

Results: CW was detected in 11 (1.03%) of 1070 patients who underwent mechanical thrombectomy. Four patients with missing data and unclear stroke aetiology were excluded from the study. CW-related stroke subtype in our study was present in 7 patients (0.65%). Successful recanalisation (mTICI 2b-3) was achieved in 6 of 7 patients (85.7%). For secondary prophylaxis, carotid stenting was performed in 4 patients with mRS 0-3 who were evaluated for clinical outcome at week 1. Ninetieth day good clinical outcome (mRS 0-2) was 57.1%.

Conclusion: Carotid Web may cause large vessel occlusion. In patients undergoing mechanical thrombectomy, the presence of CW in the carotid artery bulb should be checked. Secondary prophylaxis in symptomatic strokes due to CW may be performed by carotid endarterectomy or carotid stenting.

Keywords: Mechanical thrombectomy, carotid web, acute stroke.

ÖZ

Amaç: Karotid Web (CW) internal karotid arter veya karotid bulbun başlangıç kesimindeki posterior duvarında yer alır. Özellikle genç ve kriptojenik inmeli hastaların etiyolojisinde suçlanan bir faktördür. Kontrastlı damarsal incelemelere dikkatli bakılmazsa gözden kaçabilir. Büyük damar tıkanıklığına yaptığına dair son yıllarda yazılar çıkmaya başlamıştır. Biz de mekanik trombektomi uyguladığımız ve etiyolojisinde CW saptadığımız hastaları sunuyoruz.

Yöntemler: 2020 Ocak ile 2023 Aralık tarihleri arasında ön sistem büyük damar oklüzyonu nedeniyle mekanik trombektomi uyguladığımız ve inme etiyolojisinde karotid Web saptadığımız hastalar çalışmaya dahil edilmiştir. Karotid web tanısı mekanik trombektomi işlemi sırasında guiding katater kommon karotid arter distaline yerleştirildikten sonra üç farklı açıdan alınan görüntülere bakılarak konulmuştur.

Bulgular: Mekanik trombektomi uygulanan 1070 hastanın 11 (%1.03)'inde CW saptandı. Verileri eksik olan ve inme etiyoloji net belirlenemeyen 4 hasta çalışma dışı bırakılmıştır. Çalışmamızdaki CW ilişkili inme subtipi 7 hasta (%0.65) da vardı. 7 hastanın 6'sında (%85.7) başarılı rekanalizasyon (mTICI 2b-3) sağlanmıştır. Sekonder profilaksi için 1.haftadaki klinik sonlanıma bakılmış mRS 0-3 olan 4 olguya karotis stentleme uygulanmıştır. Doksanıncı gün iyi klinik sonlanım (mRS 0-2) %57.1 idi.

Sonuç: Karotid Web büyük damar tıkanmasına neden olabilir. Mekanik trombektomi uygulanan olgularda karotid arter bulbusunda CW olup olmadığına bakılmalıdır. CW' e bağlanan semptomatik inmelerde sekonder profilaksi karotid endarterektomi veya karotis stentleme ile yapılabilir.

Anahtar Kelimeler: Mekanik trombektomi, karotid web, akut inme.

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INTRODUCTION

The Carotid Web (CW) is a fibrous intimal flap that extends into the lumen. It is not associated with atherosclerotic changes. It is located on the posterior wall at the beginning of the internal carotid artery or carotid bulb.[1] Its radiologic appearance is very unique for the diagnosis.[2] However, it may often be misdiagnosed or overlooked due to clinicians' lack of experience. Previous trials reported that CW is accountable for a proportion of cryptogenic strokes.[3-5] In fact, it has been reported that the prevalence of CW in young patients with cryptogenic stroke is in the range of 9.4% to 37%.[6] Trials have also examined the etiologic cause of large vessel occlusions, and CW has been found to range from 0.7 to 0.9%.[7-11] Although the mechanism of CW stroke is not fully understood, it is thought to result from morphologic vessel wall characteristics and hemodynamic changes.[5,12-13] In this trial, we present patients in whom we performed mechanical thrombectomy and found CW.

MATERIAL AND METHODS

Study Design and Ethical Considerations

Between January 2020 and December 2023, patients who underwent mechanical thrombectomy for anterior system large vessel occlusion and in whom we found carotid web in the etiology of stroke were included in the trial. The Mechanical Thrombectomy Database was used to obtain patient data. Patients with missing data and unclear stroke etiology were excluded. The required Ethics Committee approval was obtained from the Non-Interventional Clinical Research Ethics Committee of Samsun University (Date: April 14, 2024; Decision No: GOKAEK 2024/4/11) and informed consent were obtained. All procedures were performed in accordance with the ethical standards of the revised 2008 Declaration of Helsinki.

Imaging Analysis and Clinical Data Collection

All patients underwent noncontrast brain computed tomography (CBCT) and craniocervical CT angiography on admission. Noncontrast brain CT was performed within 24 hours after surgery. National Institutes Stroke Scale (NIHSS), Alberta Stroke Program Early Computerized Tomography (ASPECT) score, the Modified Rankin Scale (mRS) at day 90, etiological cause of stroke, presence of carotid web on the same side as the stroke, angiographic and demographic data were recorded. Intravenous thrombolytic therapy was administered to patients who were admitted within the first 4.5 hours after symptom onset and had no contraindications. The diagnosis of carotid web was made by reviewing images taken from three different angles after placement of the guiding catheter at the distal end of the common carotid artery during mechanical thrombectomy.

Thrombectomy Technique

Mechanical thrombectomy was performed via the femoral artery. Agitated patients received conscious sedation (2 mg IV midazolam and 1 mg IV fentanyl) during surgery. After placement of the guide catheter, heparin was administered at a dose of 40 U/kg. The preferred technique for mechanical thrombectomy was either direct aspiration or a combined technique. Successful recanalization was documented as Modified Thrombolysis in Cerebral Infarct (mTICI) 2b-3, good clinical outcome as mRS 0-2, and poor clinical outcome as mRS 3-6.

RESULTS

CW was detected in 11 patients (63.6% female) out of 1070 patients (51.5% female) who underwent mechanical thrombectomy. Four patients with missing data and unclear stroke etiology (one patient had atrial fibrillation (AF), one had paroxysmal AF, one had calcific plaque at the level of the carotid web (Figure 1), and the other had an ejection fraction of 25% on transthoracic echocardiography) were excluded. In these patients, we have not been able to definitively link the etiologic cause to CW.

In our trial, CW-related stroke subtype was present in 7 patients (0.65%). The NIHSS range was 8-22 and the CT ASPECTS range was 6-9. The median age of the patients with CW was 47 years (IQR 38 - 60). Median symptom recanization time was 158 (IQR 108-310). Successful recanalization (mTICI 2b-3) was achieved in 6 of 7 patients (85.7%). As secondary prophylaxis, carotid stenting (without protective filter and with pre-/post-procedural balloon angioplasty) was performed in 4 patients with mRS 0-3 who were assessed for clinical outcome at week 1 (Figure 2). Acute stenting was not performed in any of the cases. The ninetieth day good clinical outcome (mRS 0-2) was 57.1% (Table 1). The combination technique (ADVANCE, SOLUMBRA) was used as the mechanical thrombectomy technique in all cases. In 2 cases, the ADAPT technique was used as a rescue treatment.

The vascular risk factors of the patients are presented in Table 2.

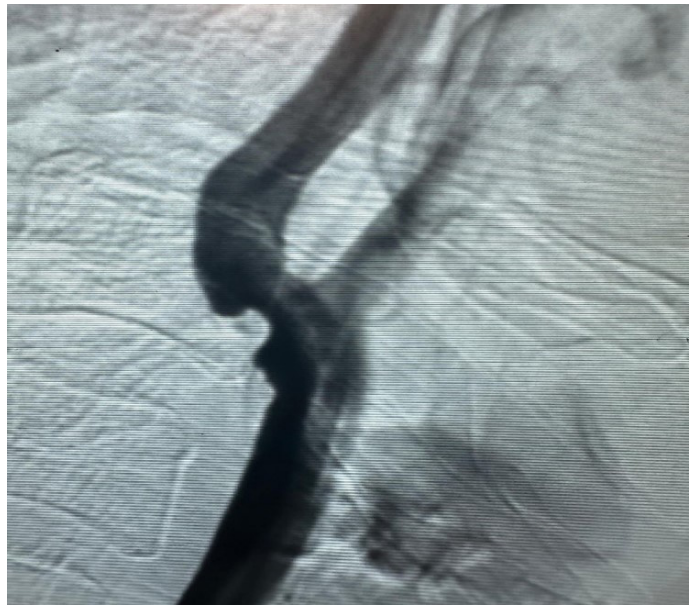

Figure 1. Not recognised as carotid web due to calcification.

MAIN POINTS

- Carotid web may be the cause of large vessel occlusion
- The presence of carotid calcification should be carefully evaluated for the diagnosis of carotid web
- Carotid artery stenting may be an option in the treatment of symptomatic carotid web

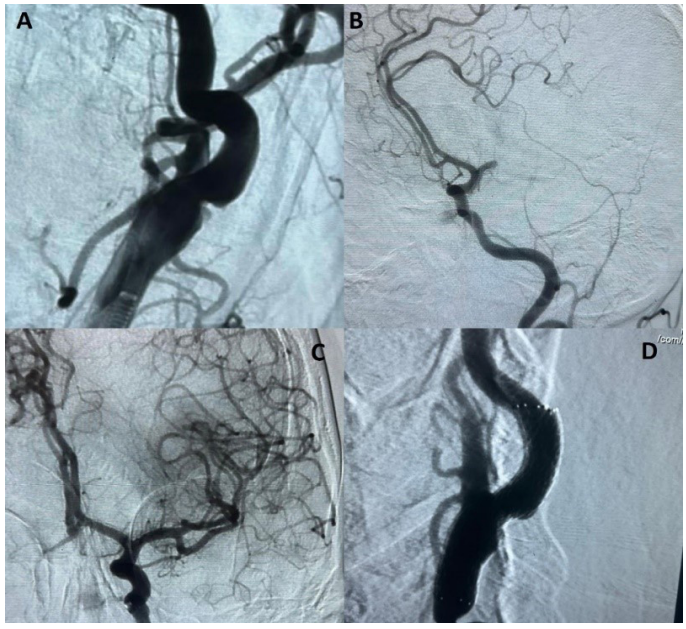

Figure 2. (A) Appearance of the carotid web at the origin in the left ICA, (B) Proximal occlusion of the left MCA M1, (C) Recanalization of the MTC 3 after mechanical thrombectomy, (D) Stenting of the carotid artery 1 week after surgery.

DISCUSSION

In our trial, 7 (0.65%) patients who underwent mechanical thrombectomy for anterior system large vessel occlusion and whose stroke subtype was attributed to Carotid Web were presented. The incidence of CW in our trial was similar to that reported in previous trials. 4 patients with mRS score 0-3 underwent carotid stenting within the first week. There were no procedure-related complications and no recurrent stroke observed during follow-up in our patients who underwent carotid stenting.

The prevalence of CW has been reported to range from 0.45% to 1.2% in patients with acute ischemic stroke and from 9.4% to 37% in patients with cryptogenic stroke.[3,5,14] CW is characterized by a 2 mm thick and >1 mm long circumferential endoluminal flap that protrudes into the lumen on the posterior wall at the beginning of the carotid bulb.[13] Although DSA is considered to be the gold standard for diagnosis, it is important to obtain images from three different angles (postero-anterior, lateral, and oblique) to avoid overlooking the CW. The typical appearance may be a shelf-shaped filling defect, retention of contrast material until the venous phase,[13] and in some cases retention of contrast material in the bulbus before the CW until the venous phase (Figure 3).

Table 1. Demographic and angiographic data of Carotid Web patients

	Age	Gender	NIHSS	ASPECT	MRs during stenting	90th day mRS	Occlusion Site	Recanalization	Secondary prophylaxis
Patient 1	38	Female	12	9	3	1	MCA M1 Distal	mTICI 2c	Carotid Stenting
Patient 2	40	Male	14	8	2	1	MCA M1 Proximal	mTICI 2c	Carotid Stenting
Patient 3	47	Female	16	8	2	2	MCA M1 Proximal	mTICI 3	Carotid Stenting
Patient 4	50	Female	10	6	-	4	MCA M1 Distal	mTICI 3	ASA
Patient 5	42	Male	8	9	1	1	MCA M1 Distal	mTICI 2c	Carotid Stenting
Patient 6	55	Male	22	7	-	4	MCA M1 Proximal	mTICI 2c	Clopidogrel
Patient 7	60	Female	12	9	-	5	MCA M1 Distal	mTICI 2a	ASA

NIHSS, National Institutes Stroke Scale; ASPECT, Alberta Stroke Program Early Computerized Tomography; mRs, Modified Rankin Score; mTICI, Modified Thrombolysis in Cerebral Infarct; MCA, Middle cerebral artery; ASA, Acetylsalicylic acid.

Table 2. Vascular risk factors of carotid web patients

	HT	DM	HL	Smoking	Stroke history	CAD	BMI
Patient 1	-	-	-	+	-	-	22.6
Patient 2	-	-	-	-	-	-	23.4
Patient 3	+	-	-	-	-	+	20.5
Patient 4	-	+	+	-	-	-	21.8
Patient 5	+	-	+	+	-	-	30.4
Patient 6	+	+	-	-	-	-	28.6
Patient 7	-	+	+	-	+	-	33.8

HT, Hypertension; DM, Diabetes mellitus; HL, Hyperlipidemia; CAD, Coronary artery disease; BMI, Body mass index.

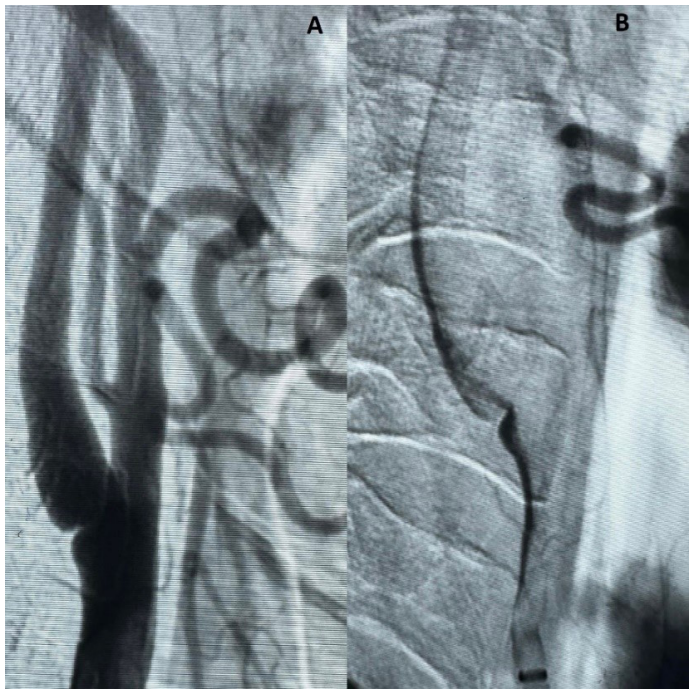

Figure 3. (A) Appearance of carotid web at origin of right ICA, (B) contrast retention due to carotid web.

The pathophysiology of thrombus formation in CW has not yet been clearly identified. CWs cause blood stasis in the intimal flap due to altered flow dynamics in the arterial lumen.[15] Decreased blood flow velocity, blood flow turbulence, and changes in endothelial tension result in increased platelet activation and aggregation.[16] The cause of stroke in patients with CW is an artery-to-artery embolism.

One trial has also revealed that the histopathology of thrombus histopathology in CW and mural thrombus histopathology in the left atrium are similar[17], raising the question of whether anticoagulant therapy should be used instead of antiaggregant therapy in secondary prophylaxis.[15,16] The high risk of ipsilateral stroke and recurrent stroke in patients with CW may be explained by the morphologic features of CW and the hemodynamic changes associated with it. Indeed, some trials have shown that the risk of recurrent stroke from CW can increase by as much as 50%.[5,18] This high rate of recurrent stroke raises the question of whether to use carotid endarterectomy or carotid stent placement instead of antiplatelet or anticoagulation treatment. Trials conducted found no stroke recurrence in cases treated with endarterectomy or stenting.[3,19-21] The lack of a positive remodeling effect may explain the ineffectiveness of medical treatments. Carotid artery endarterectomy or stenting may reduce stroke recurrence because of a positive remodeling effect. There is no clear consensus as to when to perform a carotid artery stenting procedure or an endarterectomy. In one case reported in the literature, carotid stenting was performed simultaneously with mechanical thrombectomy, whereas stenting was not performed in the same session in a patient undergoing thrombectomy for carotid web, and carotid stenting was performed in the same session after mechanical thrombectomy for stroke recurrence in the same patient.[22,23] In our cases, carotid artery stenting was performed at different sessions and on the basis of clinical outcome.

CONCLUSION

The Carotid Web can cause occlusion of a large vessel. In patients who are undergoing mechanical thrombectomy, the presence of CW in the bulb of the carotid artery should be checked. Carotid endarterectomy or carotid stenting may be used as secondary prophylaxis for symptomatic stroke due to CW.

Ethics Committee Approval: The study was approved by the Non-Interventional Clinical Research Ethics Committee of Samsun University (Date: April 14, 2024; Decision No: GOKAEK 2024/4/11). The study was conducted in accordance with the principles of the Declaration of Helsinki.
Informed Consent: Written informed consent was obtained from patients' parents who participated in this study.
Peer-review: Externally peer-reviewed.
Authorship Contributions: Concept - Ç.K.A.; Design – H.D, Ç.K.A.; Supervision – Ç.K.A.; Resources – H.D., Ç.K.A.; Materials – H.D., Ç.K.A.; Data Collection and/or Processing – H.D.; Analysis and/or Interpretation – H.D., Ç.K.A.; Literature Search – H.D.; Writing Manuscript – H.D., Ç.K.A.; Critical Review – H.D., Ç.K.A.; Other – H.D., Ç.K.A.
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