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Clinical analysis, treatment process and experience of 4 cases of carotid artery web

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Abstract

Objectives: Carotid artery web (CaW) is a vascular anomaly linked to cryptogenic ischemic stroke, especially in young patients without traditional vascular risk factors. This study analyzes the clinical characteristics, treatment strategies, and outcomes of four patients diagnosed with CaW. *Methods:* A retrospective analysis of four patients diagnosed with CaW from January 2018 to January 2022 was conducted. Treatment strategies varied: two patients received thrombolysis and mechanical embolectomy, while two received mechanical embolectomy alone. All patients were placed on long-term anti-platelet therapy. *Results:* The cases consisted of 3 males and one female, with an average age of 48 year; the patients presented with acute ischemic symptoms. Imaging confirmed CaW in each patient, with two undergoing thrombolysis and mechanical embolectomy, and two undergoing mechanical embolectomy alone. Follow-up (12-36 months) showed no recurrence of stroke or ischemic symptoms.
Conclusions: CaW is a significant, though rare, cause of ischemic stroke, especially in middle-aged males. A combined approach of thrombolysis or mechanical embolectomy, followed by long-term anti-platelet therapy, is effective in preventing stroke recurrence. Further studies are needed to establish standardized treatment guidelines.

Keywords: Carotid web, carotid stent implantation, conservative treatment

INTRODUCTION

Stroke is a non-communicable illness characterized by high prevalence, significant disability, high mortality, and considerable recurrence rate, posing a major danger to human health.[1] Ischemic stroke accounts for 70% of all strokes in China, and the annual recurrence rate of ischemic stroke is about 17.7%. So it is very important to implement the prevention and treatment measures of ischemic stroke.[2,3] Relevant clinical guidelines and consensus are clear that the treatment of ischemic stroke is mainly based on the differences in etiology, such as stroke caused by atrial fibrillation to improve atrial fibrillation and anticoagulation therapy. Stroke due to atherosclerosis is mainly treated by antiplatelet and lipid-regulating drugs.[4,5] Carotid artery web (CaW) is an important etiology factor for stroke among young adults without conventional vascular high-risk factors.[6] CaW refers to the membrane-like structure behind the bifurcation of carotid artery and protruding into the vascular cavity. The mechanism of stroke is that the webbed structure causes local abnormal blood flow to form a thrombus, which repeatedly displaces and blocks the distal intracranial blood vessels.[7,8] Due to its rarity, the imaging manifestations of this disease being similar to those of carotid artery dissection, the occurrence of non-calcified atherosclerosis and intraluminal thrombosis, all these factors increases the difficulty of clinical diagnosis. In terms of management, the treatment is not clear at this stage, and the therapeutic effect is also controversial.[9] With this background, we undergo this study based on the patients seen in our hospital, to better understand the clinical characteristics, treatment process and outcome of CaW.

METHODS

This is a retrospective analysis of the clinical

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data of four patients diagnosed with CaW between January 2018 and January 2022 seen in the Guangming District Hospital, Shenzhen, Guangdong Province. The inclusion criteria were: (1) Diagnosis of CaW confirmed by Digital Subtraction Angiography (DSA), based on the following diagnostic criteria: a diaphragm-like filling defect in the posterior wall of the carotid artery protruding into the lumen in the oblique sagittal position, accompanied by a significant delay in contrast agent flow at the angle between the carotid web and the artery.[10] (2) Age ≥18 years. (3) Availability of complete clinical data.

The exclusion criteria were: (1) Presence of severe infectious diseases. (2) Diagnosis of malignant tumors. (3) Significant organ dysfunction. (4) Carotid atherosclerotic plaque or carotid dissection. (5) History of cardiovascular and cerebrovascular diseases. (6) Subclavian or vertebral artery web. (7) Loss to follow-up or death during the follow-up period. (8) Mental illness and cognitive dysfunction.

The study was approved by the Ethics Committee of our hospital (approval number GM202410212). Written informed consents from all patients were obtained in any experimental work with humans.

Patient data

Data collected included age, sex, clinical presentation, medical history, smoking and drinking history, muscle tone in the limbs, bilateral tendon reflexes, pathological symptoms, National Institutes of Health Stroke Scale (NIHSS) scores at admission[11], Essen Stroke Risk Score (ESRS)[12], Modified Rankin Scale (MRS) prior to stroke onset[13], Glasgow Coma Scale (GCS)[14], and results from the Wadian drinking water test.

Therapeutic process

After the emergency admission, the patient was examined by two senior neurologists and the clinical condition was evaluated. After obtaining the brain plain CT and CTA examination, patients who were within the time window of intravenous thrombolysis and met the requirements of intravenous thrombolysis treatment were given intravenous thrombolysis immediately. The drug used was 70mg of alteplase, and the preoperative preparation was given and patient sent to the interventional room for endovascular treatment. For those who did not meet the requirements of intravenous thrombolysis or chose direct endovascular treatment, they were directly transferred to the interventional treatment room for angiography for vascular intervention or mechanical embolectomy.

Cerebral angiography was carried out under local anesthesia. The right femoral artery was punctured and implanted with a short sheath of 6F. The Misgurnus anguillicaudatus guide wire was used to perform cerebral angiography, and the intracranial large vessels were identified. The location of intracranial artery embolism was determined during angiography, and endovascular treatment was performed. The short sheath of 8F was placed in exchange, heparinized, and the long sheath cooperated with the multifunctional catheter to reach the initial position of the lateral internal carotid artery. The guide wire was exchanged with the suction catheter according to the guide wire, and the micro-guide wire cooperated with the microcatheter through the obstructed position, which was confirmed by X-ray film to be in the true cavity. The Solitaire stent (6-3mm stent in internal carotid artery, 4-20mm stent in middle cerebral artery (CA) and anterior CA) was inserted along the microcatheter, and negative pressure suction was observed for 5 minutes, and then mechanical thrombectomy was performed. The degree of blood flow recovery was confirmed by imaging review, and another thrombectomy was attempted if the recovery was not good. If there was in-situ stenosis, balloon dilatation was performed. If the distal lesion had poor forward flow, stenting was performed. In the case of severe stenosis or even occlusion of the proximal vessel, the center first opened the occluded proximal vessel, and then mechanically removed the distal vessel. Patients with poor patency of the offending vessel or stent thrombosis after thrombectomy can be locally infused with tirofiban.

Postoperative management and follow-up

After operation, routine targeted treatments such as improving circulation, dehydration, nerve nourishment, and blood pressure control were performed to prevent postoperative cerebral hemorrhage and the possibility of recurrent cerebral infarction. According to the patient's condition, atorvastatin calcium tablets, clopidogrel bisulfate tablets, and aspirin enteric-coated tablets and other drugs were given. The discharge and follow-up of patients were recorded. Follow-up time: until August 31, 2024, the recurrence of patients was observed.

Flow chart

Figure 1 shows the flow chart of this research.

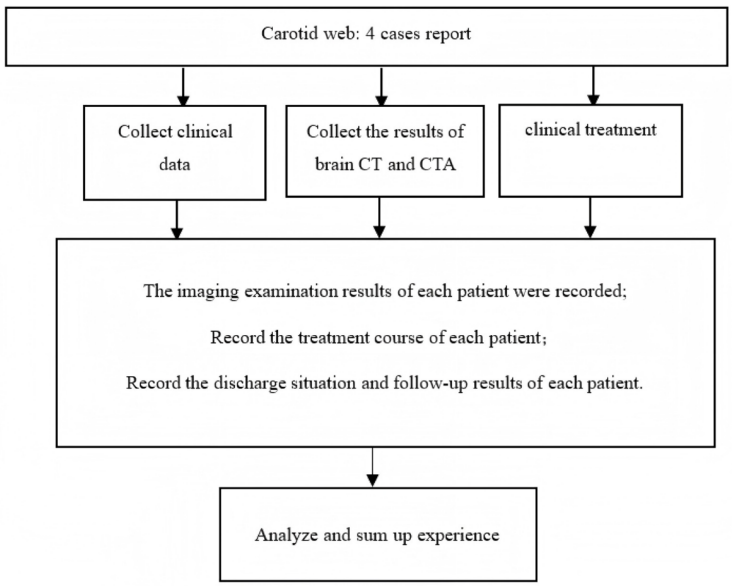

Figure 1. Research flow chart.

RESULT

Clinical data analysis of 4 patients with carotid web

Among the 4 patients with carotid webbed, 3 were male , they were mainly of middle-age (Table 1).

Imaging examination results of patients with carotid web

Patient 1: Emergency head CT examination showed cerebral infarction with a right CaW (Figure 2A). Head CTA showed occlusion of the right middle CA (Figure 2B), and DSA showed an abnormality of the right vertebral artery. The right embryonal posterior CA, and a soft plaque proximal to the right internal carotid artery (Figure 2C and 2D).

Patient 2: Emergency brain CT: The density of the left middle CA increased obviously, as shown in Figure 3.

Patient 3: Emergency brain CT: no hemorrhage, high-density shadow of the right middle CA, because the patient had a green channel, no imaging examination images.

Patient 4: Emergency head CT: no obvious abnormality was found (Figure 4A), and CTA results showed: acute cerebral infarction (Figure 4B).

Treatment of 4 patients with CaW

Patient 1: Alteplase combined with thrombectomy, right middle CA occlusion (Figure 5A), right

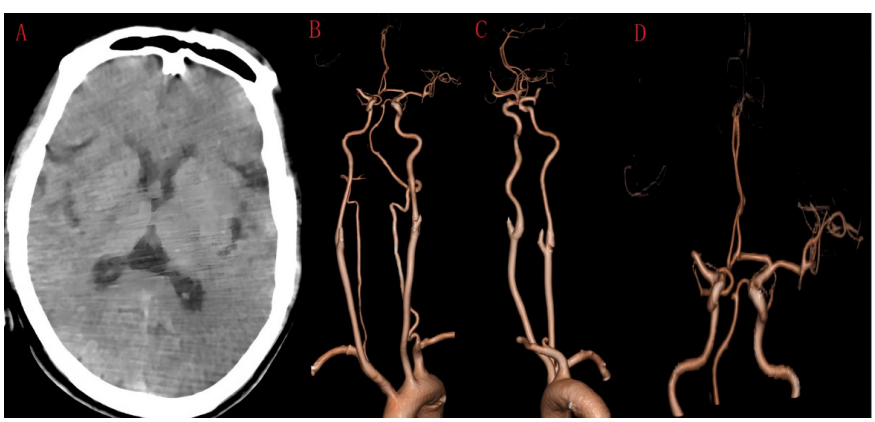

Figure 2. Imaging examination picture of Patient 1.

Table 1: Clinical data analysis of 4 patients with carotid web

Clinical data	Patient 1	Patient 2	Patient 3	Patient 4
Gender	Male	Male	Female	Male
Age (years)	58	36	56	47
Medical performance	Speech is unclear, and the left limb is weak	Speech disorder, general weakness on the right side.	Unconsciousness, right limb weakness	Unconsciousness, paralysis of the right limb
Past medical history	Cerebral infarction, right carotid webbed, pulmonary nodule	Pneumoconiosis, chronic hepatitis B, hyperuricemia, hypokalemia	History of hyperglycemia and lumbar intervertebral surgery	No
Smoking history	Yes	No	No	No
Drinking history	No	No	No	No
Muscle tension of limbs	Basically normal	Right upper limb level 1; Right lower limb level 1; Left upper limb level 4; Left lower limb level 2	Basically normal	Inactive right limb stimulation
Bilateral tendon reflex	(++)	/	(++)	Drop
Pathological sign	Negative	Negative	Positive	Positive
meningeal stimulation	No	No	No	No
NIHSS score on admission	16 points	18 points	20 points	18 points
Essen score	1 point	/	/	/
Pre-onset mRS Score	0 point	0	/	4 points
GCS score	15 points	/	/	/
Wadian drinking water test	Level II	/	/	/

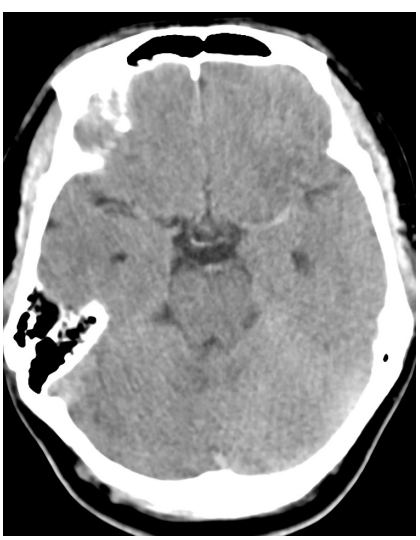

Figure 3. Imaging examination picture of Patient 2.

middle CA occlusion (Figure 5B), right carotid network (Figure 5C-D), right middle CA thrombectomy and recanalization. At 2 days after operation, MRI showed cerebral infarction with a small amount of hemorrhage in the right paraventric-radial corona-basal ganglia region and temporal lobe, mainly in the basal ganglia region. There were a few lacunar infarcts in the right frontal and parietal lobes (Figure 5E). The changes observed after recanalization of the right middle CA occlusive vessel are shown in Figure 5F.

Postoperative treatment: aspirin enteric-coated tablets 100mg orally once a night (long-term), clopidogrel bisulfate tablets 75mg orally once a night (discontinued after 3 months), atorvastatin calcium tablets 20mg orally once a night (long-term).

Patient 2: Intravenous thrombolysis with alteplase 70mg combined with mechanical

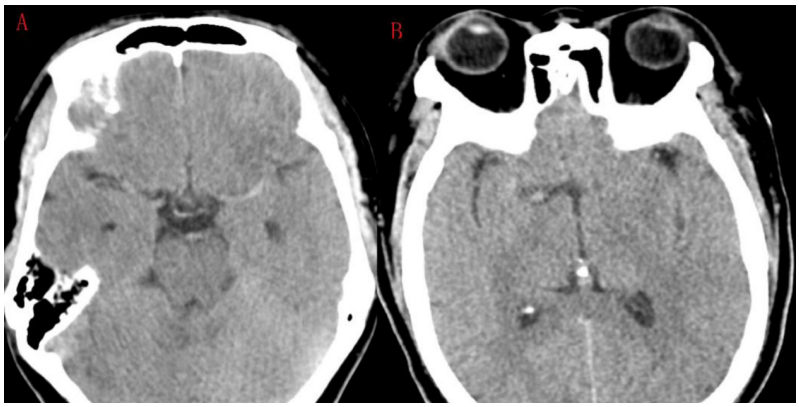

Figure 4. Imaging examination picture of Patient 4.

thrombectomy. In Figure 6A, aortic arch angiography shows a type 1 arch with webbed left internal carotid artery. In Figure 6B, a global cerebral angiogram shows occlusion of the left middle CA. Figure 6C, D shows the recanalization of the left middle CA before and after thrombectomy.

Postoperative treatment: Aspirin enteric-coated tablets 100mg orally once a night (long-term), clopidogrel bisulfate tablets 75mg orally once a night (discontinued after 3 months), atorvastatin calcium tablets 20mg orally once a night (long-term). This patient could move his right limb freely, had clear speech, and had no other discomfort. Mental health, diet, sleep, and normal urination and defecation. Nervous system examination showed that he was conscious, mentally normal, motor aphasia, bilateral pupils were equal round, about 3.0mm in diameter, and sensitive to light reflex. Bilateral frontal lines were symmetrical, bilateral nasolabial folds were equal in length, there was no intraoral deviation, and the tongue was centered. The muscle strength of the right limb was 4+, the muscle strength of the left limb was 5, the muscle tone was normal, the tendon reflexes were bilateral (++), there was no significant hypoesthesia in the limbs, the ataxia test was normal, the pathological signs were negative, and there was no sign of meningeal irritation. NIHSS score was 1 (aphasia).

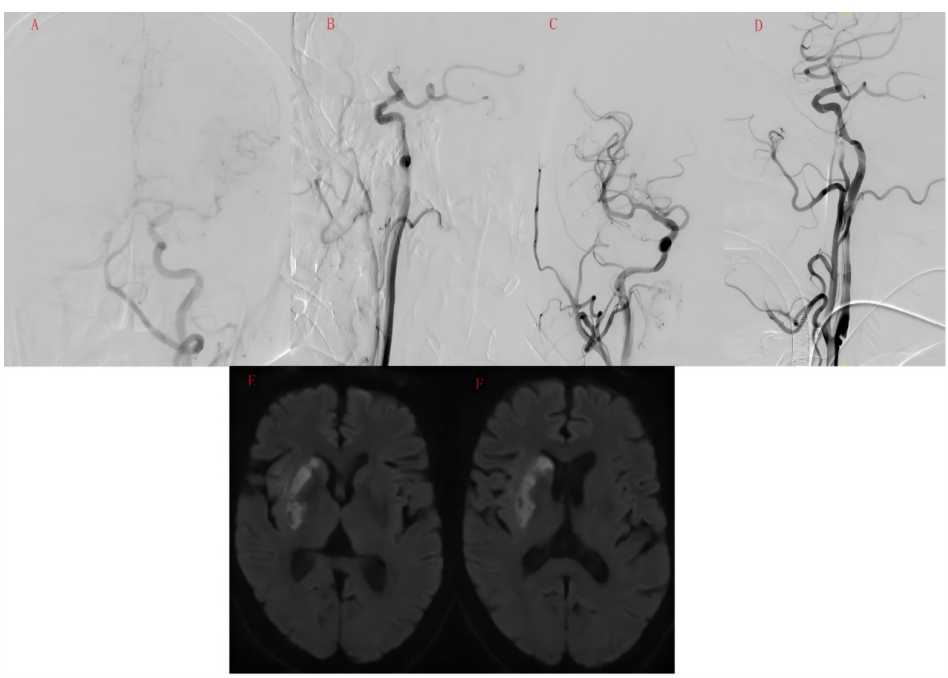

Figure 5. Treatment of Case 1.

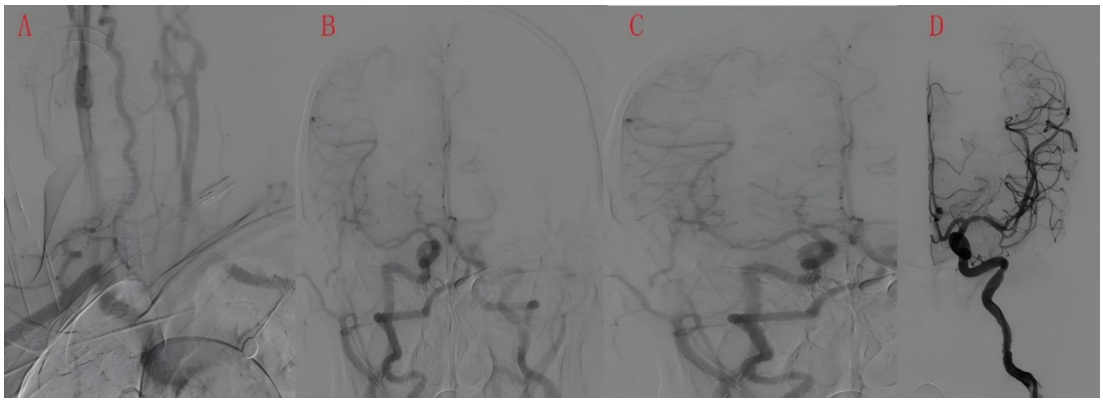

Figure 6. Treatment process of Patient 2.

Patient 3: Mechanical thrombectomy, Figure 7A shows occlusion of the A2 segment of the left anterior cerebral artery; Figure 7B: Webbed, moderate stenosis of the left internal carotid artery; Figure 7C After mechanical thrombectomy, the left anterior cerebral artery was recanalized with grade 3 forward blood flow. Figure 7D cranial MRI showed multiple lacunar cerebral infarctions in the bifrontal lobes and corpus callosum.

Postoperative treatment: Aspirin enteric-coated tablets 100mg orally once a night (long-term), clopidogrel bisulfate tablets 75mg orally once a night (discontinued after 3 months), atorvastatin calcium tablets 20mg orally once a night (long-term).

Patient 4: Mechanical thrombectomy. Figure 8A Aortic-arch angiography shows a left internal carotid web. Figure 8B shows that cerebral angiography revealed occlusion of the left middle cerebral artery. Figure 8C After mechanical thrombectomy, the left middle cerebral artery was recanalized with grade 3 forward blood flow. Figure 8D Head CT on the third day after surgery showed high density shadow in the left basal ganglia and surrounding edema zone. Figure 8E Brain MRI 5 days after surgery showed abnormal signal in the left basal ganglia, considering cerebral infarction with hemorrhagic transformation.

Postoperative treatment: Rehabilitation specialists are recommended to continue rehabilitation treatment to promote rehabilitation. Continue regular oral medications: Clopidogrel bisulfate tablets 75mg, oral, once daily; Atorvastatin calcium tablets 20mg, oral, once daily.

Results of discharge and follow-up of 4 patients with CaW

Patient 1: At discharge, the patient was in good condition with clear speech, free movement of limbs, and unimpaired defecation. The physical examination revealed clean breath sounds in both lungs, with neither dry or wet rales detected. The cardiac beat was arrhythmic, no discernible murmur was present in any valve region, the belly was flat and pliable, there was no tenderness throughout the abdomen, and both lower extremities exhibited no edema. Neurological specialist physical examination showed clear thinking and clear speech. The pupils were

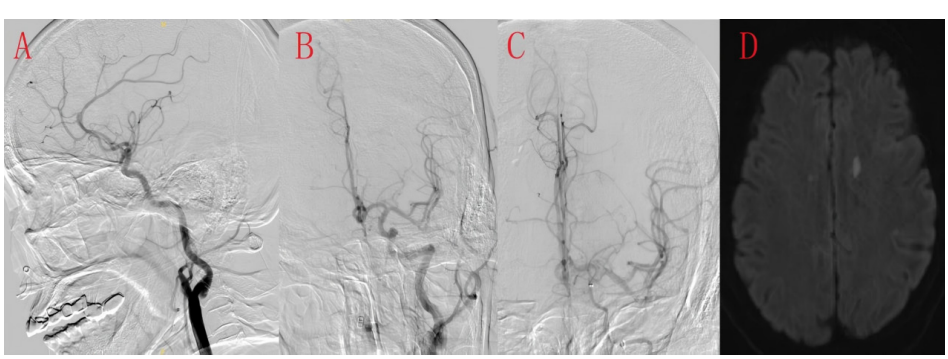

Figure 7. Treatment process of case 3.

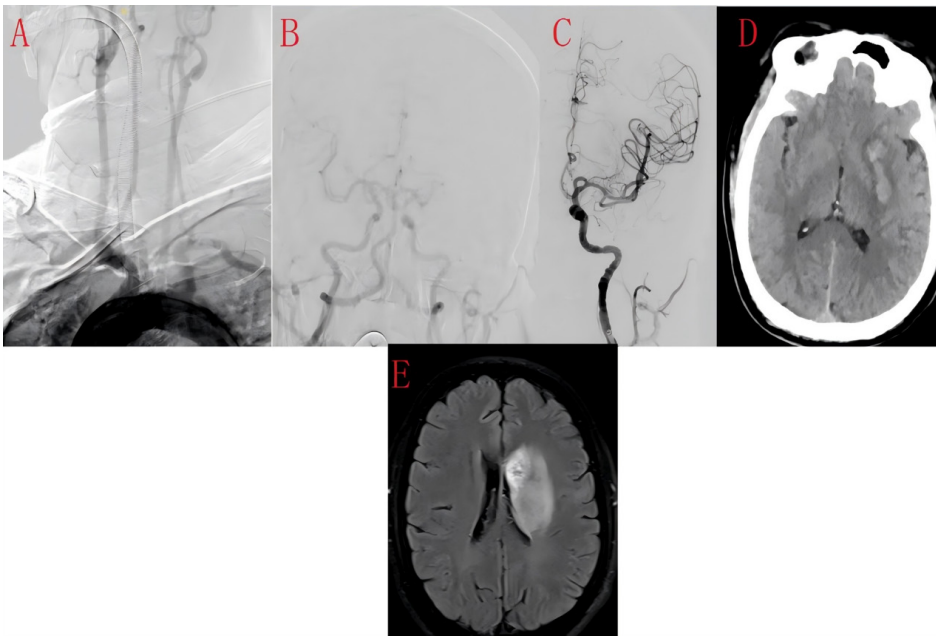

Figure 8. Treatment process of Case 4

round in size bilaterally, approximately 3.0mm in diameter, and sensitive to light reflection. Bilateral frontal-nasolabial folds were symmetrical, the muscle tone of the extremities was normal, the tendon reflexes were normal and reciprocal, the pathological signs were negative, and there was no sign of meningeal irritation. There was no sensory disturbance. The NIHSS score was 0.

Follow-up: The patient was scheduled for elective treatment of the right CaW, but the patient did not receive treatment. Aspirin enteric-coated tablets and atorvastatin calcium tablets were taken regularly, and no recurrence was found during the follow-up of 2 years. MRS Score was 0; GCS score was 15; Carotid artery color Doppler ultrasound, cerebral angiography and head and neck CTA were not reviewed.

Patient 2: The patient had normal right limb movement, clear speech, and no other discomfort. Mental health, diet, sleep, and normal urination and defecation. Nervous system examination showed that he was conscious, mentally normal, motor aphasia, bilateral pupils were equal round, about 3.0mm in diameter, and sensitive to light reflex. Bilateral frontal lines were symmetrical, bilateral nasolabial folds were equal in length, there was no intraoral deviation, and the tongue was centered. The muscle strength of the right limb was 4+, the muscle strength of the left limb was 5, the muscle tone was normal, the tendon reflexes were bilateral (++), there was no significant hypoesthesia in the limbs, the ataxia test was normal, the pathological signs were negative, and there was no sign of meningeal irritation. NIHSS score was 1 (aphasia).

Follow-up: The patient was scheduled for elective treatment of the left carotid web, but the patient was not treated. Aspirin enteric-coated tablets, atorvastatin calcium tablets, mecobalamin and traditional Chinese medicine were taken regularly, and no recurrence was found after half a year of follow-up. MRS Score was 1; The NIHSS score was 0. Carotid artery color Doppler ultrasound, cerebral angiography and head and neck CTA were not reviewed.

Patient 3: The patient was conscious and had clear speech without dizziness, headache, chest tightness, or chest pain, with moderate muscle strength in the extremities and slight back pain. Physical examination: clear mind, clear speech, no nystagmus is when eyes are fixed left and right, student equicircular, about 3 mm in diameter, sensitive light reflex, with tongue sticking out in the middle, both pharyngeal reflexes are elevated, mouth is not inclined, muscle strength of limbs is grade 5, muscle tension is normal, bilateral finger nose test and heel-kn The ee-tibia test was inaccurate, the Babinsiki sign was negative in both countries, and the Chaddock sign was (-) bilaterally. At discharge mRS Score was 1, TOAST classification: for other reasons, NIHSS score was 0.

Follow-up: The patient was scheduled for elective treatment of the left CaW, but the patient

did not receive treatment. Aspirin enteric-coated tablets and atorvastatin calcium tablets were taken regularly, and no recurrence was found after half a year of follow-up. MRS Score was 0 and NIHSS score was 0. Water swallow test class I.

Patient 4: The patient was conscious, with average spirit, average diet, moderate sleep, better right lower limb activity than before, and basically normal blood pressure. Neurological specialist physical examination showed that he was conscious, slurred speech, fluent, and basically normal advanced intellectual activities. The pupils were round in size bilaterally, approximately 3.0mm in diameter, and sensitive to light reflection. Bilateral frontal lines were symmetrical, the right nasolabial fold was shallow, the teeth were angular to the left and the tongue to the right. The muscle strength of the left upper limb was grade 5, the right upper limb was grade 2, and the right lower limb was grade 3 to 3. The muscle tension of the left limb was basically normal, but the muscle strength of the right limb decreased, and the sensory decrease was not obvious. The right tendon reflex was positive, and the right Babinski sign and Chaddock sign were positive, without meningeal irritation. The NIHSS score was 7, and the MRS Score was 3.

Follow-up: The patient has been adhering to the rehabilitation treatment, and after half a year, he can walk slowly alone with normal stool. Physical examination showed increased muscle tone in the right limb, including elbow flexor muscle group 1 and ankle plantar flexor muscle group 1, which could induce ankle clonus. Mild muscle atrophy was observed in the muscles around the right shoulder, and the right shoulder joint was passively limited: flexion 0 to 180°, pronation 0 to 65°, and supination 0 to 60°. The right hand was not swollen, so active flexion and extension was not possible. In a standing position, the right hip was significantly supinated, and she could walk slowly and horizontally independently with a hemiplegic gait. Brinell staging: stage II in the right upper extremity, stage II in the right hand, and stage IV in the right lower extremity. Activities of daily living scale: 7 points for family members (3 points for toileting + 2 points for cleaning + 2 points for staying at home), indicating that most of the life was self-care. It has been suggested that the patient should be treated selectively for the left carotid web, but this has not been done. Clopidogrel tablets and atorvastatin calcium tablets were taken regularly, and no recurrence was found after half a year of follow-up.

DISCUSSION

At present, many pathological results about CaW show that this disease, as a variant of myofibrodysplasia, often involves the bifurcation of carotid artery and the double-layer membrane structure protruding from the lumen, and some patients may show non-traditional risk factors of cerebrovascular disease, but the recurrence rate of stroke events is ≥17%.[15] Kodankandath *et al*.[16] found that the detection rate of carotid webbed was 1.2% based on ischemic stroke population, suggesting that the clinical incidence of carotid webbed was not high. In recent years, only 4 cases were admitted to our hospital, which further proved that the detection rate of carotid webbed was low at present. This may be related to the race, region and individual basis of the screening population. Osehobo *et al*.[17] found that the average age of patients with carotid webbed was about 38.3 to 46.7 years old. The ages of the four patients in this research varied from 36 to 58 years, which varied greatly, which may be related to genetic factors, lifestyle and physiological changes. In terms of gender differences, women have a higher risk of carotid web than men.[18] Previous research reports pointed out that women accounted for 58% in 25 cases of carotid web.[19] However, among the 4 cases, only one case is female, which is different from the previous research results. There may be differences in complications, eating habits, exercise, smoking and drinking, which may affect the incidence of carotid webbed.

Clinical studies have found that unilateral or bilateral CaW may be possible, but there is still controversy about this.[20] For example, Essibayi *et al*.[21] pointed out that the incidence of bilateral CaW is 58.3% higher than that of unilateral CaW. Sajedi *et al*.[21] found that the CaW was unilateral. Our results showed that all the 4 patients had unilateral CaW (1 on the right side and 3 on the left side). Due to the small size of CaW lesions, it is possible to reduce the risk of missed diagnosis and misdiagnosis by determining efficient imaging techniques. CTA has the advantages of rapid and non-invasive, which can clearly obtain morphological information of blood vessels and reconstruct them, and has high sensitivity and specificity. Previous studies have also found that CTA is consistent with subtraction angiography in the diagnosis of CaW, so CTA is the preferred examination.[22-24] However, it should be noted that the thickness of CTA scan will increase the error of CaW. At the same time, due to the limitation of pulse motion and blood flow impact, the free

edge of the CaW can swing, leading to the error of the distal motion artifact of the CaW.

Clinically, measures to prevent ischemic stroke caused by CaW include drug therapy (such as anticoagulation and platelet aggregation therapy) and invasive surgical treatment (such as angioplasty and intracranial artery embolectomy).[25-27] Based on the report on the pathogenesis of ischemic stroke caused by CaW, the effect of anticoagulant therapy is better than that of antiplatelet aggregation, but there is still no evidence.[28,29] At present, the effectiveness of angioplasty and intracranial artery embolectomy has been gradually verified, among which Marnat *et al*.[30] reported that there was no recurrence of ischemic stroke after half a year's follow-up after angioplasty of CaW with the largest sample size. In the results of this study. Two cases were treated with thrombolysis combined with mechanical thrombectomy, and two cases were treated with mechanical thrombectomy alone. However, the CaW was not treated specifically, and all of them were treated with anti-platelet aggregation after operation. All of them recovered well, and the follow-up time was different, but none of them recurred again. Therefore, patients with CaW need to seek medical attention in time and insist on follow-up to reduce the risk of stroke recurrence.

There are some shortcomings in this study. First, this study is a retrospective analysis and lacks case controls. Second, the cases were from a single center, which was not representative. In clinical treatment, although some therapeutic effects have been achieved, the follow-up time is short, and a large sample and longer follow-up time are still needed for follow-up.

In conclusion, the incidence of patients with CaW is low, and most of them are admitted to the hospital in the emergency department, with a male predominance and unilateral disease. After individualized targeted therapy, no recurrence was found in our patients.

DISCLOSURE

Data availability: The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Financial support: None

Conflict of interests: None

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