Case Report

Internal Carotid Artery Kinks and Coils: Repair with Autologous External Jugular Vein

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Abstract

Stroke is a leading cause of death in the United States and affects millions of people worldwide. Carotid artery kinks and coils can cause cerebral hypoperfusion, leading to neurovascular symptoms. These symptoms can be corrected with surgical intervention. This case report presents a 61 year old African American female with internal carotid kinks and coils with neurological symptoms requiring surgical intervention. Imaging of the internal carotid arteries demonstrated bilateral internal carotid arteries with severe tortuosity. This tortuosity was obvious during the surgery, when the internal carotid artery was seen with kinks and coils creating a 360° hairpin turn. An internal carotid artery repair was done with autologous reverse external jugular vein bypass. The external jugular vein was used because it was available and a better candidate than the great saphenous vein and the synthetic material. The patient was instructed to follow up for postoperative evaluation in 3 months with an ultrasound evaluation of the repair. The postoperative evaluation and ultrasound findings confirmed a patent artery and demonstrated that our repair successfully alleviated the patient’s symptoms completely.

ABBREVIATIONS

PS: Peak Systolic; ED: End Diastolic

INTRODUCTION

According to the American Heart and Stroke Association, stroke is the 5th leading cause of death in the United States with a prevalence of 33 million worldwide [1]. With carotid stenosis being a major contributor to the cause of stroke, understanding the history of the procedure and the current recommendations allows us to make the best surgical decisions.

The anatomical variations of carotid artery kinks and coils were known since the mid-1700s [2]. The prevalence of carotid coils in the general population remains unknown [3]. Redundant carotid arteries can lead to neurovascular symptoms, despite the absence of atherosclerosis, and require aggressive surgical repair [4]. The first carotid artery endarterectomy was done in London, England by Eastcott in 1954 [5]. Since then the advances in technology and continued research has contributed many refinements to this surgery [6].

In this study, the patient presented with a combination of internal carotid artery kinks and coils and insignificant plaque formation that left our patient with neurovascular symptoms. Surgical intervention was necessary to repair the redundant internal carotid arteries in order to relieve the patient’s symptoms. In this case report, we present a repair of internal carotid artery kinks and coils with an autologous external jugular vein.

CASE PRESENTATION

A 61-year-old African American female presented to the emergency department for syncope. The patient presented with symptoms of dizziness, described as the room spinning around her. The dizziness progressed worsened throughout the day, leading to the syncopal episode. The patient admitted that over the last 6 months she had 6 syncopal episodes. In addition, the patient described symptoms of left sided weakness over the course of 1 year, double vision, and dysarthria. She denied any preceding symptoms of chest pain or shortness of breath. The patient’s past medical history included hypertension, coronary atherosclerosis, and congestive heart failure. She had a previous history of smoking. The physical examination found the patient to be neurologically intact without abnormal physical
findings. On further evaluation, the laboratory values had 3 serial troponin levels of <0.04 ng/mL, a B type natriuretic peptide level of 57 pg/mL. These laboratory levels indicated that the patient’s symptoms were unlikely cardiac in origin. The patient’s basic metabolic panel was unremarkable. Sodium level was 136 mmol/L. Potassium was 3.5 mmol/L. Choloride was 101 mmol/L. Carbon Dioxide was 29 mmol/L. Anion Gap was 6 mmol/L. Blood urea nitrogen was 9 mg/dL. Creatinine was 0.61 mg/dL. Glucose was 120 mg/dL. A computed tomography scan of the head revealed no acute intracranial process, and further imaging was indeterminate.

The etiology of the patient’s symptoms was unclear, and cerebral vascular accident could not be completely ruled out. There was still concern for cerebral vascular accident, so the patient was admitted for further evaluation. Carotid Doppler was ordered for syncopal workup and revealed 50 % -69 % stenosis of the left internal carotid artery and 70 % -90 % stenosis of the right internal carotid artery. The peak systolic velocity of the distal left internal carotid artery was 188.5 cm/s, and the peak systolic velocity of the distal right internal carotid was 272.4 cm/s. The radiologic report further stated that the internal carotid arteries were extremely tortuous bilaterally (Figure 1, 2). A computed tomography angiogram of the head and neck did not confirm significant stenosis, but it did corroborate the tortuosity of both internal carotid arteries. The internal carotid arteries were found to make a 360º turn with severe kinks. The reconstituted images from the computed tomography angiogram clearly depicted the tortuosity of the internal carotids (Figure 3, 4). Additionally, bilateral vertebral arteries were found to be tortuous. After reviewing the preoperative imaging and the patient’s symptomatic presentation, the conclusion was made that the tortuosity of the internal carotid arteries were likely the culprit of the patient’s symptoms and warranted surgical intervention.

The patient was diagnosed with cerebral hypo perfusion secondary to internal carotid kinks and coils. The findings were discussed with the patient, and we recommended correcting the most severe of the internal carotid kinks and coils. Preoperatively, there was discussion of 3 possible options of anastomosis of the internal carotid resection: using the external jugular vein; the great saphenous vein or; a synthetic graft.

We proceeded with a resection of a redundant right internal carotid artery with a right common carotid artery to internal carotid artery bypass using a reversed external jugular vein. During surgery, the right carotid bifurcation was identified. Further dissection revealed that the internal carotid immediately dived down into a 360º hairpin turn (Figure 5). Also noted, there were severe kinks with no gross atherosclerotic disease. The internal carotid artery was clamped distally. Subsequently, the common carotid artery and the external carotid arteries were clamped. The internal carotid was completely resected. Back bleeding from the internal carotid artery was visualized. The internal carotid artery was again clamped, and the reminder of the operation was done without shunting. An end-to-end anastomosis was done using the reversed external jugular vein, which was sutured to the distal internal carotid artery and the origin of the common carotid artery (Figure 6). After the repair,
Figure 4 Shows the CT angiogram of the carotid vessels from the anterior to posterior viewpoint. Again, notice the tortuosity of the vessels bilaterally.

Figure 5 As seen, neck dissection reveals the common carotid artery (+), the internal carotid artery (-), and the external carotid artery (↓). The internal carotid dives, and immediately, it makes a 360 degree hairpin loop.

Figure 6 This picture shows the final repair. The end-to-end anastomosis was done using the reversed external jugular vein. The different arteries are indicated by the various symbols - venous repair of the internal carotid artery (↑), external carotid (←), and common carotid artery (*).

the vessels were unclamped, and direct visualization of the bypass showed adequate flow. Hemostasis was achieved. The surgical site was closed and dressed with sterile dressing. Prior to the patient being extubated, the patient was reassessed. The patient was found to follow commands, moved all her extremities, and was neurologically intact. Postoperatively, the patient continued to recover uneventfully, and she was discharged in stable condition on postoperative day 2.

**DISCUSSION**

In this case presentation, the patient presented with internal carotid kinks and coils. The neurovascular symptoms were caused by the redundancy of the artery and the kinks and coils. The patient’s symptoms of left sided weakness, double vision, dysarthria, and multiple syncopal episodes were indications for surgical intervention. Although the imaging did not find our patient to have significant internal carotid stenosis, the kinks and coils of the internal carotid arteries did produce cerebral hypoperfusion like that of carotid stenosis. As a result, it would be fair to say that the indications for repair of the internal carotid stenosis could be extrapolated to include carotid kinks and coils. There were two landmark studies done to evaluate the benefits of patients with carotid stenosis undergoing carotid endarterectomy. The two studies of note were the North American Symptomatic Carotid Endarterectomy Trial and the North American Symptomatic Carotid Endarterectomy Trial.

In 1991, the New England Journal of medicine published the North American Symptomatic Carotid Endarterectomy Trial demonstrating that symptomatic patients with high grade stenosis benefited from carotid endarterectomy [7]. When reviewing patients in this study with a high grade stenosis of ≥ 70%, those in the surgical arm had a surgical stroke risk of 9%, and those in the medical arm had a stroke risk of 26% [7]. The risk reduction of stroke of 17% over a 2 year period was very significant. The study also showed that patients with a stenosis of 50%-69% had a significant risk reduction of 6.5% over a 5 year period when undergoing surgery. The study goes on to state that these results are significant if major complications of stroke and death remain under 10% [7].

While the North American Symptomatic Carotid Endarterectomy Trial was underway, another research was taking place to determine the benefits of the surgical treatment of asymptomatic patients with carotid stenosis [8]. The findings of this study were published in the Asymptomatic Carotid Atherosclerosis Study, demonstrating the benefits of surgical treatment over medical treatment in this patient population [8]. When comparing the surgical to the medical arms, the findings were in favor of the surgical arm. Surgical patients with a carotid stenosis of ≥ 60% had a stroke risk reduction of 5.9% over a 5 year period [8].

It is clear from these two studies that surgical intervention produces better outcomes for patients with carotid stenosis. By expanding on the conclusions of these two studies, we were able substantiate our thought process and offer the patient surgical repair of her internal carotid kinks and coils. During the surgical procedure, we decided to use the patient’s external jugular vein for repair. One major complication of a
carotid endarterectomy is stenosis, which can result in strokes. To prevent stenosis of the artery, surgeons have repaired the artery by placing a patch versus primary closure [9]. The most readily accessible patches are the prosthetic patches. Of these patches the most commonly used patches are made of polytetrafluoroethylene and dacron. However, these prosthetic patches are associated with bleeding from the suture site, pseudoaneurysm, and infection. The most commonly used patch is the venous patches, and the venous patch is preferred. The luminal surfaces of the venous patches are covered with endothelial lining, making it resistant to thrombosis and restenosis [9]. Promising results of increased tensile strength with everted vein patches were shown in previous studies [10].

In addition, the use of autologous external jugular vein also provides further benefit to the patient. The external jugular veins are sometimes sacrificed during carotid endarterectomy dissection [9]. The ease of harvesting the external jugular vein without causing unnecessary trauma and dissection planes to the patient clearly set the external jugular vein as the more likely candidate over the great saphenous vein. By using the external jugular vein, we were able to avoid the extra step of harvesting the great saphenous vein. By avoiding this step, we prevented the patient from longer surgical time. It is commonly accepted that the great saphenous vein is used for other vascular bypasses. By preserving the great saphenous vein, this allows it to be used for future surgical procedures. Lastly, the expense of a synthetic material was also considered. For these obvious reasons, the external jugular vein was a better choice for our purposes.

Figure 7 This is an illustration identifying the normal cerebral vasculature. This picture helps identify the normal anatomy of the common carotid artery, internal carotid artery, and the external carotid artery of the neck [13].
Approximately 3 months after her surgery, the patient underwent an evaluation of the carotid arteries. Carotid stenosis evaluation with imaging can be done using several methods such as arterial angiography, ultrasound, or computed tomography angiography.

The gold standard of evaluating carotid stenosis is arterial angiography with digital subtraction [11]. Of these methods, the least expensive and least invasive would be the ultrasound [11]. The Washington Criteria was developed by Dr. Strandness [12]. The Washington criteria predicted percent stenosis or total occlusion based on information such as duplex peak systolic velocities and end diastolic velocities. The sensitivity and specificity were 99% and 87%, respectively [11]. A better option than duplex ultrasound evaluation of carotid stenosis is computed tomography angiography. Studies show that when compared to the gold standard, the computed tomography angiography had sensitivity of 89% and a specificity of 91% when the stenosis was >50% [11]. However, CTA did have limitations in which it was not as accurate at differentiating between moderate and high grade stenosis [11].

After consideration of the different methods of evaluating the carotid arteries, it was decided to have the patient undergo an ultrasound evaluation of the carotid arteries. The ultrasound was a better initial postoperative evaluation tool since it was less expensive and less invasive than the other methods. The ultrasound also has respectable sensitivity and specificity for identifying carotid stenosis. The results from the patient’s ultrasound showed the repair was patent. Our surgical repair of the redundant carotid arteries with reversed external jugular vein bypass proved to have a positive lasting outcome. In the end, the results of this case study substantiate the notion that surgical intervention with native external jugular vein graft is a viable option for repair.

REFERENCES