Direct Carotid Cavernous Fistula after Trigeminal Balloon Microcompression Gangliolysis: Case Report

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OBJECTIVE AND IMPORTANCE: Percutaneous gangliolysis procedures may rarely be associated with vascular complications. There are three reported cases of carotid cavernous fistulas occurring after percutaneous retrogasserian procedures. We present one case of acute symptomatic direct carotid-cavernous fistula after percutaneous balloon microcompressive trigeminal gangliolysis. This is the only reported case of this complication associated with microcompression gangliolysis.

CLINICAL PRESENTATION: A 78-year-old woman was referred to our institution with a history of abrupt onset of left-sided bruit, proptosis, chemosis, and diplopia after a percutaneous retrogasserian microcompression.

INTERVENTION: Cerebral angiography revealed a large left direct carotid cavernous fistula. Attempts at balloon embolization were unsuccessful, and the lesion was ultimately cured by transarterial and transvenous coil embolization.

CONCLUSION: Follow-up examination revealed no evidence of bruit or neurological deficit. This report highlights a unique complication of balloon gangliolysis and describes coil embolization of the fistula as the mode of treatment. (Neurosurgery 39:853–856, 1996)

Key words: Carotid artery, Carotid-cavernous fistula, Therapeutic embolization, Trigeminal neuralgia

The treatment of trigeminal neuralgia, first described by Arateus in the 1st century AD (1), has included many surgical options when medical therapy fails. One surgical option involves the lesioning of the gasserian ganglion or the retrogasserian trigeminal nerve.

There has been a steady evolution of methods used to create a gasserian lesion. Alcohol injection was first performed by Taptas in 1909. Electrocoagulation was performed by Kirschner in 1931. White and Sweet introduced controlled thermocoagulation by a radiofrequency current in 1965 (10). An additional method was evaluated in 1983 by Mullan and Lichtor (6). The procedure, based on the older Taarnhoj-Sheldon-Pudenz operation, involved microcompression of the trigeminal ganglion with a Fogarty balloon. This procedure reportedly involved little discomfort with brief hospitalization and a 12% incidence of recurrence, comparable with other procedures (6).

Vascular complications associated with percutaneous procedures are rare and include carotid artery injury, hematoma, and subarachnoid hemorrhage (10). Three cases of carotid artery fistulas have been reported, including two direct carotid-cavernous fistulas (10) and one external carotid artery fistula (8). We present one case of direct carotid cavernous fistula, which is the only reported case of this complication associated with microcompression gangliolysis.

CASE REPORT

A 78-year-old woman was referred with a history of abrupt onset of left-sided bruit, proptosis, chemosis, and diplopia after a percutaneous retrogasserian microcompression at another institution. This patient had a 2-year history of severe left-sided facial pain, consistent with atypical trigeminal neuralgia, which developed after a motor vehicle accident. The patient's history revealed no subjective bruit. The patient had a buccal trigger point, and eating exacerbated the pain, resulting in a consequent weight loss of 25 pounds. There was an early transient response to carbamazepine, but recurrent pain demonstrated the patient had failed medical therapy. The percutaneous balloon gangliolysis was performed using standard protocol without reported complication. Intraoperative lateral fluoroscopy films, however, revealed that the contrast-filled balloon was not within Meckle's cave (*Fig. 1*). After the procedure, the patient noticed a pulsating noise in the

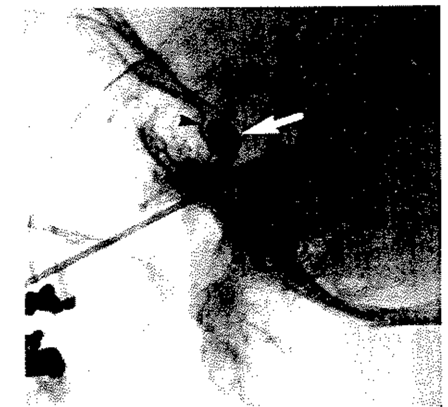

FIGURE 1. Lateral intraoperative film demonstrating the needle at the foramen ovale with contrast balloon (*arrow*) situated just posterior to the tuberculum sella (*arrowhead*). This is anterior to Meckle's cave and probably fills the posterior cavernous sinus.

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left side of her head associated with a severe headache. Over the course of several hours, the patient developed proptosis and chemosis on the left side. The patient was referred to our institution.

An initial cerebral angiogram revealed a large left direct carotid cavernous fistula (*Fig. 2*). Angiographic evidence of arterial steal from the left hemisphere was noted, with reversal of flow down the internal carotid artery (ICA) to the fistula. The left hemisphere filled through the anterior communicating artery. Because of the high flow from the ICA, it was likely that the fistula could not be treated while preserving flow through the artery and a test occlusion of the left ICA with a 1.5-mm nondetachable silicone balloon was performed for 15 minutes without neurological deficit. After the test occlusion, a 1.5-mm medium detachable silicone balloon (Interventional Therapeutics Corporation, Fremont, CA) was navigated through the ICA into the cavernous sinus. The balloon was filled with 0.5 ml of metrizamide and not solidified because of increasing patient combativeness and distress despite sedation. A postembolization angiogram demonstrated complete closure of the fistula with good balloon position and flow through the ICA (*Fig. 3*).

FIGURE 2. Lateral common carotid artery early arterial phase angiogram demonstrating a direct carotid-cavernous fistula. The fistula fills a dilated superior opthalmic vein (*arrow*), an enlarged cavernous sinus (*arrowhead*), and the superior petrosal sinus (*open arrow*).

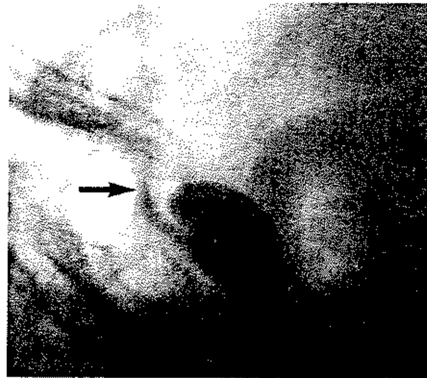

FIGURE 3. Metrizamide-filled balloon in the cavernous sinus after closure of the fistula. Note the similarity of the balloon shape and the position relative to the tuberculum sella (*arrow*) in this x-ray to the balloon used during the microcompression gangliolysis.

Two days later, the patient's bruit and ocular symptoms returned. A cranial x-ray demonstrated no balloon in the cavernous sinus. Cerebral angiography revealed the fistula had reopened. An attempt was made to close the fistula and preserve flow through the ICA, but this was not possible, so the left ICA was catheterized and multiple platinum coils (Guglielmi Detachable Coils; Target Therapeutics, Fremont, CA) were placed in the left ICA distal to the fistula and proximal to the ophthalmic artery. Additional coils were then placed in the cavernous sinus and more proximally in the ICA. The heparinization was reversed, and the patient returned to the ward. An examination 3 weeks later revealed no evidence of bruit or neurological deficit. The patient's headache and ocular symptoms had resolved. The patient also noted improvement in her left facial pain.

DISCUSSION

Many complications are described in association with the surgical treatment of trigeminal neuralgia. Injury to the IInd, IIIrd, IVth, Vth, and VIth cranial nerves have been reported in addition to intracerebral hematoma, subarachnoid hemorrhage, abscess, and stroke (10).

Carotid artery puncture is a relatively common occurrence during percutaneous ablative procedures but is usually harmless. Very few complications have been reported with injuries to the ICA. Thermal injury during radiofrequency lesioning may extend to involve vascular structures. Carotid injury may also result from a misguided, particularly far posterior or medial needle placement. In up to 4% of cases, there is a fusion of the foramen ovale and foramen lacerum, the primitive foramen lacerum medius, which may predispose to vascular injury (8).

Accurate positioning of the needle and more careful evaluation of the balloon as it was inflated could have prevented this complication. The technique of percutaneous compression of the trigeminal ganglion has been described by Mullan and Lichtor (6). In the present case, the needle may have been placed too far posterior and in the foramen lacerum. However, the surgeon did not see any blood coming from the needle and the lateral radiograph does not clearly show misplacement. If the needle is directed too medial through the foramen ovale, the carotid artery may be injured because it lies just medial to the lesion. As the balloon is inflated, it is clearly in the wrong position, not obtaining the "pear" shape that typifies the configuration of a balloon in Meckle's cave. The balloon is probably inflating in the cavernous sinus. Before this point, the needle position should have been reassessed.

There are three reported cases of carotid cavernous fistulas occurring after percutaneous retrogasserian procedures. Sekhar et al. (10) reported two carotid-cavernous fistulas, one after radiofrequency lesioning and one after retrogasserian block, that were obliterated by intracavernous injection of isobutyl-2 cyanoacrylate, using intra-arterial balloon flotation catheters (10). Revuelta et al. (8) reported one case of an external carotid artery/internal jugular vein fistula that occurred after a microcompression gangliolysis and that closed spontaneously. In all cases, a loud bruit was noticed by the patient within 2 postoperative days. It was concluded that two of these complications were the result of arterial puncture, whereas one probably involved extension of radiofrequency thermal injury to involve the carotid artery. To our knowledge, no previous reports of di-

rect carotid cavernous fistulas have been reported to occur after balloon microcompression gangliolysis. The cause of the fistula is potentially related to arterial injury from balloon inflation or from through-and-through sinus-arterial puncture. No arterial hemorrhage was noted during the procedure. The balloon used to close the fistula is strikingly similar to the balloon used to perform the compression. This similarity suggests an errant location of the compression balloon in the cavernous sinus. Generally, it is possible to preserve flow through the carotid artery when treating these lesions, but if the tear in the artery is large, carotid occlusion remains an alternative. The balloon was not solidified and deflated within 48 hours. The coils were initially deployed in the cavernous sinus, but because some of the coils herniated into the ICA, it was elected to permanently occlude the artery.

Small arteriovenous fistulas may close spontaneously, as one of the previously reported cases demonstrates. In the event that the fistula remains symptomatic, treatment involves embolization. Several large series have shown the effectiveness of transarterial balloon embolization for traumatic carotid cavernous fistulas (2, 5, 7). However, if balloon embolization fails, as was demonstrated in this case, recent advances in endovascular coils have made their useful application to this vascular complication possible.

In a large series of 227 embolization procedures for symptomatic carotid cavernous fistulas, five involved the use of platinum coils (4). These all involved cases in which standard balloon embolization was unsuccessful. This problem may occur if the fistula orifice is too small to allow entry, the venous compartment is too small to allow balloon inflation, or sharp objects puncture the balloon during inflation. There are also two reports of the use of electrothrombosis in conjunction with detachable platinum coils for treatment of carotid cavernous fistulas (3, 9). As stated by Guglielmi et al. (3), "The advantages of the electrodetachable platinum coils are related to their biocompatability, radiopacity, and thrombogenicity; they may be controlled by retrieval and repositioning." These advantages make the electrodetachable coil a reasonable alternative when balloon embolization fails.

Carotid cavernous fistulas are clearly a rare complication of percutaneous retrogasserian procedures. They may be secondary to direct arterial injury, either by needle puncture, thermal injury, or balloon inflation. Treatment is via endovascular approach using balloon or coil embolization.

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COMMENTS

The irony of this case is the minimally invasive nature of the planned treatment of the original problem (trigeminal neuralgia) and the minimally invasive cure of the complication (carotid cavernous fistula). Although this report describes primarily the therapy of this unfortunate complication, it does not emphasize risk prevention. Appropriate anteroposterior and lateral fluoroscopic or plane film images are crucial for percutaneous trigeminal neuralgia procedures. The appropriate placement of a needle, whether for the delivery of radiofrequency current, glycerol, or a balloon, requires high-resolution imaging performed by an experienced surgeon. The needle can always pass the foramen ovale. If it is placed too medial and too far posterior, it will pass laterally to medially and directly into the cavernous sinus. This ultimately will result in venous bleeding first and subsequent arterial bleeding if the needle penetrates the carotid artery. This is a well-recognized complication of percutaneous therapy for trigeminal neuralgia. A too lateral placement can sometimes result in temporal lobe puncture (temporal lobe hematoma, seizures), and a too far medial as well as posterior placement can actually damage the optic nerve (visual loss), resulting in injury to the carotid artery. Usually, this complication can be dealt with by endovascular techniques that maintain carotid patency. This would be ideal, especially in an elderly patient.

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Because a large caliber needle, 13 or 14 gauge in diameter, is required to accommodate the No. 4 Foley catheter through which the balloon is introduced into Meckel's cave, Mullan and Lichtor (1983) (1) emphasize that the tip of the needle should not enter the intracranial cavity to minimize the likelihood of entering an intracranial vessel. They recommend guiding the insertion by radiography, which should proceed up to

but not beyond the foramen ovale. They find that the catheter needs to pass for ~1 cm through the third division and ganglion to reach Meckel's cave. In the case presented by Kuether et al., the first surgeon inserted the biopsy needle deep to the lateral wall of the cavernous sinus and further through the lateral wall of the intracavernous internal carotid artery. The hole had to be in the wall of the artery, because the first surgeon's procedure created an opening between the intracranial internal carotid and the surrounding venous sinus with chemosis. The flap of the wall of the intracavernous internal carotid made by the penetration of the large biopsy needle is evidence that constant radiographic monitoring until the necessary manipulations are completed is essential.

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Unusual Complications at Iliac Crest Bone Graft Donor Site: Experience with Two Cases

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OBJECTIVE AND IMPORTANCE: Two cases of fracture of the iliac crest after graft harvesting are presented. Only six such cases have been reported in the literature, although more than 100,000 such procedures are performed each year in the United States alone. This complication adds to the morbidity of the procedure for which the graft is taken. Its avoidance by an appropriate harvesting technique will reduce patient disability and shorten hospital stay.

CLINICAL PRESENTATION: A 56-year-old man who worked as a mechanic underwent anterior cervical discectomies and fusion at C5–C6 and C6–C7 for spondylotic radiculopathies. Another patient, a 48-year-old man, required mandibular reconstruction for squamous cell carcinoma. Both grafts were harvested from the iliac crest using osteotomes. On the 9th and 3rd postoperative days, respectively, each patient developed groin pain while walking, associated with marked tenderness over the graft donor sites. X-rays showed fractured iliac crests.

INTERVENTION: Apart from bed rest for pain, no specific treatment was required.

CONCLUSION: The use of the osteotome weakens the iliac crest, leading to stress fractures caused by the pulling action of the attached muscles. To prevent this from happening, we recommend the use of the oscillating saw, leaving a 3-cm spike of iliac crest anteriorly. Nevertheless, this complication has a good long-term outcome. (Neurosurgery 39:856–859, 1996)

Key words: Anterior discectomy, Bone graft, Iliac fracture, Mandibular reconstruction

Harvesting iliac bone graft is a procedure that is frequently and routinely performed within the scope of a more important operation. This procedure and its morbidity is rarely focused on, although the complication rate ranges from 4% (2) to 39% (1). A review of the literature reveals a strikingly small number of reports on this procedure and its complications.

The site of harvesting bone grafts depends on the positioning of the patient during surgery and on the quality and quantity of bone needed for fusion. Cancellous bone graft is usually sufficient for lumbar posterolateral fusion after pedicle screw fixation. In cervical spine surgery, however, bicortical or tricortical bone grafts are used to support axial compression forces (2, 3, 15, 16, 18). Otorhinolaryngologists and maxillofacial surgeons often need bone grafts to restore functionality of the maxillofacial skeleton (6, 14). The procedures are usually performed with patients in the supine position, allowing one to harvest autogenous bicortical bone grafts from the iliac crest.

Donor site complications include local pain, nerve injury, arterial injury, hemorrhage, infection, cosmetic deformities, and exceptional fractures. Recently, we were exposed to two cases with unusual complications after the harvesting of iliac bone grafts. Although we routinely perform this procedure in more than 50 patients per year, this has never happened before. The stress fracture of the anterosuperior iliac spine is a very painful but benign complication that recovers spontaneously. We reviewed the literature and recommend paying attention to some technical details to avoid this complication.

PATIENT 1

A 56-year-old diabetic man who worked as a mechanic underwent surgery for right C6 and C7 cervical spondylotic radiculopathy, supported by the appropriate magnetic resonance imaging findings.