A Posterior Inter-hemispheric Transcingulate Approach to a Diencephalic Arteriovenous Malformation

DİENSEFALİK ARTERİOVENÖZ MALFORMASYON OLGUSUNA POSTERİOR İNTERHEMİSFERİK TRANSSİNGULAT YAKLAŞIM

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Abstract

The main goal of arteriovenous malformation surgery is to implement the total excision of the lesion by using a suitable approach that provides adequate exposure with minimal brain damage. Establishment of such an approach for the posterior diencephalon, trigone and adjacent structures presents a great surgical challenge.

A posterior inter-hemispheric trans-cingulate approach was undertaken with a 28-year-old male patient with a left posterior thalamo-caudat junction arteriovenous malformation. The lesion was successfully removed. Aside from slight monoparesis in the contralateral upper extremity during the late postoperative period, no neurological deficit resulted as a consequence of this procedure. The detailed surgical technique and subsequent clinical process are presented.

Recent surgical experience with arteriovenous malformations of the posterior thalamo-caudat junction demonstrate the effectiveness of a posterior inter-hemispheric trans-cingulate approach to the trigone region.

Key Words: Cingulate gyrus, diencephalon, intracranial arteriovenous malformation

Özet

Arteriovenöz malformasyon cerrahisinde amaç beyin dokusuna en az hasar veren ve aynı zamanda iyi bir görünüm sağlayan uygun bir yaklaşım şeklini kullanarak lezyonu total olarak çıkartmaktır. Diensefalon ve trigon bölgesine ve buraya komşu yapılara cerrahi yaklaşım son derece güç ve tartışmalı bir durumdur.

Sol posterior talamokaudat bileşke arteriovenöz malformasyonu olan 28 yaşında bir erkek hasta, posterior interhemisferik transsingulat yaklaşım yoluyla opere edildi ve lezyon total olarak çıkarıldı. Ameliyat sonrası geç dönemde, karşı taraf üst ekstremitede hafif monoparezi dışında nörolojik defisit oluşmadı. Cerrahi yaklaşım tekniğinin detayları ve klinik süreç sunulmaktadır.

Posterior talamokaudat bileşke arteriovenöz malformasyonunda yaşadığımız cerrahi deneyim, trigon bölgesine yaklaşımda posterior interhemisferik yaklaşımın etkinliğini ortaya koymuştur.

Anahtar Kelimeler: Singulat girus, diensefalon, intrakranial arteriovenöz malformasyon

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Access to posterior part of the diencephalon and trigone and adjacent structures is a great surgical challenge. There exist some well-defined surgical techniques to reach the lesions of this area, however, as these anatomical structures located deep in the cerebrum all of the previous techniques are likely to cause a certain amount of brain damage.[1,2,10,15,16]

The main goal of the surgery is to excise the lesion totally by using a suitable technique that provides well exposure with minimal brain damage. Visual cortex, great vessels, optic radiatio are the most important anatomical structures that pose difficulties to the surgeon. Thus, the surgeon should prefer the most appropriate surgical way to achieve total excision of the lesion while minimizing the risk to damage the normal anatomical structures. We have the experience with a posterior diencephalic arteriovenous malformation (AVM), and find the posterior interhemispheric transcingulate approach very useful and safe in achieving adequate exposure of the lesion and ease of manipulation. This surgical

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approach has been compared with other techniques and its advantages were emphasized below.

Case Report

A 28-year-old male patient was admitted to our department with sudden loss of consciousness and right hemiparezis. The computarised tomography (CT) of the brain revealed an intracerebral haemorrhage in left diencephalon opening lateral ventricles (Figure 1). It was later revealed that he had been admitted to another hospital a year ago with similar clinical situation probably with such a bleeding and treated with medical therapy without further investigation.

He was hospitalized in the intensive care unit of our department and given standard antiedema therapy with dexametasone and mannitol. In addition, an external ventricular drainage was placed for the intraventricular hemorrhage. At the end of the second week he became fully conscious and his hemiparesis dramatically regressed to 4/5, but suffered recent memory loss. Since it was an atypical recurrent hemorrhage, cranial magnetic resonance imaging (MRI) was taken and a lesion, which was thought to be an AVM, was detected in posterior thalamocaudat junction (Figure 2). It was confirmed with cerebral digital subtraction anjiography (Figure 3A, B). The plexiform AVM had a single feeder from left lenticulocitriate artery and had a single vein draining to the galenic system.

The patient underwent operation via posterior interhemispheric transcingulate approach for AVM resection. Patient was placed in semisitting position and the head slightly flexed and fixed with Mayfield headrest. A left sided occipital paramedian craniotomy was made (Figure 4A). We paid attention to make the craniotomy on the same axial plane with the accessing point on the cingulate gyrus and the nidus. The proper viewing angle of the surgeon under surgical microscope can only be achieved in this way for the resection of such lesion. The accessing point was estimated as six centimeters above the transverse sinus on midline for our patient. The dural flap was opened towards the sagittal sinus and the small veins were coagulated at interhemispheric area. It is important not to sacrifice the great veins, which drain the occipital lobe to the sagittal sinus. They should be preserved even when they are in the way of the surgical approach, and it is better to work through small spaces among them. After opening the dura

Figure 1. CT of the patient showing an acute intracerebral haemorrhage in left diencephalon opening lateral ventricles.

Figure 2. T2 weighted MRI showing a space-occupying lesion in left posterior thalamocaudate junction, which is thought to be an AVM.

Figure 3. Left carotid anjiography revealed a plexiform AVM, which has a single feeder from left lenticulocitriate artery and has a single vein draining to the galenic system. A: Antero-posterior view, B: Lateral view.

we reached the left cingulate gyrus under surgical microscope with gentle occipital lobe retraction. At this point, it was possible to see the arachnoidal bands, which separate the cingulate gyrus from galenic cisterna and splenium of corpus callosum. Without opening this cisterna, just anterior to parietooccipital sulcus an approximately 15mm vertical incision was carried out to cingulate gyrus and the lateral ventricle was entered (Figure 4 B, C). The thalamocaudate junction then is explored lateral to the choroid plexus. A small hemoragic focus and a yellowish colour change on the normal neural tissue were seen. The hematoma was removed first and then the pathological vessels were dissected along the cleavage plane of the malformation by bipolar forceps and aspirator with routine microsurgical technique. Although some bleedings during the steps of dissection, they were easily controlled by bipolar cauterization and the total resection of the AVM nidus could be achieved. An induced hypotension was performed neither in the preoperative nor in the peroperative

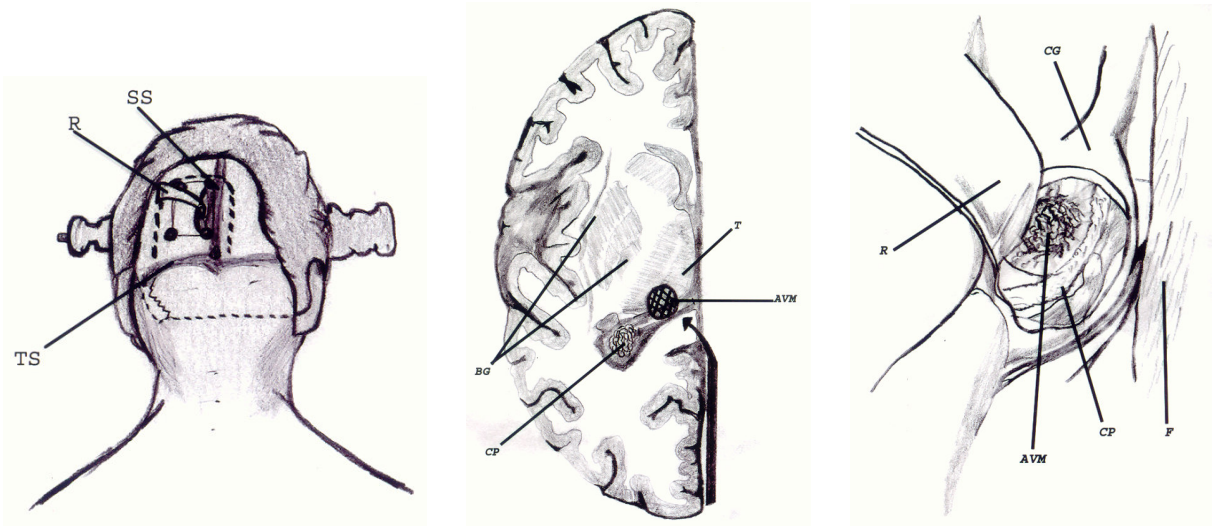

Figure 4. Illustrative drawing of craniotomy (A) and entrance to the trigone region (B, C). R: Retractor, SS: Sagittal sinus, TS: Transverse sinus, T: Thalamus, BG: Basal ganglions, AVM: Arteriovenous malformation, CP: Choroids plexus, CG: Cingulate gyrus, F: Falx, Arrow: Route of surgical approach.

Figure 5. Early postoperative MRI showing the accessing point on cingulate gyrus. A: Proton density axial section, B: T1 weighted sagittal section.

and postoperative period.

Postoperative period: After the operation, he only had 3/5 monoparesis in the contralateral arm, which healed completely before he was discharged. On the 3th postoperative day hydrocephalus was detected clinically and radiologically. Immediately ventriculoperitoneal shunt was placed. No speech, sensory, mental or intellectual resources deficits except for a recent memory loss was detected at discharge. Control angiographies and MRI showed no residual AVM (Figure 5 A, B, Figure 6 A, B).

Discussion

The cingulate gyrus extends over the entire length of the corpus callosum, anteriorly from beneath the genu to the posterior margin of the splenium, where it becomes the isthmus of the cingulate gyrus. The cingulate gyrus is separated from the remainder of the cortex by the cingulate sulcus. It consists of Broadman's areas 23, 24, 25, 29, 30 and 31. The height of the cingulate gyrus (from the callosal sulcus to the cingulate sulcus) is from 12 to 14 mm.[12,18] Pericallosal artery and its cortical branches provide the blood supply of cingulate gyrus. Functionally the anterior cingulate gyrus consists of areas 24 and 25, and has been implicated in responses to stimuli, maternal behavior, vocalization, and attention to action.[18,20] Although the function of posterior cingulate gyrus is not clear, it is believed that the dominance of cerebrum extends to the limbic system, and left posterior cingulate gyrus, fornix, thalamus, and/or caudate nucleus are critical for recent memory function.[15,20]

Caram et al and Ralston et al are the first authors who described surgery with single cases for thalamic AVM.[2,14] Experiences with the surgical treatment of these lesions have been further described by some other authors.[1,8,9,21,22,24] AVMs of diencephalon are located deep within the brain substance adjacent to several vital structures of the central nervous system. It can therefore be anticipated that surgery for these lesions might produce profound and disabling neurological sequel. Surgery isn't generally recommended for the AVMs of this region especially after the successful usage of gamma irradiation in cerebral AVMs treatment.[17] However this method requires long latency between treatment and obliteration of the malformation. During this period the patient is at the risk of rebleeding. Therefore the progressive symptoms and recurrent localized hemorrhage in a

Figure 6. Left carotid anjiography antero-posterior view (A) and latero-oblique view (B) after operation demonstrates the total excision of the AVM.

young patient, like ours can compel the physician for the surgery. Embolization has also been advocated for presurgical and preradiosurgical treatment of AVMs that are considered more difficult to treat with surgery or radiosurgery alone.[3,4,6,7] However, most of the patients with basal ganglia and/or thalamic AVMs could not undergo embolization because of anatomic variations of the feeding pedicles and/or poor endovascular access. Paulsen et al. reported their experience with 38 patients with deep AVMs involving the basal ganglia and thalamus, who underwent embolization in a total of 69 sessions.[13] Of the 38, only one achieved complete obliteration of AVM with embolization alone and the others needed a combination of embolization with radiosurgery, surgery, or both. Embolization was not employed in our patient due to the poor endovascular access.

The common surgical approaches to the posterior diencephalon region are through transcallosal, parasplenial and various transcortical routes.[5,10,15,16,19] None is completely satisfactory for solving all potential operative problems, such as adequate visualisation of the lesion, early obliteration of feeding vessels without unacceptable neurologic loss. Yasargil also described the posterior interhemispheric precuneal approach via parietooccipital sulcus, which is the safest, and minimal invasive access when compared with other surgical approaches for trigone lesions described up to now.[23]

Since posterior portion of the thalamus located deep and anterior to the atrium, access via parietooccipital sulcus may not achieve satisfactory exposure to manipulate the lesion as it was in our patient. Therefore we preferred to incise the cingulate gyrus to shorten the distance between the AVM and accessing point on the cerebral tissue. Since the cingulate gyrus is only 12 to 14 mm in height, a cingulotomy allows better visual angle than callosotomy or precuneal access for exposure of such posterior thalamic AVM. When necessary, it is also possible to broaden the incision up and down through gyrus cinguly (Figure 5B). Cingulate cortex lesions have very little debilitating consequences upon brain function.[11] In our patient cingulotomy didn't cause a gross neurologic deficit. He had recent memory loss, which existed prior to the operation. Another advantage of this approach is that it doesn't require opening of galenic cistern and thus prevents the risk of injury of galenic vein and other great vessels such as distal branches of posterior cerebral artery.

It was thought that the location of AVM in our patient was not suitable for accessing through parasplenium of corpus callosum. This approach would necessitate vigorous occipital lobe traction, opening of galenic cisterna and deeper

manipulation that all might have higher risk of injury to critical areas of central nervous system when compared with the transcingulate approach.

It is necessary to choose the most appropriate approach for each patient according to the location of lesion. The posterior interhemispheric transcingulate approach provides excellent and safe access to posterior thalamocaudate junction lesions without resulting in gross persistent neurologic deficits. The posterior interhemispheric transcingulate approach deserves further attention as an alternative to the parasplenial and precuneal parietooccipital sulcus approach in selected patients.

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