Optimum Sylvian Fissure Dissection Needed for Anterior Circulation Aneurysms

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Abstract

Background: Pterional transsylvian approach was optimized when the dissection of the sylvian fissure extended to the anterior ascending ramus and that further splitting yielded no additional gain. The point where the ascending ramus arises anatomically corresponds to the sylvian point. This study was applied in cases with rupture aneurysm where the brain is more friable, the blood obscures the fissure and its contents.

Objective: In this study, the optimum exposure was achieved by dissection of sylvian fissure till anterior ascending ramus whatever dissection started distally in sylvian fissure or by reaching optic carotid cistern earlier.

Patients and Methods: This study carried on 20 patients admitted in Cairo University Hospitals with rupture anterior circulation aneurysms requiring surgical clipping through pterional transsylvian approach providing some brain relaxation and early proximal control of the aneurysm by opening the opticocarotid cistern first, then distal fissure is dissected.

Results: Optimum exposure and clipping by reaching the anterior ascending ramus in 12 patients (60%). However, the number of the patient needed dissection distal to Anterior Ascending Ramus (AAR) was 8 patients (40%).

Conclusion: Optimum exposure in sylvian fissure dissection for rupture anterior circulation aneurysm is achieved by reaching anterior ascending ramus. Further dissection distal to anterior ascending ramus provided no additional gain in exposure.

Key Words: Sylvian fissure – Aneurysms – Dissection – Optimum – Splitting.

Introduction

PTERIONAL transsylvian approach is one of the most commonly used approaches in neurosurgery. It has been used to treat pathological features arising from the circle of Willis, orbita, superior orbital fissure, medial sphenoid ridge, cavernous sinus, sella, parasellar and subfrontal regions, insula, and uncus when the sylvian fissure is opened widely, the regional exposure would increase.

Pterional transsylvian approach was optimized when the dissection of the Sylvian fissure extended to the anterior ascending ramus and that further splitting yielded no additional gain.

Sylvian fissure is formed of superficial and deep part:
A- The superficial part has a stem and three rami; the stem begins medially at the anterior clinoid process and extends laterally along the sphenoid ridge between the junction of the frontal and temporal lobes to the pterion, where the stem divides into anterior horizontal, anterior ascending, and the posterior rami. The posterior ramus, the longest, represents the posterior continuation of the fissure.
B- The deep part is formed of sphenoidal and operculoinsular compartment [1].

The natural upward retraction of the apex of the pars triangular is commonly creates the largest opening in the superficial compartment of the sylvian fissure and provides an area on the convexity where the sylvian fissure is widest, and where it is often safest to begin opening the fissure. The apex of the pars triangular is sited directly lateral to the anteroinferior part of the circular sulcus and the anterior limit of the basal ganglia [1].

Factors affecting the optimum sylvian fissure dissection:
A- Brain retraction and cisternal dissection:
Retractors should "hold" brain tissue that has already been thoroughly dissected. Extensive preliminary dissection minimizes any "pull" on brain tissue. Maneuvers that slacken the brain also min-
imize retraction pressure, like evacuating cisternal Cerebrospinal Fluid (CSF), most importantly, retraction can avulse an aneurysm’s dome. Aneurysms with intraparenchymal hemorrhage often adhere to that portion of brain.

**B- Hydrocephalus:**
Cerebrospinal Fluid (CSF) drainage with an intraoperative Intraventricular Catheter (IVC) is sometimes necessary described by paine method.

**C- Brain relaxation:**
A swollen brain with an intraparenchymal clot from a ruptured aneurysm is difficult to dissect. Brain transgression may help access the hematoma and relieve intracranial pressure [2].

Hematoma evacuation before securing an aneurysm is a dangerous move, but sometimes is necessary to facilitate the subarachnoid dissection. Dome projection is carefully considered, and clot near the dome is left alone. Clot away from the dome is slowly and gently removed until the brain slackens. Additional clot evacuation can wait until after the aneurysm is clipped. The dome connects with this remaining clot, and evacuation is easily accomplished from this subarachnoid direction [2].

Cerebrospinal fluid drainage is often indicated in patients with acute hydrocephalus after aneurysmal SAH the relaxed brain makes surgery safer in ruptured aneurysm surgery and facilitates trans-sylvian approach may consider placement of a lumbar drain or dehydrating measures.

**D- Vasospasm:**
Blood in the subarachnoid space makes the sylvian fissure dissection is difficult as the fissure obscured by blood and thick and tethered arachnoid, this can avoided by irrigation by saline by the assistant with papaverine which added mainly at the end of operation.

**E- Types of Sylvian fissures:**
- Atrophic fissures in older patients are wide open with minimal contact between the frontal and temporal lobes.
- Apposed fissures are more common with large areas of contact between the frontal and temporal lobes. Interdigitated fissures, either frontal-herniating.
- Temporal-herniating.
- Tightly apposed with contoured areas of contact, and the angle of approach must follow this rolling contour [2].

**Precautions and pitfalls:**
Sharp dissection is the rule within the sylvian fissure; however, much of the arachnoid and fissure may be split with careful dissection with the suction and bipolar.

Dissection may occasionally result in an inadvertent subpial dissection plane, particularly in patients with SAH.

The surgeon should also be careful not to occlude any lenticulostriate vessels with temporary clips because such trauma may result in permanent occlusion. Sylvian veins likewise should be protected.

**Patients and Methods**
The admission, progress notes and outcome data of 20 patients with rupture anterior circulation aneurysms requiring surgical clipping through pterional transsylvian approach were collected prospectively and retrospectively from patients analyzed at the end of our study. All these patients were admitted to the Neurosurgery Departments in Cairo University Hospitals from July 2013 to July 2014.

Patients with ruptured intracranial aneurysm in this study were classified according to hunt and hess classification into:
- **Good clinical condition:** When hunt and hess grading of the patients is Grade I, II or III.
- **Poor clinical condition:** When hunt and hess grading of the patient is Grade IV or V.

All patients in this study were diagnosed and treated according to the following management protocol.


**Diagnostic studies for intracranial aneurysms:**
1- **Computed Tomography (CT) scanning:**
CT scanning should be the first diagnostic study performed to evaluate the possibility of a subarachnoid hemorrhage. CT scans are very sensitive in detecting acute hemorrhage, and they can demonstrate the presence of a subarachnoid hemorrhage in 90 to 95 percent of patients who undergo scanning within 24 hours after the hemorrhage [3,4].

CT scans are also very useful in detecting any associated intracerebral hemorrhage or hydroceph-
alus, and the distribution of blood may offer important clues to the location of the ruptured aneurysm [5].

Fisher et al., in 1980 classify the CT finding in SAH into four grades [6].

2- Cerebrospinal fluid studies:

Xanthochromia (yellow discoloration) of the supernatant after centrifugation of the cerebrospinal fluid is diagnostic of a subarachnoid hemorrhage. Xanthochromia may be due to high cerebrospinal fluid protein or to blood breakdown products. The latter appear reliably more than 12 hours after subarachnoid hemorrhage [7].

3- Magnetic Resonance Imaging (MRI):

MRI with flair (fluid attenuated inversion recovery) techniques demonstrates SAH in the acute phase as reliably as CT, but MRI is impracticable because the facilities are less readily available than CT scanners, and restless patients cannot be studied unless anaesthesia is given. After few days up to 40 days, however, MRI is increasingly superior to CT in detecting extravasated blood. This makes MRI a unique method for identifying the site of the hemorrhage in patients with a negative CT scan but a positive lumbar puncture [8].

Thrombosed intracranial aneurysms that were not visualized on angiography will be clearly demonstrated with MRI because standard MRI is the best method for demonstrating the presence of a thrombus within the aneurismal sac [9,10].

4- MRI Angiography (MRA):

Although it is the most commonly used diagnostic study in screening for intracranial aneurysms, MRI angiography is only rarely sufficient for surgical planning [5].

5- Cerebral angiography:

- Digital Subtraction Angiography (DSA):

Conventional angiography remains the method of choice for detecting an intracranial aneurysm and determining its anatomical characteristics. Although the risks associated with conventional angiography are very low, they are not negligible. Such risks include cerebral infarction, the formation of a hematoma or pseudo aneurysm at the puncture site, and renal failure [11].

- CT angiography:

CT Angiography (CTA) has been available and applied since the early 1980s but recently, multislice helical CT angiography has been used to detect intracranial aneurysms, and preliminary reports indicate that the sensitivity and specificity of multislice helical CTA for cerebral aneurysms is rapidly approaching that of the gold standard, DSA [12].

6- Transcranial Doppler ultrasound.

Splitting the Sylvian fissure:

The SF was dissected sharply, and the strongest arachnoid adhesions between the frontal and temporal lobes were incised as the splitting progressed. The procedure was divided into four steps: (1) Opening of the basal cisterns to expose the carotid bifurcation, (2) Dissection of the sphenoidal compartment to the limen insulae to expose the M1 segment of the middle cerebral artery (MCA), (3) Dissection of the operculoinsular compartment to the AAR to expose the M2 segments of the MCA, and (4) dissection progressing 2.0cm distal to the Anterior Ascendant Ramus (AAR) [13].

Results

In this study we have 12 patients (60%) were operated by exposure and clipping by reaching AAR, however there were eight patients (40%) need distal dissection.

According to the factors affecting dissection of sylvian fissure:

A- According to hydrocephalus:

- There were 12 patients with hydrocephalic changes and 8 patients were not hydrocephalic.
  - In 3 patients: Paine intraventricular drainage was done with optimum exposure (15%).
  - In 4 patients: Paine technique, dehydrating measure and CSF drainage by lumbar drain was done with optimum exposure (20%).
  - In 5 patients: All measures was done without optimum exposure (25%).

So, among the hydrocephalic patients we had seven patients with optimum exposure and five patients without optimum exposure.

B- According to vasospasm:

Vasospasm denotes severity of SAH.

There were 15 patients with vasospasm preoperatively.

- 8 patients operated with optimum exposure (53.3%) and 7 patients (46.7%) without optimum exposure.

- So, vasospasm is an important determining factor in sylvian fissure dissection.
Clinical case:

A female patient 60 years old hypertensive presented with headache and history of fits, CT brain showing SAH.

H & H Grade II, fisher Grade II with CT angio showing Acom aneurysm.

Left (pterional) craniotomy was done due to left dominant A1 segment and five bur holes were made.

Dural opening was done and Cerebrospinal Fluid (CSF) drainage done by the insertion point for an intraoperative IVC is the one described by Paine.

The dissection was done till the level of AAR. So, recognition and opening of three arachnoid cisterns (carotid, chiasmatic, and lamina terminalis) leads to the ACoA junction.

- The ipsilateral A2 segment is identified distally.
- Temporal clip applied then dissection of the aneurysm neck and the permanent clip applied but before application of the clip and all perforators confirmed not to be included in clip.

Fig. (1): Graph showing comparison between patients need distal dissection and patients with optimum exposure by reaching AAR.

Fig. (2): CT Angio showing A-com aneurysm.

Fig. (3): Intraoperative photo showing clip on aneurysm.

Discussion

The PT-TS approach is one of the most commonly used approaches in neurosurgery. It has been used to treat pathological features arising from the circle of Willis, orbita, superior orbital fissure, medial sphenoid ridge, cavernous sinus, sella, parasellar and subfrontal regions, insula, and uncus [13]. It represents a standard against which alternative approaches to the same targets must be contrasted and compared.

Most of neurosurgeons use a combined approach of Sylvian fissure dissection, providing some brain relaxation and early proximal control of the aneurysm by opening the opticocarotid cistern first. The distal fissure is then dissected in the plane that is most easily and readily identifiable.

Türe et al., suggested that the “Sylvian point” can be used as a starting site to open the Sylvian fissure [14]. The superficial part of the Sylvian fissure is divided into a stem and three rami [1,14]. At the level of the pterion, the stem gives rise to the anterior horizontal and ascending ramus and the posterior ramus [1]. These rami define three parts of the inferior frontal lobe, the pars orbitalis, triangularis and opercularis. The confluence of these three rami is known as the Sylvian point.

Although the Sylvian point has been recommended as the starting point for dissection of the Sylvian fissure [14,15] it is occasionally difficult to find because it lies beneath superficial Sylvian veins.
Some neurosurgeons systematically split the sylvian fissure widely; others have stressed that wide opening of the fissure is not required in most cases [16]. Disadvantages, such as potential complications related to damage of cerebral veins [17], additional time to perform the operation, and manipulation of the MCA with high risk of vasospasm, have been noted [18].

There are 20 patients with Fisher Grade III & IV, in this study proved optimum exposure not affected in most cases by the SAH, where 14 patients (70%) with Fisher Grade III, IV the surgeon achieved optimum exposure by reaching to AAR with no need for distal dissection of sylvian fissure compared to 6 patients (30%) who need distal dissection.

So the area of surgical exposure and the angles of approach progressively increased as splitting of the sylvian fissure progressed toward the pars triangularis are at the level of AAR. Further dissection provided no additional gain in exposure, splitting the SF also permitted greater elevation of the frontal lobe without increasing the extent of retraction. Although the position and the force applied to the retractor blade were held constant, the linear distances between the skull base and frontal lobe increased as splitting of the sylvian fissure progressed from the basal cisterns to the pars triangular is at the level of AAR [13].

PT-TS approach was optimized when the dissection of the Sylvian fissure extended to the anterior ascending ramus and that further splitting yielded no additional gain. The point where the ascendant ramus arises anatomically corresponds to the Sylvian point [18].

Important precautions and pitfalls: Sharp dissection is the rule within the sylvian fissure; however, much of the arachnoid and fissure may be split with careful dissection with the suction and bipolar. Dissection within the fissure requires precise fine motor skills, an understanding of sylvian anatomy, practice, and the ability to "see through" the often blood-stained and blood-filled arachnoid.

Pathway of subarachnoid dissection to the basilar apex begins with splitting the sylvian fissure followed by an opening the carotid cistern then lamina terminalis cistern is opened to mobilize the frontal lobe and fenestrate the lamina terminalis, thereby releasing Cerebrospinal Fluid (CSF) and relaxing the brain [2].

Manipulation of the MCA branches may cause postoperative vasospasm [2,19].

This study can be applied for the increasing interest in the keyhole surgery concept to minimize the exposure and the handling of cerebral tissue without compromising the surgical view of vascular lesions and the operative results [20].

Conclusions:
The key element of this approach is dissection of the arachnoid membrane between the frontal and temporal lobes (i.e., splitting the Sylvian fissure) to expose the middle cerebral artery in its depths, so progressive opening of the Sylvian fissure to the level of anterior ascending ramus increased exposure to the basal cisterns. At that point, the area of approach was optimized, the angles of attack were widest, and elevation of the frontal lobe was maximized.

In this study, we confirmed objective extent of dissection of the Sylvian fissure that maximizes surgical exposure and minimizes the need for retraction. When the Sylvian fissure is opened widely, the regional exposure would increase.

Further dissection distal to anterior ascending ramus provided no additional gain in exposure and splitting of the Sylvian fissure.

This study was applied in cases with rupture aneurysm where the brain is more friable, the blood obscures the Sylvian fissure with congested veins caused by subarachnoid hemorrhage, compared to the previous study which only done in silicone-injected cadaver heads with more "rigid" consistency when compared to live cerebral tissues.

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