

Anatomical variations of sylvian fissure and characteristics of middle cerebral artery

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Abstract

Introduction: Based on Computed Tomography Angiography (CTA) of the brain to determine the distribution of the defined anatomical variations of the Sylvian fissure (SF) in the patient without brain lesions and characteristics of the sphenoidal segment (M1) of the middle cerebral artery (MCA).

Patients and methods: A cross-sectional study of 31 patients without intracranial pathologies has conducted from January 2023 – March 2023 in Viet Duc University Hospital. The 5 types-Maslehatys classification was used to evaluate the SF anatomy on CTA as well as M1 of MCA details such as the length, diameter and termination.

Results: The patients mean age was 48.68 ± 21.07 ; male/female ratio was 1.8, symmetric and mirror-imaged coherence of the SF was observed in 17 patients accounting for 54.8%. The highest frequent rate was type 2 accounted for 38.7%, the lowest frequent rate was type 5 in 3.2%, the frequency of type 1, type 3, and type 4 were 19.4%; 22.6%, and 16.1%, respectively.

In the MCA study, a bifurcation was observed in 54.8%, a Trifurcation was observed in 9.7% and a false Bifurcation in 35.5%.

The mean length of M1 segment of MCA was 17.57 ± 3.16 mm, the mean diameter of the M1 segment was 3.12 ± 0.53 mm.

The distribution of SF types showed significant differences in patients younger than 63 years old.

Conclusion: CTA of the cerebral arteries was an effective and useful tool for evaluation of SF and MCA anatomy.

Key words: Sylvian fissure, middle cerebral artery, imaged study.

Introduction

Sylvian fissure (SF), or the lateral sulcus, was first illustrated in Tabulae Pictae by Fabrici d'Acquapendente in 1600. Anatomically, the SF is formed by the frontal, parietal and temporal lobe and can be divided in a superficial and deep part.

The superficial part is composed of a stem and three rami (anterior horizontal, anterior ascending, and posterior). [1] The deep part is divided into a sphenoidal and operculoinular portion. The SF gives passage to the middle cerebral artery (MCA) and enables surgical access to the insula region.

Microsurgical dissection of the SF is a standard approach in neurosurgery, especially for MCA aneurysms [2], [3].

By his thorough intraoperative observations of the Sylvian cistern and the SF, Yasargil described four anatomical variations of the SF. The first type is defined as a straight wide SF, the second type as a straight narrow SF. [4] The third and fourth type includes a partially herniated frontal and temporal lobe into the SF, respectively. Based on Yasargil's descriptions an adaptation of the appearance of the SF on cranial computed tomography scanning was published by Ngando HM and al [5]. For neurosurgeons, it is important to know about the anatomical variations when operating within or through the SF. However, this can be difficult, e.g., if an intracerebral hemorrhage or mass lesions alters the radiographic presentation. Therefore, it would be worthwhile if the surgeon could conclude from the opposite SF to the afflicted one. Hence, we conducted this study to determine the distribution of the defined SF types in a normal population and to analyze its bilateral superposable presentation based on the CT images. Furthermore, we examined the course of the MCA and the division of the MCA branches in relation to the SF types [6], [7], [8], [9].

Materials and methods

Selection criteria

Adult patients without previous brain lesions history were taken CTA of the brain at VietDuc University Hospital from January 2023 to March 2023 selected.

Exclusion criteria

Any brain pathologies detected in CT images were excluded.

Methods

We retrospectively reviewed the brain CTA of selected patients and classified the SF into one of five subtypes following the modified classification of Maslehaty [10]. Type 1 was defined as wide and straight SF, type 2 as narrow and straight SF, type 3 as a wide SF with herniation of the frontal or temporal lobe, type 4 as a narrow SF with herniation of the frontal or temporal, and type 5 as a SF with herniated temporal and frontal lobe.

The SF's symmetric and mirror-image coherence was determined.

We analyzed the course of MCA: diameter of M1 (human primary motor cortex), length of M1, and the presence of bifurcation, trifurcation, or false bifurcation (M1 or sphenoidal segment of MCA originates at the terminal bifurcation of the internal carotid artery).

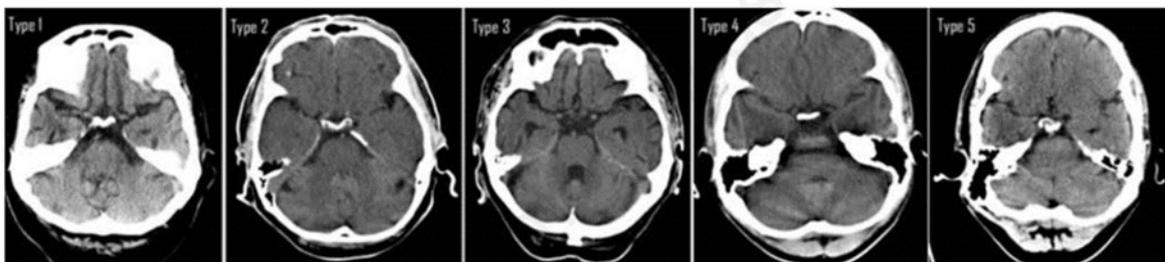


Image 1. Classification of SF on CTA [10].

Site of study:

Department of Neurosurgery, Viet Duc University Hospital.

Results

During the study, we have collected the

documentation of 31 adult patients (20 men and 11 women), male/female ratio was 1.8. The mean age was 48.68 ± 21.07 (aged from 18 to 81 years old) and the SF was confirmed by diagnostic imaging.

Some characteristics of study subjects were shown in the following tables.

Table 1. The distribution of SF types.

SF type	N	(%)
Type 1	12	19.4
Type 2	22	35.5
Type 3	14	22.6
Type 4	10	16.1
Type 5	4	6.5

In our analysis about the symmetric and mirror-image coherence of SF, 17 cases (54.8%) had this feature while 14 (45.2%) cases did not have.

We divided the type of morphology of proximal of MCA in three types: (1) bifurcation (34 cases; 54.8%); trifurcation (6 cases; 9.7%), and false bifurcation (22 cases; 35.5%)

When calculating the M1 segments, we found the length of M1 was 17.57 ± 3.16 mm (range 9.4 to 25.9 mm) and the diameter of M1 was 3.12 ± 0.53 mm (range: 1.9-4.4 mm).

Table 2. The relation between MCA types and SF types.

		MCA form			Total
		Bifurca- tion	Trifurca- tion	False- bifurca- tion	
SF types	Wide (type 1;3)	19 73.1%	2 7.7%	5 19.2%	26 100%
	Narrow (type 2;4;5)	15 41.7%	4 11.1%	17 47.2%	36 100%

Table 3. The distribution of SF types in over and under 63-year-old groups.

		Under 63-year-old	Over 63-year-old
Sylvian fissure	Wide (type 1;3)	14 33.3%	12 60%
	Narrow (type 2;4;5)	28 66.7%	8 40%
Total		42 100%	20 100%

Discussions

We conducted a study on TCA of 31 patients, the ratio of male and female was 1.8; the average age was 48.68 ± 21.07 ; the youngest patient was 18 years old, the oldest patient 81 years old. According to study of

Nguyen T.S et al, the display and dimensions of the MCA on 256 MSCT data, showed the average age was 62.9 ± 16.2 and the ratio of male and female was 1.1611, so our patients were younger, and the ratio of male/female patients was higher.

In the report of Ngando H, the type of SF was divided into 5 categories: Type 1: straight, broad; Type 2: narrow, straight; Type 3: wide, SF with frontal or temporal lobe herniate into the fissure; Type 4: narrow SF with frontal or temporal lobe herniate into the fissure; Type 5: has both frontal and temporal lobe herniate into the fissure. Thirty-one CT scan images, there are sixty-two images of SF in two hemispheres, the most frequently encountered is the narrow and straight SF (type 2) that accounts for 35.5%, the lowest ratio is the type 5 – the twisted SF, with both the frontal and the temporal lobe herniate into the SF accounting for 6.5% and the SF type 1, 3 and 4 accounted for 19.4%; 22.6% and 16.1%, respectively. In Maslehatys study, SF type 3 and type 4 were most common with the highest proportion, 26.6% and 29.6%, respectively [10].

Statistically, we found that the distribution of wide-type SF (type 1 and 3) and narrow-type SF (type 2, 4 and 5) by group of patients over and under the age of 63 years, the difference was statistically significant (Tab. 2). In the group of patients over the age of 63 years, the wide-type SF accounted for 60% (Tab.3), while in the sub-63-year-old group, the narrow-type SF represented 66.7%. This problem may be due to a decrease in brain volume associated with an increase in the age of the patient. It may be assumed that elderly patients with type 1 and type 3 of SF may have already had type 2;4 or 5 as young. So, the SF should be considered as an age-changing area.

According to Maslehatys [10], the symmetric and mirror-image coherence of the SF between the right and left hemispheres accounted for 88.7%, which is of statistical significance. This is very valuable issue in neurosurgery, especially with the surgery was performed via through the SF. The surgeon may predict the type of SF in the side that needed surgery (changed image on CTA due to blood

clotting, localization block, swelling...) based on the side without injury with high reliability. In our study, the symmetric SF ratio was 54.8%.

The average MCA diameter was 3.12 ± 0.53 mm, the average length of the M1 section was 17.57 ± 3.16 mm. No statistically significant correlation was found between the diameter and the length of the M1 section with the type of SF. In the report of T.S Nguyen has also gave the same results, with the average M1 diameter was 3.25 ± 0.43 mm and the average length of M1 segment was 19.98 ± 6.1 mm [11].

The morphology of proximal MCA with the highest rate was the bifurcation accounted for 54.8%, followed by false bifurcation accounting for 35.5%, the trifurcation with the lowest rate with 9.7% in our series.

Maslehaty has studied and found that the type of MCA has highest ratio of bifurcation, accounted for 72%, false bifurcation and trifurcation accounted for 16% and 12%, respectively. We found a statistically significant correlation between type of MCA and wide-narrow SF groups ($p=0,039<0,05$). The wide SF group with MCA bifurcation accounted for the highest percentage of 73.1%, while the narrow SF group with the MCA false bifurcation accounted for the highest rate of 47.2%.

Conclusions

Based on the study of SF anatomy on CTA of 31 patients, we found the variable anatomical region, the narrow and twisted SF were appeared more commonly in patients younger than 63 years of age. There was a correlation between characteristics of the MCA and the type of SF. These factors may affect the surgeons choice to approach the SF.

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