Comparison of Three Approaches of Pituitary Adenoma Excisions through Sphenoid Sinus

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ABSTRACT

Objective: This study aimed to compare three different surgery approaches for pituitary adenoma excision.

Methods: A total of 162 patients underwent pituitary adenoma excision through the sphenoid sinus approach. Among patients, 5 underwent the sublabio-septo-sphenoidal approach (abbreviated as "sublabio approach"), 7 underwent the sphenoid sinus approach and 150 underwent the nasal septum approach.

Results: The operative cases that underwent the sublabio approach showed severe surgical trauma because of the complicated operation procedure. The sphenoid sinus approach was relatively easy to operate, but the procedure may confuse an inexperienced operator, which occurred in 2 out of 7 cases in our study. The anatomical landmark was clearer under the nasal septum approach than the other approaches. Thus, operators were less likely to make mistakes during the nasal septum operation. In our study, a success rate of 100% was obtained for the 68 patients who underwent nasal septum operation.

Conclusion: The nasal septum approach was suitable for most patients with pituitary adenoma. The hierarchy of the anatomy was distinctive and easily controlled. Thus, the entire nasal septum operation was relatively safe, effective and minimally invasive and can be completed by an operator with sufficient anatomical knowledge and operation skill.

Keywords: Nasal septum, operation approach of pituitary adenoma, pituitary adenoma excision, sphenoid sinus

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INTRODUCTION

The most popular operation strategy for pituitary adenoma (1) cutting surgery is the sphenoidal approach, in which multiple surgical paths are available (2-4). We used three different approaches to remove the adenoma: sublabio-septo-sphenoidal approach (SSS approach), direct transnasal approach to the sphenoid sinus and nasovestibulo-septo-sphenoidal approach. Initially, the sublabio-septo-sphenoidal approach was applied. After cutting the oral mucosa and prior to surgery, the anterior nasal spine, septal cartilage and bony nasal septum were anatomised and the bony nasal septum was removed (5). This approach has a long surgical path and a complicated procedure and can cause relatively massive damage. Subsequently, the direct transnasal approach to the sphenoid sinus was applied; the nasal speculum was inserted through the surgical side of nasal cavity directly to the anterior wall of sphenoid sinus to perform the surgery (6). The path of this approach and the time consumed were significantly shorter and the resources used were fewer than those of other approaches. However, given the absence of the anatomical signs of bony nasal septum, serious disorders can arise when operators with little experience miss the midline and damage the important structures near the sphenoid sinus. Finally, the nasovestibulo-septo-sphenoidal approach was applied to remove the adenoma by cutting the mucosa of the nasal septum on the surgical side and subsequently applying blunt dissection between the mucosa and the bony nasal septum at the bottom of the nasal cavity (7). The nasal speculum was inserted into the space toward the anterior wall of the sphenoid sinus, and the space was subsequently expanded along the midline anatomical sign into the sinus to perform the operation. The bony nasal septum is evident in this approach; hence, the chance

of aberrancy is minimised and the risk of structure damage near the sphenoid sinus is decreased. Our department enlisted 162 patients for pituitary adenoma cutting surgery through the sphenoidal approach. The nasovestibulo-septo-sphenoidal approach is the most popular strategy among the approaches used. The summary of the study is presented in this paper.

MATERIALS AND METHODS

General Data

A total of 162 cases (65 males and 97 females) were included in this study. The age range for all patients was 21 years old to 79 years old, with an average of 51.3 years old. Disease duration was from 2 months to 13 years, with an average of 36.1 months. A total of 153 patients underwent the initial operation, and 9 of these patients underwent a second operation. Five cases underwent the sublabio approach, whereas 7 and 150 cases underwent the sphenoid sinus and the nasal septum approaches, respectively. This study was conducted in accordance with the declaration of Helsinki. This study was conducted with approval from the Ethics Committee of Wuhan No.1 Hospital. Written informed consent was obtained from all participants.

Clinical Response

The clinical manifestations included the following: 71 cases of headache, 11 cases of fatigue and weakness, 93 cases of decreased visual acuity and visual field defect, 48 cases of

amenorrhaea, 41 cases of galactorrhaea, 19 cases of sterility, 7 cases of sexual dysfunction, 11 cases of facial changes and acromegalia and 27 cases found by accident during medical examination.

Image Examination

The tumours were categorised by regular magnetic resonance imaging (MRI) and coronal computed tomography (CT) scanning (8). The following tumours were identified by CT scan: 23 microadenomas (maximum diameter <1.0 cm), 112 macroadenomas (maximum diameter >1.0 cm) and 27 enlarged macroadenomas (maximum diameter >3.0 cm). The types of sphenoidal sinus were as follows: 131 sellar, 24 presellar (5 partial fusion of sellar bottom and sinus) and 7 conchal.

Surgical procedure

The preparation, anaesthesia, body position, removal of tumour, and post-surgery process are almost the same for the sublabio-septo-sphenoidal approach, the sphenoid sinus approach and the nasal septum approach. Thus, detailed description of the processes was not included in this paper.

Sublabio approach

The labrum was dragged open, and a radical incision was made on the mucosa of the labrum between two canines. Spina nasalis anterior was dissected along with septal cartilage and bony nasal septum. Subsequently, a long nasal endoscope was set to both sides of the bony

nasal septum, and the endoscope was shifted to both sides. The bony nasal septum was removed, and the sphenoid sinus anterior wall and openings on both sides were exposed. The tumour was removed using a regular procedure, and the endoscope was pulled out. The upper lip incision was sutured using an absorbable tile, and the bilateral nasal was packed by sponge or gauze.

Sphenoid sinus approach

The nasal endoscope was inserted into the operation-side of the nasal to anterior wall and was shifted to both sides to induce rupture. The bone and mucosa were ruptured at the combination of sphenoid sinus anterior wall and nasal septum root by exerting sufficient force. Cartilage and bony nasal septum with the mucosa were pushed to the contralateral. The bone crest was located at the fracture site under microscope, and the endoscope was adjusted back and forth along the anatomical landmark until the sphenoid sinus anterior wall and lateral openings were fully exposed. The tumour was removed, and the endoscope was pulled out. Bilateral nasal was packed by sponge or gauze without any suturing.

Nasal septum approach

The columella and alar were dragged open to expose the mucosa of the nasal septum on the surgery side. The combination of cartilage and bone was identified by observing the colour difference of skin and mucosa and by touching the material of cartilage or bone. Electrocautery was applied to the mucosa at the combination site, followed by a curved incision of the mucosa (2.0 cm). Blunt dissection was applied on the mucosa and the bone of

the nasal septum. A nasal endoscope was inserted into the gap towards the interior wall of sinus, and shifted forcefully at both sides to rupture the bone and push the cartilage and bony nasal septum to the contralateral space with intact mucosa. The position of the endoscope was adjusted along the anatomical landmark of the residual bone crest and shifted sideways until the sphenoid sinus anterior wall and lateral openings were fully exposed. The tumour was removed using a regular procedure, the endoscope was pulled out and the bilateral nasal was packed by sponge or gauze without any suturing.

RESULTS

Five cases underwent surgery through the sublabio approach. In this approach, the upper lip mucosa incision, spina nasalis anterior, septal cartilage and bony nasal septum dissection and bony nasal septum removal were required because of the complication of the operation and the remarkable damage. Seven cases underwent surgery through the sphenoid sinus approach. This approach did not require the anatomy of organs above. Hence, the difficulty of the entire surgery decreased. However, the operator can easily miss the direction, and finding the opening of the sphenoid sinus may be difficult because following the landmark of the residual of bone crest at the fracture site caused by endoscope was required. Misdirection occurred in 2 out of the 7 cases. To determine the sphenoid sinus, a C-arm X-ray generator was applied to help locate the sphenoid sinus. A total of 150 cases underwent surgery through the nasal septum approach. This approach involved incision of the mucosa of the nasal septum under the microscope and application of blunt dissection between the mucosa and bone. Nasal

endoscope was inserted into the gap, and the endoscope was shifted to rupture the bone of the combination of anterior wall of sinus and the root of nasal septum without separation of mucosa. Finally the opening of sphenoid sinus was found by identifying the landmark of the residual bone crest. The operation process occurred near the bony nasal septum. The anatomical mark is sufficiently clear and the possibility of misdirection is minimised. In the 150 cases, this approach successfully allowed entry to the sphenoid sinus and surgery was done.

Follow-up examinations were performed by enhanced MRI from 2 d to 3 mo after surgery. The tumour was completely excised in 132 cases, mostly excised in 15 cases and partially excised in 13 cases.

DISCUSSION

Pituitary adenomas, which relapse easily (9), account for 10% to 15% of all the primary brain tumours and 19% of the surgical resections of primary brain tumours (10). The sphenoid sinus approach can be used for approximately 96% of patients with pituitary adenomas. Thus, the sphenoid sinus approach is the preferred strategy for the removal of pituitary adenomas and is comparable with the endoscopic approach (11, 12). The sphenoid sinus approach can be divided into sublabial approach and intranasal approach (13). The sublabial approach is sometimes complicated with pyocele (14), and thus, was not recommend by Diaz et al. (15). The intranasal approach involves less pollution, less injury and less complication compared with the sublabial approach (16). Improvement was observed for the 162 different cases that

underwent surgery through the sphenoid sinus approach surgery. The midpiece nasal septum approach is the main strategy used for removing pituitary adenomas in our department. The summary for this method is as follows.

Various comparisons of intranasal approaches are presented in the next section. Starting from the 1990s, the domestic literature intranasal approach has been categorised into the following three major categories: midpiece nasal septum approach, nasal columella–nasal septum approach and directly sphenoid sinus approach.

Directly sphenoid sinus approach is used extensively at present because of its time-saving advantage (17). However, this approach cannot be conducted in the presence of a bony nasal septum anatomical landmark, which easily causes midline deviation (18). When conducted by surgery doctors who lack experience, the vital structure of the sphenoid sinus parasellar may be damaged, which can lead to severe complications (19). Hence, this approach may not be applicable when the surgeons in a hospital lack experience.

Nasal columella-nasal septum approach is not as widely used as the abovementioned one at present (20). In this approach, nasal columella incision and nasal septum removal are required. Scarring may be left behind, nasal columella may be skewed, nasal appearance may be transformed and perforation of nasal septum may occur after the surgery.

Nasal columella-nasal septum approach, also known as submucosal-nasal septum-sphenoid sinus approach (nasal septum approach), is used in our department. Direct sphenoid sinus approach involves the direct bracing of the root of the nasal septum and anterior sphenoidal wall. The bone and mucosa are split simultaneously. Compared with nasal septum approach, this injury is more serious. The resetting of the root of the nasal septum

after surgery proceeds slowly. The wound of the sphenoid sinus and nasal junction is large, and the traumatic reaction and symptoms of nasal secretions after surgery are comparatively more serious. No nasal mucosa incision is evident, but contusion and laceration of the root of nasal septum exist. Nasal septum approach involves initially cutting the mucosa at the junction between cartilage and bony nasal septum and separating the channel in the natural gap between the bony portion and the mucosa. In this case, the wound surface is large, but only slight trauma is induced. Except for the sharp incision injury, the nasal septum mucosa and the turning point of mucosa can be maintained completely. The sphenoid sinus and nasal junction can be maintained as the original mucosa structure. This approach can be performed in the presence of the bony nasal septum landmark and on a clearly anatomical level. This approach also involves a low possibility of deviation from the midline, which helps avoid accidental injury on vital structures, such as cavernous sinus and internal carotid artery. Moreover, this approach can easily be learned and performed by surgery doctors who lack experience.

Procedures for the nasal septum approach: Procedure to avoid nostril laceration: Laceration of the nostril skin can occur easily when nasal endoscope approach is used improperly. Considering the elasticity of the nostril skin, slow extension was required during the establishment of the nasal endoscope. Thus, the passage was gradually extended for the surgery.

Procedure to avoid nasal mucosa laceration: Bleeding can be reduced by infiltrating the nasal mucosa with adrenaline before surgery. During the cutting of the nasal membranous septum, the operator and the assistant should mutually coordinate to separate the nasal

columella and nasal alae and carefully identify the junction between cartilage and bony nasal septum. After the full fulguration for mucosa at the junction, an arcuate condition is considered. Incision width should be greater than the nasal endoscope width. When the abovementioned separation has been executed, the location of the nasal endoscope relative to the nasal cavity bottom should be close to the perpendicular plate. In addition, nasal septum puncture or mucosal laceration should be avoided. When the operation is performed correctly, complete separation of the mucosa is possible. The nasal endoscope initially stays at the anterior sphenoidal wall after insertion, and subsequently, gradually forced to brace the opposite side for the fracture between anterior sphenoidal and the root of the perpendicular plate. Excessive force must be avoided to prevent laceration of the nasal mucosa at the root of the nasal membranous septum.

Procedure to avoid deviation of the midline during operation: In front of the sella turcica is the basis cranii, and at the rear is the slope. On both sides of the sella turcica are the internal carotid artery and the cavernous sinus. If the surgery exceeded the front side, the chance of inflection after surgery can increase when ethmoid sinus was exposed. In addition, the opening of anterior cranial fossa dural can lead to cerebrospinal fluid leakage and brain tissue injury. If the surgery exceeded the rear side when the posterior fossa was reached after the opening of the slope bone, the exposure of the posterior cranial fossa dural can lead to cerebrospinal fluid leakage and basilar artery or brainstem injury. Deviation of the midline can lead to cavernous sinus damage on both sides, and internal carotid artery fatal. The opening of midline bony crest and sphenoid sinus on both sides was the important landmark of this approach. After bracing with the nasal endoscope, a bony crest that was formed by the

remnant perpendicular plate of the ethmoid bone can be found at the place of the root fracture of the nasal septum; this landmark can be considered as the midline. Slowly and symmetrically, both sides should be braced, and front and rear adjustment of the nasal endoscope position fully exposes the anterior sphenoidal wall and bilateral sphenoid sinus to the operator's field of vision. Upon reaching the sphenoid sinus, not much is found in the middle of the septum of the sphenoidal sinus. Thus, the septum of sphenoidal sinus cannot be marked as the midline, and the midline bone is always marked. When deviation occurs, the C-arm of the X-ray machine should be used to find the fluoroscopy location and avoid performing a blind operation that could lead to accidental damage of important structures.

Procedure for the reset of nasal midline structures: When the nasal endoscope is extracted after the surgery, the separated mucosa should be reset. When the operation is appropriate, mucosa can be attached on bony nasal septum, and mucosal incision can resume its neat involution. When surgery is complete, the bilateral nasal area should be stuffed with expansion sponge or gauze. By symmetrical squeezing, the bilateral stuffed and braced nasal septum can be reset, and the separated mucosa can firmly be attached on bony nasal septum. This operation is beneficial for the healing of nasal midline structures.

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