·Clinical Research·

Transcranial surgery through pterional approach for removal of cranio –orbital tumors by an interdisciplinary team of nurosurgeons and ophthalmologists

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Abstract

• AIM: To investigate the specialty of transcranial surgery through pterional approach for removal of cranio-orbital tumors, introduce the ophthalmological experiences of entering the orbit to reduce the incidence rate of associated complications of this operation.

• METHODS: We performed a retrospective analysis of a series of 37 cases involving patients who underwent transcranial surgery through pterional approach for treatment of cranio-orbital tumors in our department in the past 8 years. Pterion approach craniotomy was performed to all patients. After removing tumors in the skull by the neurosurgeon, ophthalmologist removed tumors in orbit. We took measures below to decrease complications, including grounding optic canal through an abrasive drilling when necessary, hanging various extraocular muscles to be exposed for protection, refrigerating by refrigeration heads to remove tumors, at last sewing up orbit septum after surgery.

• RESULTS: Tumors were removed completely in 32 cases, and incomplete in 5 cases due to extensive invasion into the cavernous sinus or sphenoid sinus. Of all the cases, benign tumors were demonstrated in 28 cases (75.6%, 28/37) and malignant in 9 (24.3%, 9/37). The most common lesion type was meningioma in 11 cases (29.7%, 11/37). Extraocular muscles (EOM) impairment, occurring in 21 cases (56.7%, 21/37), was the most frequent postoperative complication. The most serious consequence was vision loss occurred in 4 cases (10.8%, 4/37). Other complications, such as 11 cases of transient blepharoptosis 29.7% (11/37), 5 cases of mydriasis in 13.5% (5/7); 2 cases of cerebrospinal rhinorrhea in 5.4% (2/37).

• CONCLUSION: Cranio-orbital tumors can be removed completely using transcranial approach, and the pterional approach offers excellent exposure. Cooperation of interdisciplinary team of neurosurgeons and ophthalmologists conduces to full use of respective professional advantages. The experience of ophthalmic operation technology can decrease occurrence of ocular complications after surgery.

• KEYWORDS: cranio-orbital tumors; transcranial operation; complications; ophthalmic operationl experiences

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INTRODUCTION

Cranio-orbital tumors are uncommon in clinic, the morbidity rate was from 6.9% to 15.71% according to the references [1,2]. For most patients, surgical removal of the tumor is the best way to restraint the disease aggravation [3-6]. As the disease involved in ophthalmology, neurosurgery and even more fields, it is difficult for a specialist with restricted knowledge performing the surgery separately to get the best curative effect. Previously, orbit skull communicating tumors are removed by a neurosurgeon. Ophthalmologists seldom participate in such surgery [4-6]. However, it is indicated in both domestic and overseas literatures that eye complication incidence rate is much higher than that of other complications [2,4,7]. So, how to decline the incidence of eye complication become a challenge in front of neurosurgeons and ophthalmologists. In this study, we described 37 cases of

transcranial surgery by an interdisciplinary team of nurosurgeons and ophthalmologists from May 2000 to February 2008 in Ophthalmology Department of Xiangya hospital. The experiences of ophthalmological surgical techniques and the tips of avoiding complications were also discussed.

PATIENTS AND METHODS

Patients From May 2000 to February 2008, 37 patients with cranio-orbital tumors underwent a transcranial surgery through pterional approach by an interdisciplinary team of neurosurgeons and ophthalmologists at Department of Ophthalmology, Xiangya Hospital, Central South University, Changsha, China. The patients were 21 males and 16 females, median age of 51 years, ranging from 5 to 61 years. 22 tumors occurred on the left orbital and 15 on the right orbital. Of all these cases, 30 patients underwent surgical procedures for primary resection and 7 for recurrent tumors who had a history of orbitotomy or craniotomy in other hospitals. The period of follow-up ranged from 4 months to 6 years. Clinical examinations were performed by a neurosurgeon and an ophthalmologist jointly.

The clinical ophthalmologic examination contained testing of visual acuity with and without correction, Humphrey visual field, fundus, ocular motility, proptosis, vascular pulsation and periorbital changes. This protocol was performed preoperatively, 1 week after the surgical intervention and every six months later respectively. All patients had exophthalmoses, measured using the Hertel proptometer. The mean Hertel's exophthalmometry measurement was 20mm, ranging from16 to 25mm. The preoperative BCVA ranged from no light perception of 4 cases, finger counting to 0.05 of 7, 0.05 to 1.0 of 21 and over 1.0 of 5. In 27 cases, the tumor had spread from the orbit into the intracranial cavity. In 10 cases, the tumor had spread from the intracranial cavity into the orbit. Paranasal sinuses or temporal fossa were involved in 5 cases including frontal sinus involving in 2 cases, ethmoidal sinuses in 2 and temporal fossa in 1. In 5 cases, the occupying lesions broke through the dura and invaded the brain parenchyma. 22 patients who had larger lesion scope and foramen opticum or superior orbital fissure involved was accompanied with one or more extraocular muscle dyskinesia before the operation.

All patients in this study underwent preoperative orbital computed tomography (CT) and B-scan ultrasonography. Magnetic resonance imaging (MRI) was performed on 17 patients.

Methods

Surgical techniques All patients had a pterional approach. Surgery was performed under general anesthesia. The patient was placed supine. The head was rotated 45 degrees toward the opposite side and fixated in a head holder. The skin incision began at the level of the zygomatic arch (1cm anterior to the tragus), curved along the hairline, and ended at 1-2cm near the midline. The cutaneous flap was elevated and reflected inferiorly. The temporalis muscle and fascia were incised vertically, exposing the zygomatic process of the frontal bone and the supraorbital margin of frontal bone (Figure 1). The craniotomy was performed with four holes. A fretsaw was used to cut between holes. The Bone flap was removed and preserved. An osteotomy of the superior wall of the orbit was performed using a rongeur. When necessary, the lateral wall of orbit was cut away together. The dura was opened and CSF was drained to achieve brain relaxation and wide exposure of the tumor. Osteoclastic removal of the frontal and temporal bones and the greater wing of the sphenoid were performed through skull base. Subsequently, the superior orbital fissure and the optic nerve were identified (Figure 2). The unroofing of the optic canal was performed and the orbital septum was incised. The lateral rectus, superior rectus and oblique muscles were retracted medially. If necessary, medial and lateral rectus muscles were retracted medially as well (Figure 3,4). Care was taken to preserve extraocular muscles and optic nerve. Following exposure of the anterior portion of the tumor, a standard retinal cryoprobe was used to freeze the tumor (Figure 5). While obvious ice formation on the tip of the cryoprobe could be seen after 1-2 minutes freezing, adhesions between the tumor and surrounding tissues were relieved and the tumor was pulled out gently with rotating movements. After complete removal, a closed drainage was placed in each case.

RESULTS

Histopathologic Features Twenty-eight patients (75.6%) had benign and 9 (24.3%) had malignant tumors. Of all the benign tumors, the most common was meningioma in 11 cases (29.7%), followed by inflammatory pseudotumor in 6 cases (16.2%), neurilemoma in 4 cases (10.8%), fibrous dysplasia, astroma and optic nerve glioma in 2 cases each (5.41%), and pituitary adenoma in 1 case (2.7%). The most frequent malignant tumor was malignant meningioma in 4 cases (10.8%), followed by non-Hodgkin lymphoma in 2 cases (5.4%), rhabdomyoma, malignant hemaningioendothelioma and malignant optic nerve glioma in 1 case each (2.7%).

Postoperative Complications Vision loss was recorded in 4 cases (10.8%, 4/37) as a result of optic nerve injury in 1 patient. And the optic nerve was cut in the remaining 3 patients, 2 with optic nerve glioma and 1 with malignant

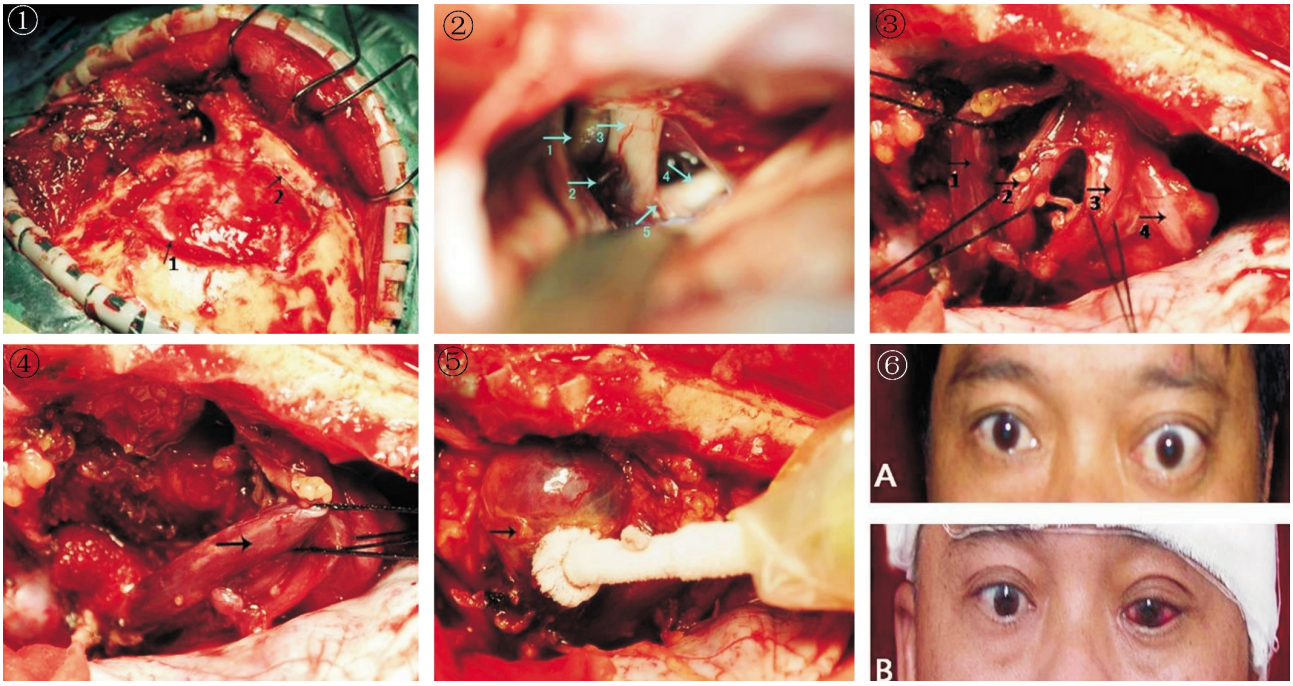

Figure 1 After performing skin incision, the temporalis muscle and fascia are incised vertically 1: Remove the skull; 2: The supraorbital margin of frontal bone are exposed.

Figure 2 Part of cerebrospinal fluid is aspirated after opening the duramater, then important structure with orbit is exposed 1: Internal carotid; 2: Internal jugular vein; 3: Left optic nerve; 4: Right optic nerve; 5: Optic chiasma.

Figure 3 Separate and protect the extraocular muscle 1: Lateral rectus; 2: Superior rectus; 3: Levator muscle; 4: Medial rectus.

Figure 4 Pull away extraocular muscles to side of tumor.

Figure 5 Following exposure of the anterior portion of the tumor, a standard retinal cryoprobe was used to freeze the tumor and pull it out carefully.

Figure 6 Patient with exophthalmia A: Before surgery; B: After surgery exophthalmia was alleviated.

optic nerve glioma, whose preoperative visual acuity was poor. Vision was worse in 6 cases (16.2%, 6/37), declined from 2 to 3 line. Transient blepharoptosis occurred in 11 cases (29.7%, 11/37), 7 cases with remission within 6 months. 15 patients had limitation of the EMO (transient in 11, and permanent in 4) due to excessive traction during operation(40.5%, 15/37). Five patients presented a unilateral dilated pupil(13.5%, 5/37), accompanying with vision loss in 4. Two patients had cerebrospinal rhinorrhea (5.4%, 2/37) and were treated successfully with a pack. Exophthalmia had been alleviated in all patients (Figure 6), measured from 5 to 9mm by Hertel proptometer. Three patients (8.1%, 3/37) had improved their visual acuity from 0.05 to 2 lines.

DISCUSSION

Due to the special position and high incidence of ocular complications, the surgery for removing the cranio-orbital tumor has attracted the attention of ophthalmologists in recent years [8, 9]. Orbit, Anterior Cranial Fossa and Middle Cranial Fossa are in close neighboring, separated by thin Superior Wall of Orbit only. There are mainly 4 channels for connection: Orbit-Optic Canal-Skull Channel, Orbit-Sphenoidal Fissure-Skull Channel, Orbit - Sphenomaxillary Fissure-Skull Channel and Orbit-Destruction of Bone-Skull Channel [4,18]. Both Tumors in Orbit and Intracranial Tumors nearby overrun to contralat region mainly through four channels. Secondly, tumors at both sides of roof of Orbit shall pass through thin Bone Wall to enter into contralat region. Since 20th Century, with development in microsurgery of neurosurgery, there are many approaches to cut cranio-orbital tumors in accordance with different tumor positions and sizes. It mainly includes Pterional Approach, Subfrontal Exdural Approach, Frontotemporal Obito-Zygomatic Approach and Improved Pterion Approach [4,10-15]. Tumors can be excised if a proper approach is selected. Our experiences were that a Classical Pterion Approach can basically meet demands to exposure for extirpation of cranial-orbital tumor, though other approaches are applicable to some special tumors, such as Frontotemporal-orbital-zygomatic approach is adopted for cranio-orbital tumors involving sinus cavernosus, Improved Pterion Approach is better for removing the tumor across superior orbital fissure [10-15]. However, narrowness of Orbit space and its closeness to Sinus Paranasales, great loose adipose tissue in the Orbit, abundant nerve blood vessel at Orbital Apex

and complicate muscle structure constitute obstacles to the surgery. Previously, the tumor extirpation is performed by a neurosurgeon independently and incidence rate of eye complication is increased arisen from insufficient protection of important tissues in the Orbit due to limited Orbit dissection knowledge of operator. In recent years, it has been shown from statistics both domestic and overseas, that most cranio-orbital tumors can be extirpated completely by transcranial surgery. However, according to the report of Gabibov [1], and Li G [2], primary complication is Impaired Vision and drawback of eye movement [10-13] which is in accordance with our statistical result. Vision loss and decline were the one of the most serious complications. In our study, there were 27.0% (10/37) patients suffered from this complication. Except three of them were cut off the optic nerve because of optic nerve glioma, we hold the view that the rest cases was mainly arisen from injury of optic nerve when Optic Canal is opened, or optic nerve oppressed caused by internal bleeding and edema of Orbit. So, when it was necessary to open Optic Canal, we grinded off bone wall with abrasive drilling instead of Bone Rongeur Removal Method. Compared to the statistic data reported by Juan Guo, vision loss occurred for 32 out of 71 patients (45.0%), the incident rate in our research is much more less (27.0%), which implied that grind off bone wall with abrasive drilling could protect the optic nerve. Vision of 3 patients is improved after surgery, which is probably attributed to release of oppression on Optic Nerve after extirpation of the tumor. Extraocular muscles impairment is the most frequent complication .To protect the extraocular muscle, we separated and pull away the muscle during the operation. We observed that 15 patients had their Extraocular Muscles injured during operation, and 11 patients had recovered totally or partially within half a year (73.3% , 11/15). Ptosi is treated as complication of Extraocular Muscle Injury too. 11 patients in our study recorded as Peosi, and 7 patients recovered within half a year, proportion of which is 63.6% . All these conditions indicate that tension injury occurred probably due to suspension of Extraocular Muscles during operation is restorable. Cryotherapy has been used in the removal of orbital tumors for several years [8, 16]. The author holds that a better effect can be achieved in extirpation of tumors with application of Standard Retinal Cryoprobe to the operation for retinal detachment. Firstly, it can prevent tumor from smash by a forceps holder; Secondly, normal tissues around are carefully separated by pulling tumor through a cryopencil to reduce injury of normal tissues. Furthermore, the cryopencil has less area, no instance of destruction to normal tissues has been discovered hitherto due to excessively low temperature. In addition, do not injure the first nerve of the trigeminal while cutting the tumor at Orbital Apex to prevent forfeiture of cornea sense, and avoid injury of the ciliary ganglion while removing the tumor nearby the lateral wall to prevent dilated pupils [16-18]. After the tumor was removed, sew up the orbital septum strictly to effectively prevent shift of contents in the orbit after surgery [19]. Two patients were attacked by Cerebrospinal Rhinorrhea after surgery. They were healed after filling without infection, which indicates that it is very important to prevent the complication through careful restoration on Cerebral Dura Mater. After all, we stressed that craniotomy treatment has its own complications ,such as Rise of skull pressure, Haematoma, Pneumocephalus, Infection, Cerebral nerve damage, Leakage of cerebrospinal, Cerebral infarction, Hydrocephalus, etc [20,21]. If Ophthalmologist fails to treat the complication of craniotomy well, many postoperative complications may probably occur [22].

To extirpate cranial-orbital tumors through Pterion Approach provided good operation visual field. Furthermore, ophthalmologists are familiar with dissection of orbital apex area and master meticulous operation technique, which conduces to decrease of postoperative complication compared with traditional external orbitotomy or external and internal orbitotomy [23] and better control of postoperative complications compared with independent surgery by a neurosurgeon only. To extirpate the tumor completely, ophthalmologist and neurosurgeon should perform surgery together. We believe that curative effect of the surgery can be maximized and some unnecessary complications can also be prevented.

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