DOI: https://doi.org/10.24412/2587-7569-2025-1-60-74

Surgical aproaches to cavernous hemangiomas of the orbit (clinical cases)

M.Sh. Amiralieva[1], I.V. Grigoriev[1], S.A. Melchenko[1], A.A. Kalandari[2], O.I. Patsap[1], M.B. Dolgushin[1], I.V. Senko[1]

[1]Federal Center of Brain Research and Neurotechnologies, Federal Medical and Biological Agency of Russia; Bld. 10, 1 Ostrovityanova St., Moscow 117513, Russia;
[2]N.V. Sklifosovsky Research Institute for Emergency Medicine, Moscow Healthcare Department; 3 Bolshaya Sukharevskaya Sq., Moscow 29090, Russia

Contacts: Madina Shamilevna Amiralieva *amiralievamadina@mail.ru*

Cavernous hemangioma of the orbit (CHO) is the most common benign vascular malformation in adults. Surgical resection is considered the optimal treatment strategy for CHO with the aim to totally remove the malformation with the best functional and cosmetic results. During CHO resection, different types of approaches are used depending on the size and location of the malformation, specialization and preferences of the surgeon.

The article presents 3 clinical cases of patients with CHO who underwent treatment at the Federal Center of Brain Research and Neurotechnologies of the Federal Medical and Biological Agency (FCBRN of FMBA of Russia). In two cases, the CHO was resected using a modified orbitozygomatic approach, in one case a transnasal endoscopic approach was applied.

The choice of surgical approach to orbital neoplasms continues to be a topic of discussion between ophthalmologists, neurosurgeons and maxillofacial surgeons. Surgical treatment of CHO requires additional clinical and anatomical research to systematize surgical techniques, taking into consideration the wide range of approaches, specific anatomy of the orbit, localization of CHO, specialization of the surgeon, and individual characteristics of the patient.

Keywords: cavernous hemangioma of the orbit, surgical approach to orbital neoplasms, orbitozygomatic approach, transnasal endoscopic approach

For citation: Amiralieva M.Sh., Grigoriev I.V., Melchenko S.A. et al. Surgical approaches to cavernous hemangiomas of the orbit (clinical cases). Neyrokhirurgiya = Russian Journal of Neurosurgery 2025;27(1):60–74. (In Russ.).
DOI: https://doi.org/10.24412/2587-7569-2025-1-60-74

BACKGROUND

Orbital neoplasms are rare – from 3 to 5 cases per 1 million people per year. However, only 1 out of 3 cases is benign [1, 2].

Cavernous hemangioma of the orbit (CHO) is the most common benign orbital lesion [2, 3]. CHOs grow slowly and are not accompanied by pain in the most cases. The growth of CHOs lead to compression of functionally important structures in the limited space of the orbit. As a rule, patients seek help when severe visual impairment or pronounced exophthalmos appears [4].

The most optimal strategy of the treatment of CHO is a surgical resection. The choice of surgical approach to CHO depends on the size of the hemangioma and its location relative to the optic nerve and eye muscles [5, 6]. Specific features of the orbital anatomy, the need for a multidisciplinary approach and the high risk of postoperative complications determine the diversity of surgical approaches and interdisciplinary interest in CHO.

The article presents 3 clinical cases of patients with CHO treated at the Federal Center of Brain Research and Neurotechnologies of the Federal Medical and Biological Agency (FCBRN of FMBA of Russia). In 2 cases, CHO resection was performed using a modified orbitozygomatic approach (OZA), in 1 of 3 cases, an transnasal endoscopic approach (TEA) was used.

CLINICAL CASE 1

Male patient B., *44 years old, complained of decreased visual acuity in the right eye and anterior displacement of the eyeball. The symptoms had been bothering him for about 2 years. Over time, the symptoms became more severe. Examination revealed right-sided exophthalmos of up to 3 mm, mild hyperopia, and retinopathy. Visual acuity: OD = 0.5, OS = 0.98; visual fields are normal.*

Magnetic resonance imaging (MRI) revealed a hypervascularized space-occupying lesion in the superolateral part of the right orbit, measuring 23 × 18 × 18 mm, hyperintense in T1 mode after the contrast administration and isointense in T2 mode, which was localized within the muscular cone, compressing and displacing the optic nerve medially and downwards (Fig. 1).

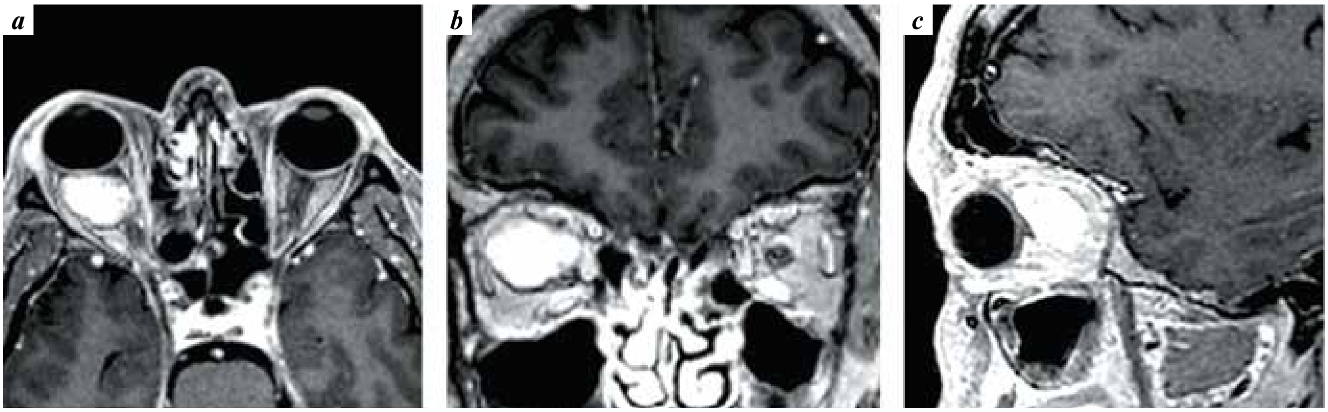

Fig. 1. *Cavernous hemangioma of the right orbit in patient V. Preoperative contrast-enhanced T1-weighted magnetic resonance imaging: a – axial view; b – frontal view; c – sagittal view. Cavernous hemangioma in the upper lateral part of the right orbit intensively accumulates contrast and displaces the right optic nerve medially and downwards*

Taking into account the clinical data and the results of instrumental examinations, a decision was made to perform microsurgical resection of the optic nerve from the modified OZA. After opening the periorbita, a pathological mass of red-violet color was visualized, surrounded by a fibrous capsule, not fused with the surrounding structures. The pathological formation was separated from the surrounding tissues along the periphery, cut off from the feeding vessels and removed as a single block (Fig. 2). The intraorbital, previously compressed part of the optic nerve returned to its original position. After removal of the formation, the zygomatic orbital bone block was reestablished and fixed with interrupted sutures (Fig. 3).

Microscopic examination of the removed mass lesion revealed areas of pathologically altered vascular bed: vascular and sinusoidal polygonal cavities of various sizes, separated by thin connective tissue septa, lined with flattened dystrophic endothelium. Smooth muscle cells and elastic fibers in the trabeculae were absent, fibrosis was visualized (Fig. 4). The morphological diagnosis was cavernous hemangioma.

The transient diplopia and a decrease in the severity of exophthalmos were noted in the early postoperative period.

The patient was discharged in satisfactory condition on the 10th day after the operation. During the ophthalmological examination before discharge, positive dynamics was noted in the form of visual functions restoration. Visual acuity: OD = 0.7, OS = 0.98; visual fields are normal for all colors.

At the follow-up examination one month after the operation exophthalmos and signs of diplopia had completely regressed. No signs of residual CHO *were detected at MRI 6 months after the surgery, (Fig. 5).*

CLINICAL CASE 2

Male patient T., *51 years old, complained of discomfort and anterior displacement of the left eyeball. The symptoms had been bothering the patient for 6 months. The examination revealed left-sided exophthalmos up to 3 mm, background retinopathy and retinal vascular changes, complex myopic astigmatism, moderate myopia OD and mild myopia OS, visual acuity – OD = 1.0, OS = 0.4. The visual field of the right eye was normal for all colors. The visual field of the left eye showed normal peripheral boundaries and narrowing for colors in the temporal half.*

MRI revealed a mass lesion in the left orbit measuring 26 × 17 × 17 mm, located between the lateral rectus medulla and the optic nerve, displacing the latter medially. The formation intensively accumulated contrast agent (Fig. 6).

The patient underwent microsurgical removal of a mass lesion in the left orbit using a modified OZA. After opening the periorbita, a pathological neoplasm of red-violet color and dense consistency was visualized at a depth of about 4 mm. The mass lesion was separated from the surrounding tissues along the periphery, cut off from the feeding vessels, and removed as a single block. Signs of compression-ischemic neuropathy of the left optic nerve in the form of hyperemia of the epineurium were noted. After removal of the lesion, the zygomatico-orbital bone block was reestablished and fixed with titanium plates and mini-screws (Fig. 7). In order to achieve a better cosmetic result, the skin was sutured with an intradermal suture (Fig. 8).

Microscopic examination revealed a morphological diagnosis as cavernous hemangioma (Fig. 9).

The decrease in the severity of exophthalmos was noted in the early postoperative period. During the ophthalmological examination after the operation, positive dynamics was noted in the form of visual functions restoration: visual acuity – OD = 1.0, OS = 0.8; visual fields are normal for all colors. The feeling of discomfort in the left orbit regressed. The patient was discharged in a satisfactory condition on the 10th day after the operation. MRI in 6 months after surgery did not reveal any residual tumor (Fig. 10).

CLINICAL CASE 3

Female patient S., *52 years old, complained of decreased visual acuity and discomfort in the left eye. The symptoms had been bothering the patient for 1 year. Exophthalmos was not detected during the examination. Ophthalmological examination revealed the following: OS – partial atrophy of the optic nerve, slight blanching of the optic disc in the nasal*

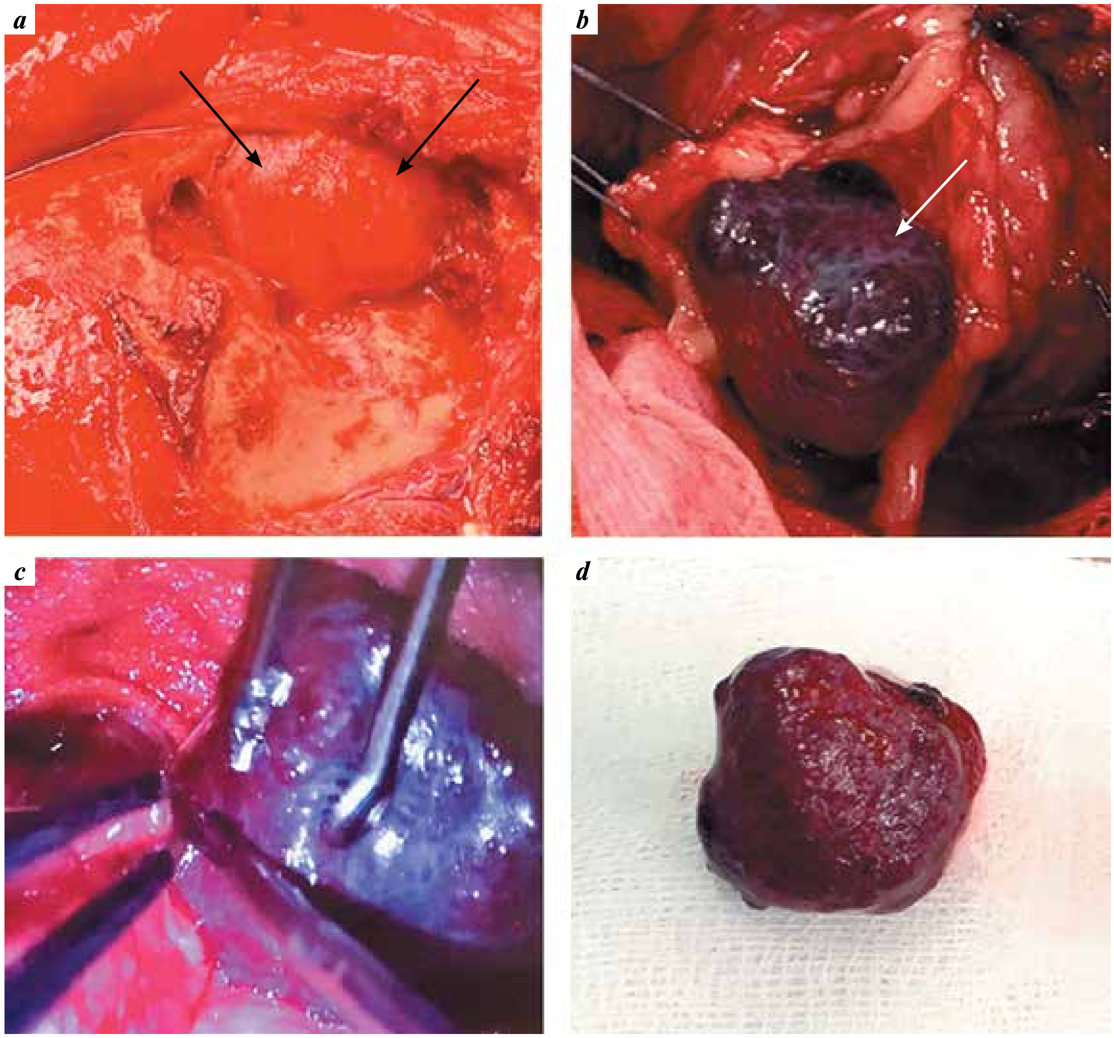

Fig. 2. *Intraoperative images of the patient V.: a — periorbital soft tissues after orbitozygomatic approach (black arrows); b — cavernous hemangioma of the orbit after periorbital dissection (white arrow); c — bipolar coagulation of the cavernous hemangiomas vessels; d — cavernous hemangioma (surgical specimen) after removal*

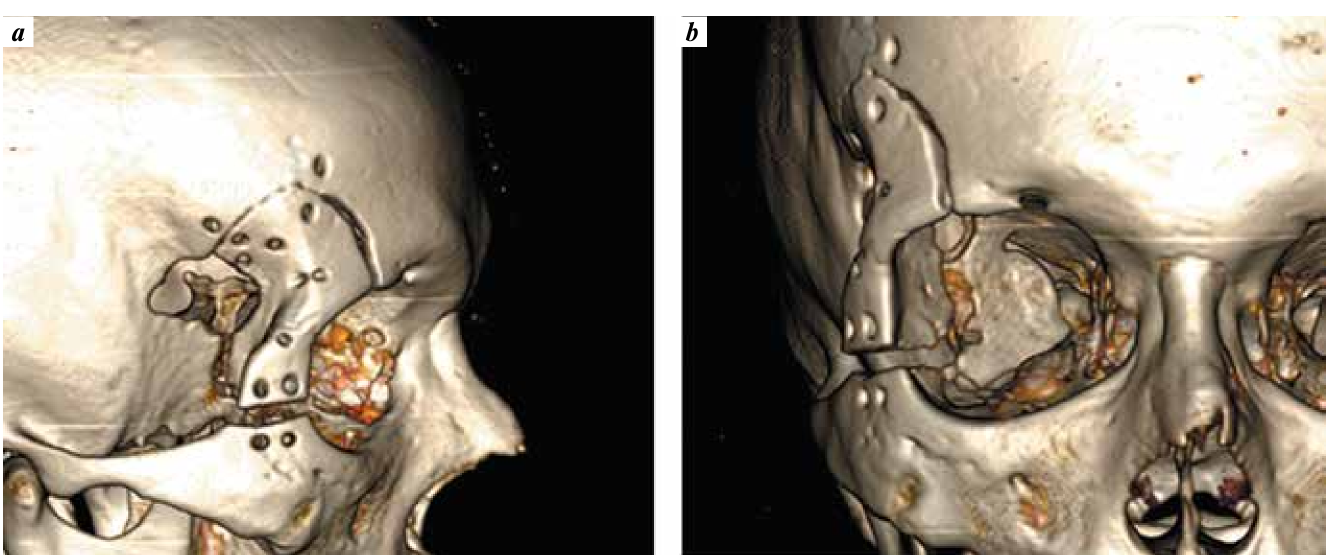

Fig. 3. *Postoperative computed tomography of the patient V., 3D reconstruction: a — lateral view; b — frontal view*

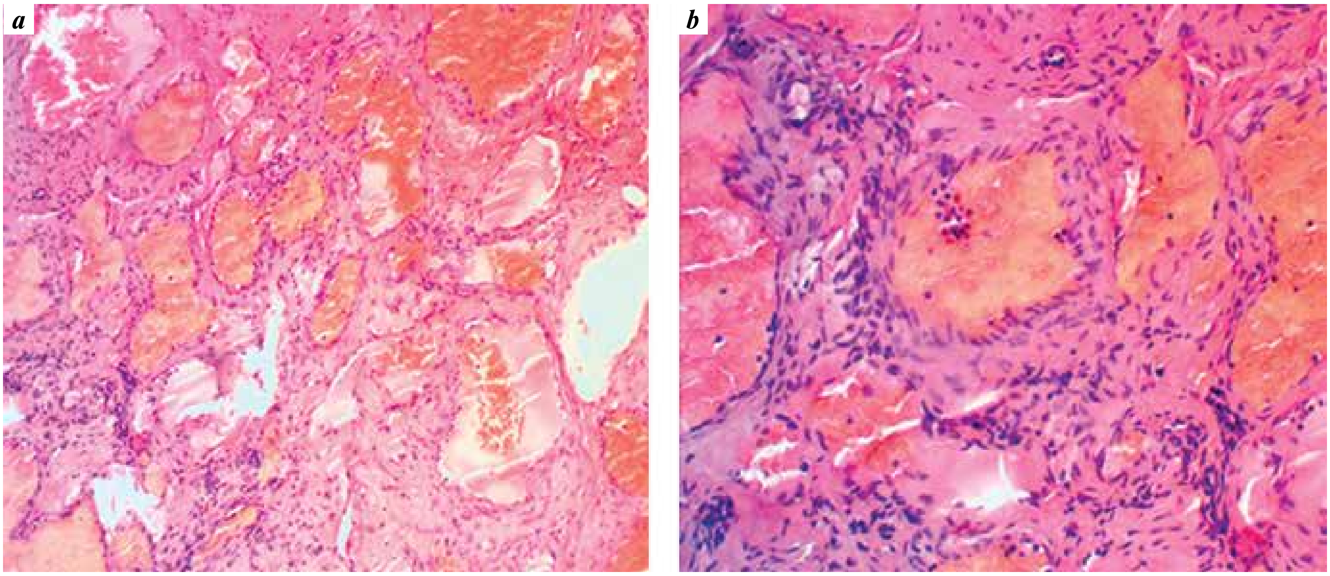

Fig. 4. *Cavernous hemangioma of the orbit of the patient V., histological specimen (hematoxylin and eosin staining): a — ×100; b — ×200*

Fig. 5. *Contrast-enhanced T1-weighted magnetic resonance imaging of the patient V. in 6 months after surgery. Images show the straightened right optic nerve after total removal of the orbital cavernous hemangioma: a — axial view; b — sagittal view*

Fig. 6. *Cavernous hemangioma of the left orbit in patient T. Preoperative contrast-enhanced T1-weighted magnetic resonance imaging: a — axial view; b — frontal view; c — sagittal view. Cavernous hemangioma in the lateral part of the left orbit intensively accumulates contrast and displaces the left optic nerve medially*

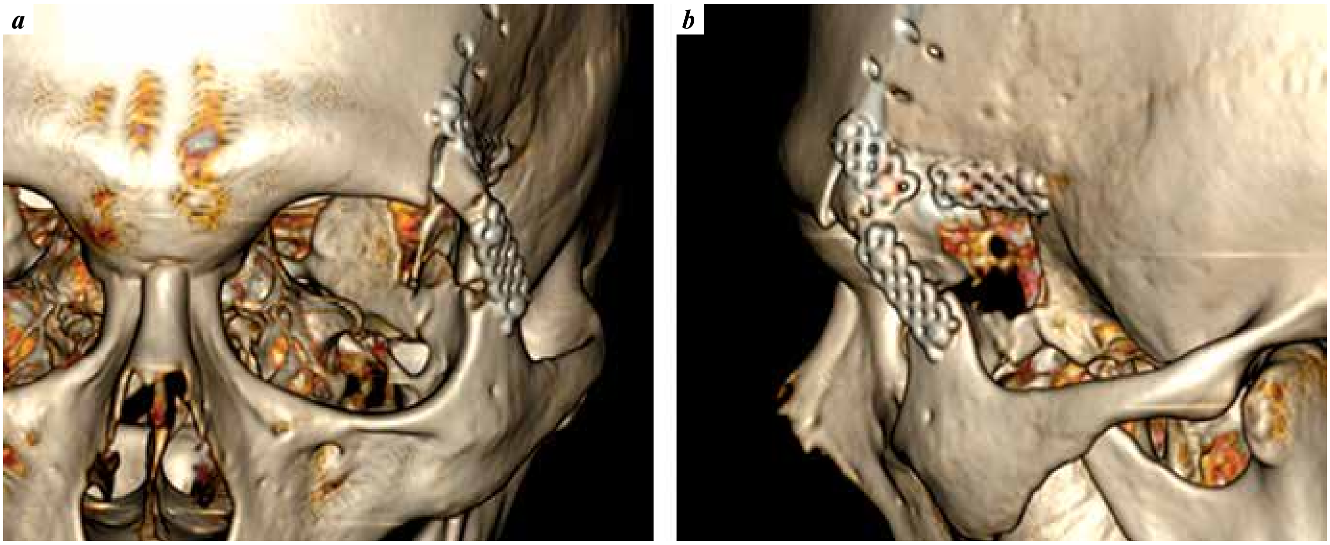

Fig. 7. *Postoperative computed tomograthy of the patient T., 3D reconstruction: a – frontal view; b – lateral view*

Fig. 8. *Patient T. Intradermal suture after modified orbitozygomatic approach*

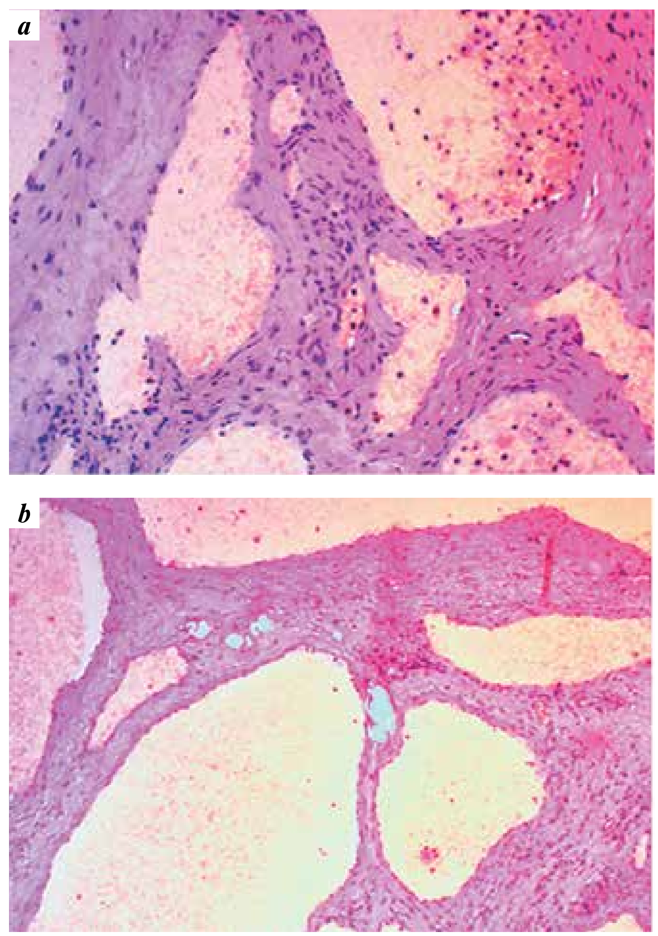

Fig. 9. *Cavernous hemangioma of the orbit of the patient V., histological specimen (hematoxylin and eosin staining): a – ×100; b – ×200*

area, clear borders, slightly narrowed arteries, normal-sized veins, OU – mild myopia, incipient cataract. Visual acuity: OD = 1.0, OS = 0.6; visual fields are normal.

MRI revealed a mass lesion medial to the optic nerve in the region of the apex of the left orbit, measuring 9 × 13 × 8 mm. The formation compressed and displaced the optic nerve laterally and upward (Fig. 11).

The patient underwent transnasal endoscopic resection of a mass lesion of the left orbit (Fig. 12). In the area of the orbital apex, a whitish-gray, densely elastic CHO was visualized. The lesion was separated from the surrounding tissues and the optic nerve and totally resected in separate fragments.

The day after the surgery, the patient noted a double vision. Ophthalmological examination revealed exotropia of OS, limited adduction of the eyeball, limited downward mobility of the eyeball, and slight limitation of upward gaze. Neuropathy of the oculomotor nerve and paresis of the medial

НЕЙРОХИРУРГИЯ
Russian Journal of Neurosurgery
1 ТОМ 27 Vol. 27 2025

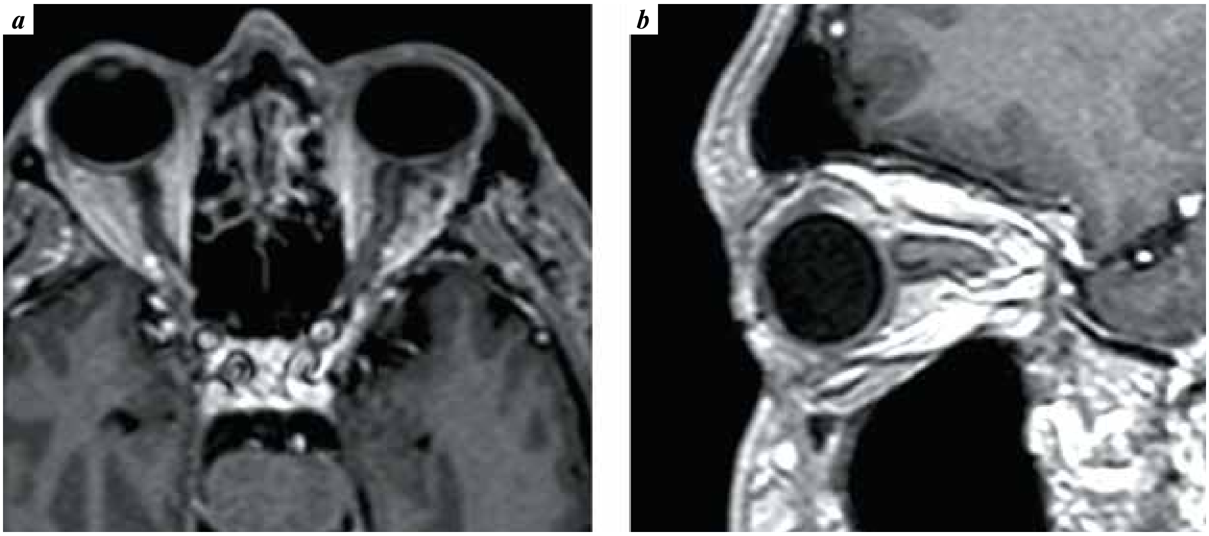

Fig. 10. *Contrast-enhanced T1-weighted magnetic resonance imaging of the patient T. in 6 months after surgery. Images show the straightened left optic nerve after total removal of the orbital cavernous hemangioma: a – axial view; b – sagittal view*

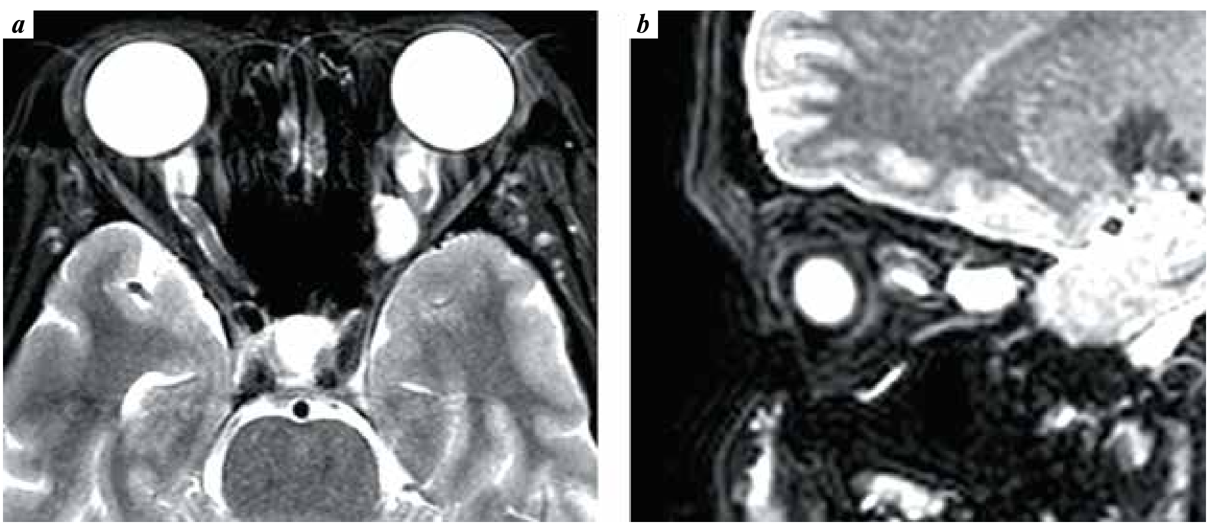

Fig. 11. *Cavernous hemangioma of the apex of the left orbit in patient S. Preoperative T2-weighted magnetic resonance imaging: a – axial view; b – sagittal view*

rectus muscle (MRM) of the eye were diagnosed. Visual acuity: OD = 1.0, OS = 0.7.

Microscopic examination of the removed mass lesion revealed a morphological diagnosis of cavernous hemangioma.

Upon examination before discharge oculomotor nerve neuropathy and paresis of the ocular MRM partially regressed. Positive dynamics was noted in the form of visual functions restoration: visual acuity – OD = 1.0, OS = 0.9. The patient was discharged in a satisfactory condition on the 5th day after the operation. During follow-up one month later neuropathy and paresis regressed completely. MRI in 3 months after the operation showed no signs of residual CHO (Fig. 13).

DISCUSSION

Three patients, two of whom were operated microsurgically and one with the endoscopic transnasal approach, showed improvement in their condition and regression of neurological deficit. In addition, total resection of the cavernous hemangioma of the orbit was achieved, which was confirmed by MRI. The use of a modified OZA allowed to visualize completely the superolateral CHO and associated intraorbital anatomical structures. TEA was the most convenient and least traumatic when approaching the orbital apex. In the early postoperative period, one patient experienced transient neuropathy of the oculomotor nerve and transient paresis of the MRM of the eye, which completely regressed one month after the operation.

Orbital cavernous hemangioma is the most common benign vascular lesion of the orbit in adults [2, 7]. As a rule, CHO is detected in patients in the 4th–5th decades of life [4, 8]. It has been established that the development of CHO is influenced by female sex hormones, therefore, in 60 % of cases,

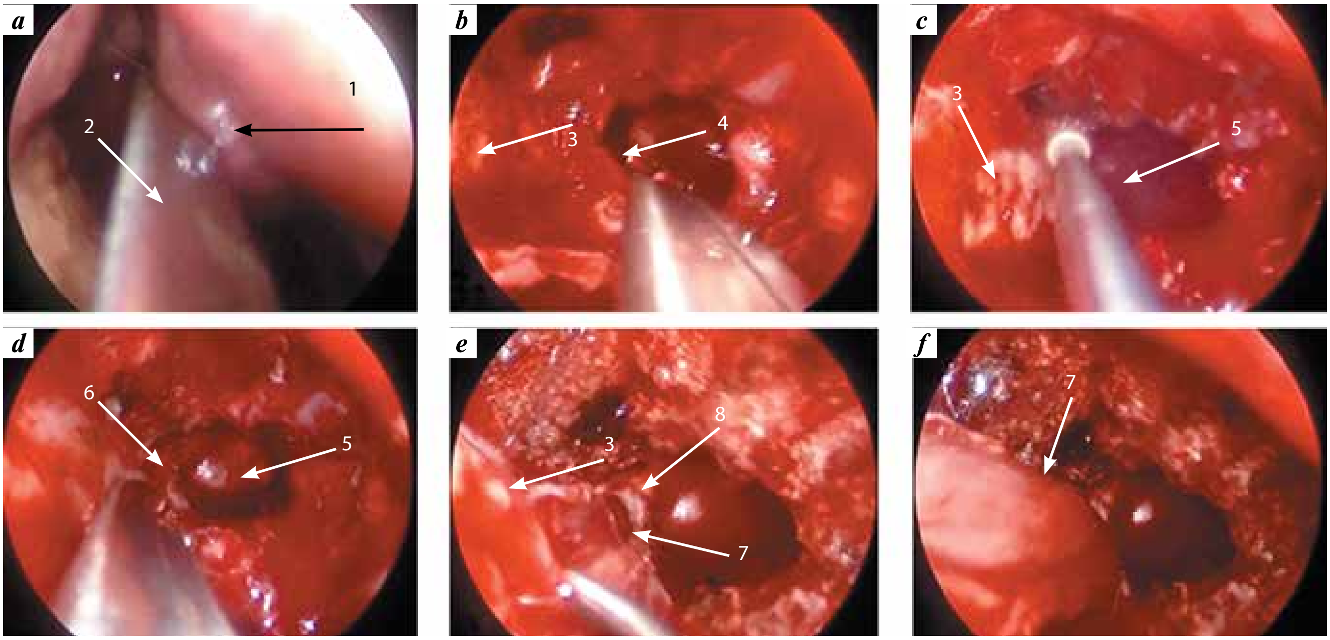

Fig. 12. *Intraoperative images of patient S.: a – lateralization of the left middle nasal concha; b – anterior sphenoid sinus wall resection; c – thinning of the left optic nerve canal walls; d – approach to the left optic nerve canal; e – periorbital dissection; f – after transnasal resection of the orbital apex cavernous hemangioma. 1 – left middle nasal conch; 2 – elevator; 3 – periorbital tissu; 4 – the wall of the sphenoid sinus; 5 – the sphenoid sinus; 6 – optic nerve canal; 7 – enlarged medial rectus muscle; 8 – left optic nerve canal*

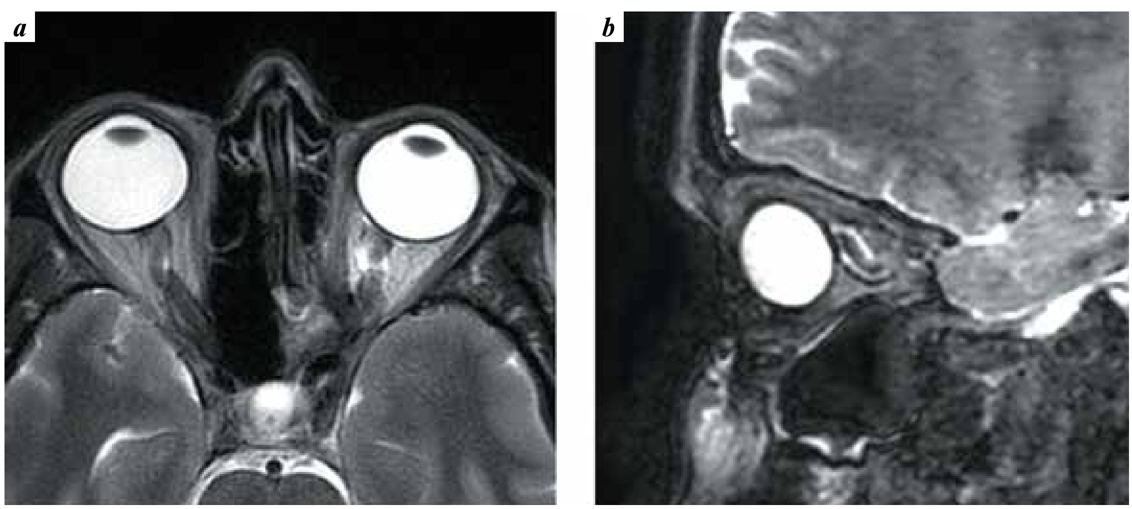

Fig. 13. *T2-weighted magnetic resonance imaging of the patient S. in 3 months after removal of the cavernous hemangioma of the apex of the left orbit: a – axial view; b – sagittal view*

hemangiomas affect women [7, 8]. According to the study by A. Jayaram et al., devoted to inestigate of the menopause effect on the clinical course of cavernous hemangiomas, the most CHOs either decrease or remain stable in postmenopause due to decrease of the level of circulating estrogens/progesterone [8].

At present, there is no consensus on the pathogenesis of CHO. Most authors do not regard CHO as a tumor, but classify it as anomalies in the development of venous vessels with slow blood flow [4, 5, 9, 10]. According to the 2018 classification of the International Society for the Study of Vascular Anomalies (ISSVA) and the classification of J. Rootman, CHO is a low-flow venous malformation [9].

Macroscopically, cavernous hemangioma is a rounded formation of red-blue color, with an uneven surface, clearly delimited from the surrounding tissues due to the presence of a capsule [5]. Microscopically, CHO is represented by densely located dilated vascular channels separated by fibrous septa. On a histological preparation of CHO, one can see the lumen of the vessels filled with blood and thrombi – this is a manifestation of slow blood flow, therefore hemorrhages from such formations are extremely rare [4, 11].

The mechanism of CHO growth is not completely clear. Some authors suggest that the growth of hemangiomas is caused by capillary proliferation with the formation of cavernous cavities due to progressive ectasia [12]. Other researchers believe that the growth of CHO occurs due to repeated hemorrhages inside the hemangioma, which leads to the formation of cavities with thrombi and the formation of new caverns as a result of stromal-vascular degeneration [13, 14].

Clinically, CHO manifests itself as painless, slowly progressing axial exophthalmos, decreased visual acuity, and impaired oculomotor function [15]. Diplopia, eyelid edema, and conjunctival chemosis are less common [16].

The most optimal treatment strategy for CHO is a surgical resection. According to B. Kim et al., even small orbital apex lesions require early surgical intervention [17]. After total removal of the hemangioma, the recurrence rate is low. The following possible causes of recurrence are described in the literature such as continued growth with incomplete excision of CHO, growth of an undiagnosed hemangioma, and the appearance of a new CHO [18]. However, G. Harris et al. argue that cavernous hemangioma is not recurrent even with partial resection. The authors point out that an increase in a new lesion in the same orbit is often mistakenly interpreted as continued growth of an incompletely removed CHO [12].

The choice of surgical approach to orbital lesions remains a subject of debate among ophthalmologists, neurosurgeons, and maxillofacial surgeons [19].

The main aim of CHO surgical treatment is a total resection with the best functional and cosmetic result. Various approaches are used to remove CHO, the choice of which depends on both the localization of the lesion relative to the optic nerve and muscles, and the specialization and preferences of the operating surgeon [6, 10]. Routine approaches to the orbit include lateral orbitotomy, anterior orbitotomy, and transcranial approaches [20].

Despite the development of minimally invasive methods, routine approaches are still used more often. Most methods provide the wide surgical field and the possibility of more radical resection, but each has its own characteristics. Lateral orbitotomy is indicated for lateral extraconal tumors. Anterior orbitotomies and transconjunctival access are designed for small, well-defined lesions [21]. Transpalpebral access is indicated for medium-sized intraconal tumors located above the optic nerve [22, 23].

Neurosurgeons get used to perform the following common transcranial approaches such as pterional craniotomy with orbital wall resection, lateral supraorbital craniotomy, modified OZA, bifrontal craniotomy with subfrontal approach with orbital roof resection, supraorbital (transbrow) supraorbital approach. Transcranial approaches are especially convenient for pathologies involving large areas of the orbit and tumors with extraorbital and intracranial spread [21, 24, 25].

Standard pterional or frontotemporal craniotomy provides access to the entire anterior supralateral orbit. Further resection of the sphenoid wing provides access to the posterior supralateral areas and the orbital apex. If access to the anterior orbit is required, the craniotomy can be extended to the frontotemporal OZA. As a rule, the inferomedial region of the orbit is difficult to access with a transcranial approach, in which case it is advisable to use a transzygomatic or two-flap OZA, which will allow access to the infratemporal fossa and the inferior part of the orbit [26].

The orbitozygomatic approach is used for tumors located in the region of the superior orbital fissure, optic canal, and orbital apex, as well as for mass lesions of lateral extraconal and intraconal localization. OZA is a frontozygomatic craniotomy with removal of the roof and lateral wall of the orbit, which makes it possible to approach the upper lateral part of the orbit and the anterior cranial fossa simultaneously, thereby increasing the radicality of resection in large tumors with extraorbital spread into the optic canal or into the anterior cranial fossa through the superior orbital fissure [27, 28].

Y. Numa et al. evaluated the OZA for 5 histologically different intraorbital tumors. In surgical treatment of HCO, the difficulty lies in identifying the feeding vessels. After detection of the vessels supplying the tumor, their coagulation and resection, the cavernous hemangiomas were easily resected completely due to the presence of a capsule and the absence of adhesion to neural structures. Small tumors were totally removed as a single block, and in cases of large tumors with intracranial spread, the authors turned to subtotal resection and decompression of neural structures.

The advantage of transcranial OZA is the visibility of the optic nerve along its entire length (intra- and extracranial), the ability to control the anatomical structures of this area [29]. In addition, OZA provides wide access for successful removal of orbital tumors with minimal resection of bone structures, so the cosmetic results with this transcranial approach are satisfactory. For a better aesthetic effect, the incision is performed within the scalp [30].

In turn, TEA is widely used to approach the medial and inferior parts of the orbit. Currently, this is the only method that allows approaching the mass lesions of the lower medial part of the orbit [1]. The complexity of the approach to the lower medial orbit is due to the peculiarities of the vascular-nerve anatomy of this area, without knowledge of which it is quite difficult to achieve a good result [31, 32].

In 2014, B.S. Bleier et al. conducted anatomical studies of the medial intraconal space of the orbit and described 3 zones of increased surgical complexity based on the course of the inferomedial trunk (IMT) of the ophthalmic artery (Fig. 14). Zones A and B are localized anterior to the conditional vertical line passing through the point of exit of the IMT from the ophthalmic artery. These zones are divided by the belly of the MRM into the lower (zone A)

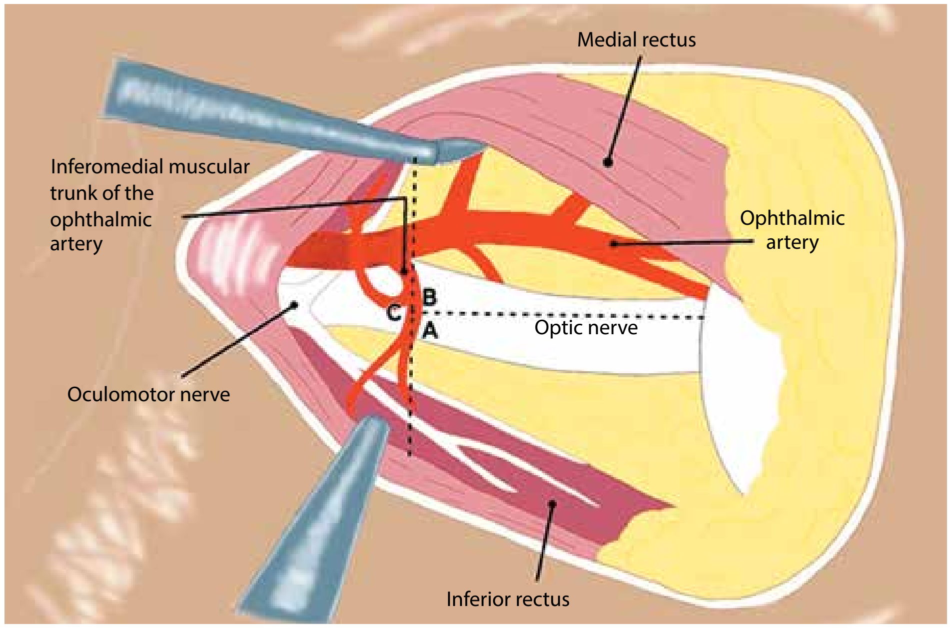

Fig. 14. *Schematic diagram demonstrating the three conceptual zones of the medial intraconal orbit (black dotted line). Zone A lies anterior to the IMT insertion and inferior to the non-retracted MRM. Zone B lies anterior to the IMT insertion and superior to the non-retracted MRM belly. Zone C lies posterior to the IMT insertion (designed by the authors)*

and upper (zone B). The most dangerous zone C is located posterior to the inferomedial artery; here the distance from the MRM to the optic nerve is 1 mm.

In addition, it is worth considering the low range of controlled mobility during traction of the MRM in this area [1, 31, 32]. TEA combines the following advantages: no traction of the brain, minimal impact on the medial wall of the orbit, good illumination and magnification, which helps to minimize the risk of postoperative complications. In addition, the use of natural corridors prevents trauma of the head muscles [33].

There are limitations in the use of TEA, determined by the plane of resectability (PR) [1, 32]. PR is a plane passing through the outer edge of the contralateral wing of the nose and through the optic nerve. The zones accessible for endoscopic intervention are medial to the vertical axis of the optic nerve and lateral and below PR. Everything that is above PR and lateral to the vertical axis of the optic nerve is a blind zone for the endoscope (Fig. 15) [1, 31, 34].

In 2019, E.E. Rassi et al. developed a staged system for selecting patients for endoscopic transnasal resection of cavernous hemangiomas of the orbit – Cavernous Hemangioma Exclusively Endonasal Resection (CHEER) (Table 1). CHOs located medial to the optic nerve plane are subject to exclusively transnasal resection. In some cases, TEA can be used for formations localized below and lateral to the PR.

The staging of the CHEER system is developed taking into account the increasing complexity of CHO removal and potential risks. The CHEER classification is based on the location of the CHO relative to the extraocular muscles, the IMT of ophthalmic artery, and the foramina of the orbit

Fig. 15. *Image demonstrating the plane of resectability (PR) in a left orbit, extending from the contralateral nares through the long axis of the optic nerve (white dotted line). Tumors medial to the optic nerve (blue shaded region) are often resectable via an exclusively transnasal endoscopic approach (TEA). Tumors that extend lateral to the optic nerve but remain inferior to the POR (yellow shaded region) may also be amenable to an exclusively TEA. Tumors lateral to the optic nerve and superior to the PR (red shaded region) are not good candidates for an TEA (designed by the authors)*

(Fig. 16). The size of the mass lesion is not taken into account in the classification [35].

Stage I mass lesions include all CHOs localized outside the muscular cone. Extraconal CHO is visible immediately after opening the periorbita and does not require muscle abduction or dissection. All subsequent stages include CHOs of intraconal localization, since surgical manipulations here are technically complex and associated with a high risk

Table 1. *Cavernous Hemangioma Exclusively Endonasal Resection classification (CHEER, 2019) [35]*

Stage	Cavernoma location
I	Extraconal cavernoma of the orbit
II	Intraconal cavernoma of the orbit anterior to the inferomedial muscular trunk of the ophthalmic artery and inferior to the horizontal axis of the medial rectus
III	Intraconal cavernoma of the orbit anterior to the inferomedial muscular trunk of the ophthalmic artery and superior to the horizontal axis of the medial rectus
IVA	Intraconal cavernoma of the orbit posterior to the inferomedial muscular trunk of the ophthalmic artery without extension into the optic canal
IVB	Intraconal cavernoma of the orbit posterior to the inferomedial muscular trunk of the ophthalmic artery with extension into the optic canal or an isolated OCH within the optic canal
VA	Extraconal/intraconal cavernoma of the orbit with pterygopalatine and/or infratemporal fossa extension through the inferior orbital fissure
VB	Extraconal/intraconal cavernoma of the orbit with intracranial extension through the superior orbital fissure

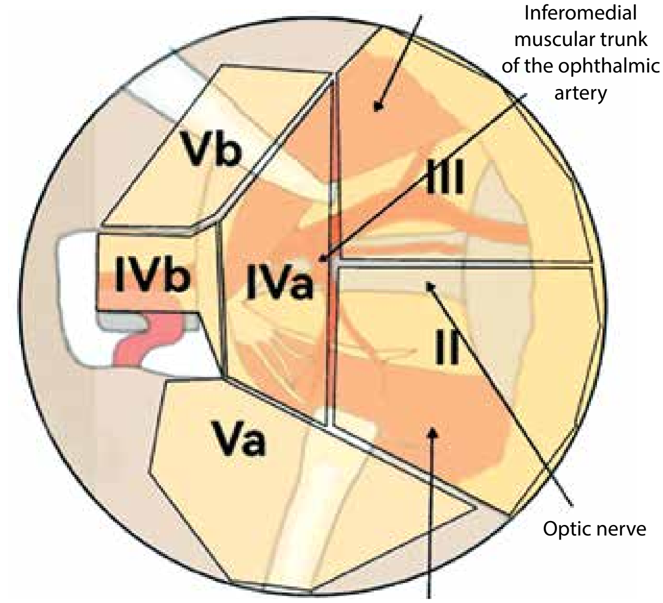

Fig. 16. *CHEER (Cavernous Hemangioma Exclusively Endonasal Resection) staging system with representative tumors by stage (designed by the authors)*

of intra- and postoperative complications. The second most important structure in this area after the optic nerve is the ophthalmic artery, namely its IMT.

The inferomedial muscular trunk crosses the medial intraconal space, departing from the lateral surface of the ophthalmic artery 9 mm anterior to the optic canal, and approaches the medial and inferior rectus muscles. Thus, this branch is in the conditional risk zone during dissection and its injury may lead to intraconal hemorrhage and/or ischemia of the medial and inferior rectus muscles.

In the intraconal space, a high-risk zone is identified posteriorly to the IMT (stage IV) (Fig. 16), where the oculomotor and optic nerves are located in a millimeter from the intervention area. CHOs located anterior to the optic canal (stage IVA) differ from those that pass into or are located in the optic canal (stage IVB). Anterior to the IMT, the intraconal space is divided by the horizontal axis of the MRM into an upper zone (stage III) and a lower zone (stage II).

The CHOs above the MRM axis (stage III) are located close to the anterior and posterior ethmoid arteries, so their removal is associated with a high risk of damaging of these arteries. Access to stage III CHOs requires significant retraction of the MRM, which also increases the complexity of resection and the risk of postoperative complications. The CHOs below the MRM axis (stage II) are the most distant from the optic nerve and ethmoid vessels, therefore, their resection is relatively safer.

Stage V lesions include hemangiomas that extend beyond the orbit. Hemangiomas that extend through the inferior orbital fissure into the pterygopalatine fossa (stage VA) are differentiated from hemangiomas that extend through the superior orbital fissure into the middle cranial fossa (stage VB). Stages I–III hemangiomas suggest the possibility of total resection, unlike stage VB hemangiomas, in which the probability of complete removal is less than 50 %. As the stage increases, the risk of postoperative complications increases [35].

In 2018, N. Montano et al. analyzed 70 cases of intraorbital tumors and recommended to use the OZA for intraconal formations involving >1 area of the orbit, the TEA for primary tumors, medial or inferior localization without extraorbital spread, and the transpalpebral approach for mass lesions of the superior and superolateral parts of the orbit located extraconally [36].

In search of the safest approaches to orbital tumors, A. Paluzzi et al. came up with the Round-the-Clock system, dividing the orbit into 12 parts according to a clock face (Fig. 17). Depending on the location of the tumor, an appropriate ideal approach can be selected. TEA is suitable for tumors localized within 1–7 o'clock, transzygomatic osteotomy – for 6–8 o'clock. For lateral lesions (8–10 o'clock), the preferred approach is lateral microorbitotomy. For mass lesions of the superolateral part of the orbit, within 9 to 1 o'clock, OZA is applicable. The Round-the-Clock system provides an individual approach to surgery of mass lesions along the entire orbital circumference [37].

The presence and severity of complications after resection of orbital hemangiomas depend on their size and location, severity of symptoms in the preoperative period,

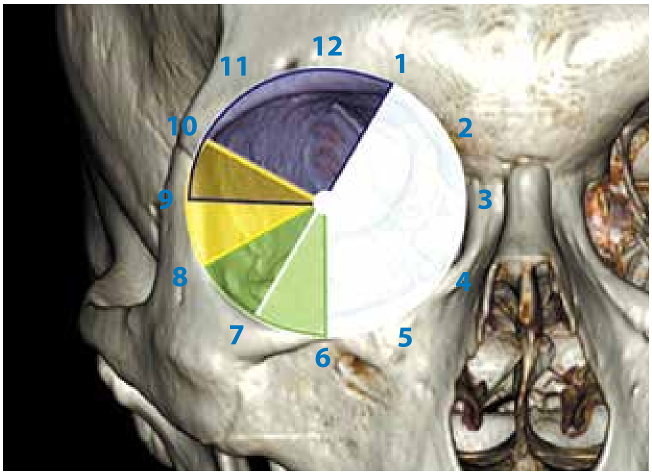

Fig. 17. *The Round-the-Clock system. Transnasal endoscopic approach for 1–7 hours (white color), transzygomatic osteotomy for 6–8 hours (green color). For lateral lesions of 8–10 hours (yellow), a lateral microorbitotomy. For upper lateral part of the orbit, in the range from 9 to 1 hours – orbitozygomatic craniotomy (blue) (designed by the authors)*

the selected approach and the experience of the surgical team [38, 39]. According to statistical analysis by P.M. Dubal et al., the use of TEA in the treatment of CHO in 29.6 % of cases was accompanied by postoperative complications, 76 % of which were transient [40]. While using TEA, the most common complications are transient diplopia, enophthalmos and nasal liquorrhea [1, 4].

During transcranial approaches to CHO in the papers of P. Clarós et al., the most common postoperative symptoms were decreased visual acuity (42.1 % of cases) and enophthalmos (70 % of cases), which regressed within 6 months after surgery [38]. From all early complications after surgery, 23.7 % of cases included eyelid edema, subconjunctival hemorrhage, chemosis, and transient paresis of the lateral rectus muscle of the eye [40].

CONCLUSION

When choosing a surgical method for treating CHO, the following factors should be taken into account: localization of CHO relative to the optic nerve and extraocular orbital muscles, presence of intracranial spread through the optic nerve canal or superior orbital fissure, and size of the formation. For removal of CHO of the lower medial localization and orbital apex without extraorbital spread, the use of TEA is recommended.

For resection of lateral, superolateral localization of CHO and in case of intracranial spread, preference should be given to transcranial approaches. Surgical treatment of CHO requires additional clinical and anatomical studies to systematize surgical treatment methods taking into account a wide choice of approaches, localization of CHO, specificity of orbital anatomy, surgeon specialization and individual characteristics of a particular patient.

ЛИТЕРАТУРА / REFERENCES

1. Reshef E.R., Bleier B.S., Freitag S.K. The endoscopic transnasal approach to orbital tumors: a review. Semin Ophthalmol 2021;36(4):232–40. DOI: 10.1080/08820538.2021.1890794
2. Shields J.A., Shields C.L., Scartozzi R. Survey of 1264 patients with orbital tumors and simulating lesions: the 2002 Montgomery Lecture, Part 1. Ophthalmology 2004;111(5):997–1008. DOI: 10.1016/j.ophtha.2003.01.002
3. Manual on clinical ophthalmology. Ed. by A.F. Brovkina. Moscow: Meditsinskoe informatsionnoye agentstvo, 2014. (In Russ.).
4. Calandriello L., Grimaldi G., Petrone G. et al. Cavernous venous malformation (cavernous hemangioma) of the orbit: current concepts and a review of the literature. Surv Ophthalmol 2017;62(4):393–403. DOI: 10.1016/j.survophthal.2017.01.004
5. Yan J., Wu Z. Cavernous hemangioma of the orbit: analysis of 214 cases. Orbit 2004;23(1):33–40. DOI: 10.1076/orbi.23.1.33.28992
6. Grusha Ya.O., Ismailova D.S., Eksarenko O.V. et al. Giant cavernous hemangioma of the orbit (case report). Vestnik Oftalmologii = Russian Annals of Ophthalmology 2014;130(2):44–9. (In Russ.).
7. Jayaram A., Lissner G.S., Cohen L., Karagianis A.G. Potential correlation between menopausal status and the clinical course of orbital cavernous hemangiomas. Ophthalmic Plast Reconstr Surg 2015;31(3):187–90. DOI: 10.1097/IOP.0000000000000240
8. Rootman J., Heran M.K., Graeb D.A. Vascular malformations of the orbit: classification and the role of imaging in diagnosis and treatment strategies. Ophthalmic Plast Reconstr Surg 2014;30(2):91–104. DOI: 10.1097/IOP.0000000000000122
9. Rootman D.B., Heran M.K.S., Rootman J. et al. Cavernous venous malformations of the orbit (so-called cavernous haemangioma): a comprehensive evaluation of their clinical, imaging and histologic nature. Br J Ophthalmol 2014;98(7):880–8. DOI: 10.1136/bjophthalmol-2013-304460
10. Jeon C., Hong S.D., Woo K.I. et al. Use of endoscopic transorbital and endonasal approaches for 360° circumferential access to orbital tumors, J Neurosurg 2020;135(1):103–12. DOI: 10.3171/2020.6.JNS20890
11. Bachelet J.T., Berhouma M., Shipkov H. et al. Orbital cavernous pemangioma causing ыpontaneous compressive pemorrhage. J Craniofac Surg 2018;29(3):706–8. DOI: 10.1097/SCS.0000000000004285
12. Harris G.J., Jakobiec F.A. Cavernous hemangioma of the orbit. J Neurosurg 1979;51(2):219–28. DOI: 10.3171/jns.1979.51.2.0219
13. Garner A. Cavernous haemangioma of the orbit: a consideration of its origin and development. Orbit 1988;7(3):149–56. DOI: 10.3109/01676838809032013
14. Simard J.M., Garcia-Bengochea F., Ballinger W.E. Jr. et al. Cavernous angioma: a review of 126 collected and 12 new clinical cases. Neurosurgery 1986;18(2):162–72. DOI: 10.1227/00006123-198602000-00008
15. Shchurova I.N., Pronin I.N., Mel'nicova-Pitskhelauri T.V. et al. Orbital hemangiomas: capabilities of modem neuroradiological diagnostics. Zurnal Voprosy neyrokhirurgii im. N.N. Burdenko = Burdenko's Journal of Neurosurgery 2018;82(4):57–69. (In Russ.).
16. Otto C.S. Coppit G.L., Mazzoli R.A. et al. Gaze-evoked amaurosis: a report of five cases. J Ophthalmol 2003;110(2):322–6. DOI: 10.1016/S0161-6420(02)01642-1
17. Kim B.S., Im Y.S., Woo K.I. et al. Multisession gamma knife radiosurgery for orbital apex tumors. J World Neurosurg 2015;84(4):1005–13. DOI: 10.1016/j.wneu.2015.04.042

18. Bagheri A., Khandan S., Salour H. et al. Recurrent orbital cavernous hemangioma due to overlooked multiple tumors. J Ophthalmic Vis Res 2012l;7(3):244–7.
19. Curragh D.S., Halliday L., Selva D. Endonasal approach to orbital pathology, ophthalmic plast reconstr surg. 2018;34(5):422–7. DOI: 10.1097/IOP.0000000000001180
20. Cho K.J., Paik J.S., Yang S.W. Surgical outcomes of transconjunctival anterior orbitotomy for intraconal orbital cavernous hemangioma. Korean J Ophthalmol 2010;24(5):274–8. DOI: 10.3341/kjo.2010.24.5.274
21. Srinivasan A., Bilyk J.R. Transcranial approaches to the orbit. Int Ophthalmol Clin 2018;58(2):101–10. DOI: 10.1097/IIO.0000000000000224
22. Dzhindzhikhadze R.S., Dreval O.N., Lazarev V.A., Poliakov A.V. The Transpalpebral keyhole approach in surgery of orbital cavernomas: a case report and literature review. Zurnal voprosy neyrokhirurgii im. N.N. Burdenko = Burdenko's Journal of Neurosurgery 2018;82(3):73–80. (In Russ., In Engl.). DOI: 10.17116/neiro201882373
23. Low C.M., Stokken J.K. Typical orbital pathologies: hemangioma. J Neurol Surg B 2021;82(1):20–6. DOI: 10.1055/s-0040-1722633
24. Cho R.I. Transcutaneous and transconjunctival surgical approaches to the orbit. In: Oculofacial, orbital, and lacrimal surgery. Ed. by A.J. Cohen, C.N. Burkat. Springer Cham, 2019. Pp. 591–601.
25. Dandy W.E. Prechiasmal intracranial tumors of the optic nerves. Am J Ophthalmol 1922;5:169–88.
26. Gardner P.A., Zenonos G.A., Formentin C., Pichugin A. Transcranial approaches to the orbit. J Neurol Surg B Skull Base 2020;81(4):450–8. DOI: 10.1055/s-0040-1713855
27. Matsuo S., Komune N., Iihara K. Translateral orbital wall approach to the orbit and cavernous sinus: anatomic study. Oper Neurosurg (Hagerstown) 2016;12(04):360–73. DOI: 10.1227/NEU.0000000000001145
28. Cherekaev V.A., Yakovlenko Yu.G., Belov A.I., Lasunin N.V. Case of cavernous hemangioma of the optic canal and superior orbital fissure. Zhurnal Onkologiya im. P.A. Hertsena = P.A. Herzen Journal of Oncology 2014;3(3):73–8. (In Russ.).
29. Numa Y., Kawamoto K. Frontozygomatic approach to intraorbital tumors. Skull Base 2007;17(5);303–10. DOI: 10.1055/s-2007-986433
30. Chang C.W. Orbitozygomatic approach for excisions of orbital tumors with 1 piece of craniotomy bone flap: 2 case reports. Surg Neurol 2007;68(Suppl 1):S56–9; discussion S59. DOI: 10.1016/j.surneu.2007.02.014
31. Banks C., Husain Q., Bleier B.S. Endoscopic endonasal intraconal orbit surgery. World J Otorhinolaryngol Head Neck Surg 2019;6(2):100–5. DOI: 10.1016/j.wjorl.2019.07.001
32. Bleier B.S., Healy D.Y. Jr., Chhabra N., Freitag S. Compartmental endoscopic surgical anatomy of the medial intraconal orbital space. Int Forum Allergy Rhinol 2014;4(7):587–91. DOI: 10.1002/alr.21320
33. Franco J., Zwagerman N., Snyderman C. et al. An update on the endoscopic endonasal approach to orbital and orbital apex lesions: a series of 97 patients. J Neurol Surg B Skull Base 2020;81(S 01): S1–S272. DOI: 10.1055/s-0040-1702333
34. Ma J., Zhou B., Qian H. et al. Transnasal endoscopic resection of orbital cavernous hemangiomas: our experience with 23 cases. Int Forum Allergy Rhinol 2019;9(11):1374–80. DOI: 10.1002/alr.22383
35. Rassi E.E, Adappa N.D., Baglia P. et al. Development of the international orbital Cavernous Hemangioma Exclusively Endonasal Resection (CHEER) staging system. Int Forum Allergy Rhinol 2019;9(7):804–12. DOI: 10.1002/alr.22316
36. Montano N., Lauretti L., D'Alessandris Q.G. et al. Orbital tumors: report of 70 surgically treated cases. World Neurosurg 2018;119:e449–e58. DOI: 10.1016/j.wneu.2018.07.181
37. Paluzzi A., Gardner P.A., Fernandez-Miranda J.C. et al. "Round-the-Clock" surgical access to the orbit. J Neurol Surg B 2015;76(1):12–24. DOI: 10.1055/s-0033-1360580
38. Claró P., Choffor-Nchinda E., Lopez-Fortuny M. et al. Orbital cavernous haemangioma; profile and outcome of 76 patients managed surgically. Acta Otolaryngol 2019;139(8):720–5. DOI: 10.1080/00016489.2019.1618913
39. Zhang X., Hua W., Quan K. et al. Endoscopic endonasal intraconal approach for orbital tumor resection: case series and systematic review. Front Oncol 2022;11:780551. DOI: 10.3389/fonc.2021.780551
40. Dubal P.M., Svider P.F., Denis D. et al. Short-term outcomes of purely endoscopic endonasal resection of orbital tumors: a systematic review. Int Forum Allergy Rhinol 2014;4(12):1008–15. DOI: 10.1002/alr.21402

Authors' contributions
M.Sh. Amiralieva: development of the concept and design of the research, material search and processing, article writing;
I.V. Grigoriev, S.A. Melchenko, A.A. Kalandari: development of the concept and design of the research, management of patients, performing operations, material search and processing, article writing, editing of the article;
O.I. Patsap, M.B. Dolgushin, I.V. Senko: development of the concept and design of the research, editing of the article.

ORCID of authors
M.Sh. Amiralieva: https://orcid.org/0000-0002-9140-0645
I.V. Grigoriev: https://orcid.org/0000-0002-1320-5772
S.A. Melchenko: https://orcid.org/0000-0001-7060-0667
A.A. Kalandari: https://ocid.org/0000-0003-4161-0940
O.I. Patsap: https://orcid.org/0000-0003-4620-3922
M.B. Dolgushin: https://orcid.org/0000-0003-3930-5998
I.V. Senko: https://orcid.org/0000-0002-5743-8279

Conflict of interest. The authors declare no conflict of interest.

Funding. The work was performed without external funding.

Compliance with patient rights. The patients gave written informed consent to the publication of their data.

Article submitted: 13.01.2023. **Accepted for publication:** 19.11.2024. **Published online:** 15.04.2025.