Clinical Characteristics and Prognosis of Adult Orbital Cellulitis in a Tertiary General Hospital

Bangtao Yao  
NANJING LISHUI PEOPLE’S HOSPITAL

Yuhua Ding  
JIANGSU PROVINCE HOSPITAL

Xiaogui Zhao  
NANJING LISHUI PEOPLE’S HOSPITAL

Bei Wang  
NANJING LISHUI PEOPLE’S HOSPITAL

Gang Liu  
NANJING LISHUI PEOPLE’S HOSPITAL

Fei Wang ( wangfei_njmu@163.com )  
JIANGSU PROVINCE HOSPITAL  
https://orcid.org/0000-0003-0885-8178

Research article

Keywords: Orbital cellulitis, endophthalmitis, rhinosinusitis, endogenous infection, best-corrected visual acuity, prognosis

DOI: https://doi.org/10.21203/rs.3.rs-46703/v1

License: © This work is licensed under a Creative Commons Attribution 4.0 International License.  Read Full License
Abstract

Background: Adult orbital cellulitis (OC) occurs relatively rarely, and comprehensive studies that retrospectively evaluate OC are lacking. Here we aimed to examine the clinical characteristics and prognosis of OC in a tertiary general hospital.

Methods: Between October 2010 and May 2019, patients presenting with clinical symptoms of OC in a tertiary general hospital were analyzed in this retrospective study. Twenty-six cases were identified for a detailed review. In these cases, 16 males and 10 females were diagnosed with orbital cellulitis by clinical characteristics and multimodal examinations. We divided patients into three groups: (1) patients secondary to rhinosinusitis, (2) patients secondary to endogenous infection(s) without endophthalmitis, and (3) patients secondary to endophthalmitis. For each group, the age, gender, eye type, combined systemic diseases, clinical presentation, leukocyte count, blood culture, diagnostic imaging, therapeutic methods, length of stay, time of post-operation, and patient prognosis were analyzed in detail.

Results: There were no significant differences regarding age, gender, preoperative leukocyte count, exophthalmia, blood culture, treatment, or visual changes within the three groups (P>0.05). There were significant differences, however, in postoperative leukocyte count and ophthalmoplegia between the three groups (P<0.05). The preoperative and postoperative logarithm of the minimum resolution angle scored by the best-corrected visual acuity (LogMAR BCVA) of group 3 were statistically significant compared to group 1 and group 2 (P<0.05).

Conclusion: We confirmed that the prognosis of OC patients combined with systemic diseases was poor; the visual outcome of OC secondary to endophthalmitis was more serious than that, secondary to sinusitis or endogenous infection without endophthalmitis. The level of leukocytes may indicate the condition of the disease.

Background

Orbital cellulitis (OC) is an urgent and deadly inflammation of the orbital soft tissue. OC is more common in children and relatively rare in adults [1]. Patients often present with blepharedema, ptosis, exophthalmia, ocular pain, and visual impairment [2]. OC can spread to the adjacent tissue or the cavernous sinus, leading to cavernous sinus thrombophlebitis and endanger the patient’s life [3]. Computed tomography (CT) scans or magnetic resonance imaging (MRI) are the standard tools for diagnosing OC, defining the extent of the infection, and identifying the size and location of the orbital abscess [2, 4].

Several reports suggested that sinus inflammation, endophthalmitis, or endogenous infection metastasis could cause OC [5-7]. To the best of our knowledge, however, the available retrospective and comprehensive studies regarding the clinical characteristics and prognosis of adult OC in the literature are lacking. This article aims to describe the detailed clinical features and prognosis of adult OC in a tertiary general hospital over a 10-year period.

Methods

Study Design

This study was designed as a retrospective review of the medical records of 26 adult patients diagnosed with OC. The patients were admitted to a tertiary general hospital between October 2010 and May 2019. Children patients with OC were excluded from the review. Age, gender, eye type, combined systemic diseases, clinical presentation, leukocyte count, blood culture, CT or MRI, therapeutic methods, length of stay, time of post-operation and prognosis are all described in detail.

This study was designed and conducted in accordance with the Declaration of Helsinki and was submitted to the appropriate review board. All participating patients provided informed consent for this study.

Statistical Analysis

We collected data from the patients’ clinical records, and they were processed with SPSS (Statistical Package for Social Sciences, version 19.0, IBM). For categorical variables, Pearson’s χ² or Fisher’s exact test was used; for continuous variables, Kruskal-Wallis test was used. Two-tailed tests of significance were performed, and P values <0.05 were regarded as statistically significant.

Results

Demographics

The adult patients, 16 males and 10 females that were diagnosed with OC, had a median age of 48 years (range 32.75-66.50). All patients presented with OC in only one eye, with 14 cases that occurred in the right eye and 12 cases that occurred in the left eye. The patients were divided into three groups according to etiology: (1) patients secondary to rhinosinusitis, (2) patients secondary to endogenous infection(s) without endophthalmitis, and (3) patients secondary to endophthalmitis. In the six cases comprising group 1, the instances of OC were split evenly between the right and left eyes. Group 2 (n=3) included two right eye cases and one left eye case. Finally, in group 3 (n=17), nine and eight cases presented in the right and left eyes, respectively (Tables 1, 2, 3). There were no significant differences in age or gender among the three groups (P>0.05).

Clinical Presentation

Group 1 and group 2 patients presented with blepharedema and moderately reduced visual acuity. Group 1 had five cases with exophthalmia and five cases with ophthalmoplegia, while group 2 had two cases with exophthalmia and two cases with ophthalmoplegia, with one patient presenting with both (Tables 1,
The patients in group 3 presented with blepharedema and severe visual impairment: 11 cases with exophthalmia, 5 cases with ophthalmoplegia. The best-corrected visual acuity (BCVA) of 15 cases presented with no light perception (NLP), 1 case had LP, and 1 case had BCVA of 2/20 (Tables 3).

**Combined Systemic Diseases**

OC does not always present alone. Two cases were complicated with diabetes in group 1, and 1 case was secondary to T-cell lymphoma. In group 2, two cases were complicated with iron-deficiency anemia or secondary to acute lymphocytic leukemia. Five cases were caused by trauma in group 3. Furthermore, 3 cases were complicated with liver or cervical abscesses, and 10 cases were complicated with other systemic diseases including sepsis, diabetes, hypertension, organ failure, or hematopathy (Tables 1, 2, 3).

**Leukocyte Counts**

Routine blood examinations were performed on all patients, and leukocyte counts were analyzed. The normal value of leukocyte counts was 4.0-10.0×10⁶/uL. The leukocyte counts of 6 patients, 3 patients, and 16 patients were abnormal before the treatment in groups 1, 2, and 3, respectively. While after treatment, the leukocyte counts of 5 patients and 16 patients returned to normal in groups 1 and 3, respectively. However, the total leukocyte counts of 3 patients in group 2 remained abnormal consistently. (Table 1, 2, 3).

**Blood Cultures**

Blood cultures were obtained from all patients, the bacterial culture and fungal culture were both ordered in the blood culture, and three of them were positive. Two cases tested positive with *Klebsiella pneumoniae*, and one case showed positive with *Pseudomonas aeruginosa*. The fungal cultures were all negative. (Table 2, 3).

**CT or MRI**

Each patient received CT initially. MRI was performed in ten patients. (Table 1, 2, 3). CT scans revealed swollen orbital soft tissue, increased fat density, and opacification of the involved sinuses in the patients with sinusitis. Two cases presented bony destruction, and thickening of the associated muscles was present in eight cases. Optic nerve involvement was demonstrated in one case. In addition, we observed one case combined with cavernous sinus thrombophlebitis.

MRI revealed ill-defined infiltration of orbital fat. Only four cases demonstrated an extremely hyperintense signal representing orbital abscess formation when analyzed by diffusion-weighted imaging (DWI) and the corresponding hypointense signal on the apparent diffusion coefficient (ADC).

**Length of Stay**

In group 1, the mean hospital stay was 17.17±9.87 days, and the mean time to discharge after operation was 12.33±9.45 days. For group 2, the mean hospital stay was 19.33±3.06 days, and the mean time to discharge after operation was 2.00±3.46 days. Finally, in group 3, the mean hospital stay was 11.94±5.73 days with a mean time to discharge after operation of 5.71±3.80 days (Table 1, 2, 3).

**Therapeutic Methods and Prognosis**

All patients diagnosed with OC were treated with active treatments once admitted to the hospital, including systemic, topical antibiotics, and further therapeutic plans were made according to the patients' conditions.

Three cases in group 1 were treated with endoscopic sinus surgery, while another three cases were treated conservatively. Only one patient could not visualize hand motion at the time of hospitalization and had NLP at the time of discharge. In this case, we considered that inflammation spread to the optic nerve. One case in group 2 was treated with abscess incision, and the other two cases were treated with conservative treatment.

Six cases in group 3 were treated with intravitreal injection of vancomycin and cefazolin. Five and two cases were treated with the evisceration of eye contents and enucleation, respectively. Abscess incision treated two cases, and three cases were treated with conservative treatment. Unfortunately, all patients had a BCVA of NLP (Table 1, 2, 3).

Microbial cultures of the drained abscesses from three patients were performed, and *Klebsiella pneumoniae* was identified and cultured in one patient. In two patients, there was no growth reported.

**Group Comparisons**

There were no significant differences in preoperative leukocyte count, exophthalmia, blood culture, treatment, and visual changes among the three groups (P>0.05). There were significant differences in postoperative leukocyte count and ophthalmoplegia between the three groups (P<0.05). The preoperative and postoperative minimum resolution angle in logarithm best-corrected visual acuity (LogMAR BCVA) of group 3 were statistically significant compared with group 1 and group 2 (P<0.05) (Table 4, 5).

**Discussion**

OC can be divided into anterior orbital septum cellulitis and posterior orbital septum cellulitis [8]. A variety of reasons cause OC. Firstly, inflammation of ethmoid, maxillary, frontal, or sphenoid sinuses can lead to OC [5]. Secondly, reports indicate that endophthalmitis commonly causes OC [6]. Thirdly, some OC
patients had secondary endogenous infection metastasis [7]. Immunocompromised patients or in patients with systemic diseases, such as leukemia, T-cell lymphoma, sepsis, diabetes, OC more easily leads to endogenous and secondary infections [9].

OC resulting from rhinosinusitis occurs most frequently in children and rarely in adults [2]. Contradicting this finding, however, Siedek et al. found that 75% of rhinosinusitis-caused OC patients in their study were adults [5]. The anatomy of the sinus lies close to the orbit. As a result, sinus inflammation may spread directly to the orbit through the bone, or indirectly through the valveless venous plexus surrounding the orbit and the sinuses [10]. Spread through the ethmoid sinusitis was the most common because due to the thin ethmoid bone [2]. According to Stammberger's classification, OC is the most serious ocular complications, secondary to rhinosinusitis (stage IV) [11]. Reports suggested that stages I and II can be treated conservatively, while stages III and IV were recommended to receive surgery [5]. In our group 1 of all adult patients, five patients belonged to stage IV: 60% (n=3) of which were treated with endoscopic sinus surgery. Of those that received surgery, 66.7% (n=2) recovered, while one patient with T-cell lymphoma deteriorated.

OC also can be caused by endophthalmitis or panophthalmitis. While the underlying mechanism remains unclear, it is generally assumed that intraocular inflammation can spread to the periocular tissues, resulting in orbital cellulitis [6, 12]. Intraocular inflammation can spread to the periocular tissues, resulting in orbital cellulitis [6, 12]. In traumatic endophthalmitis, the wound may implant the pathogenic bacteria directly in the periocular or orbital tissues. By a similar mechanism, cataract, strabismus, or retinal detachment surgery can also lead to OC [13-15]. Endogenous endophthalmitis is especially prone to occur in immunocompromised patients or patients with severe systemic diseases. In these cases, the primary origins of the infection cannot be found [9].

Endophthalmitis patients with mild symptoms can be treated conservatively, but severe cases can be treated with intravitreal injection. In these instances, vancomycin and cefazolin have proven effective in controlling the inflammation [16]. If the disease still progresses, enucleation or evisceration surgery should be performed [17]. In our study, six cases in group 3 were treated with intravitreal injection (vancomycin and cefazolin), five cases were treated with evisceration of the eye contents, two cases were treated with enucleation, and three cases were treated conservatively. In total, 17 cases (100%) of OC with secondary endophthalmitis were effectively controlled. We considered that the OC secondary to endophthalmitis could be controlled if active treatments are given.

K. pneumoniae is a small, packaged, gram-negative bacterium, and secondary endophthalmitis complicated with a liver abscess is considered a clinical syndrome closely associated with diabetes in Asians [18-19]. In our study, two patients cultured positive for K. pneumoniae infection by blood culture. They were found with cervical abscesses and sepsis, however, which were not associated with liver abscesses. On the contrary, the blood cultures of the two liver abscess patients were negative with pathogenic bacteria.

The OC in only three patients was caused by endogenous infection without endophthalmitis. In these instances, one case was complicated with acute lymphocytic leukemia, and one situation was complicated with iron-deficiency anemia and ulcerative colitis. In the first patient, the blood cultured positive for P. aeruginosa, and the patient had complications with sepsis during the hospitalization period. Their condition deteriorated eventually even after timely treatment.

Routine blood tests showed evidence of an increase in leukocyte count in most OC patients [2]. In our study, comparisons among the three groups illustrated that postoperative leukocyte counts of patients in group 2 changed more dramatically than the other two groups. We also noticed that the incidence of ophthalmoplegia in group 3 was less than that of other groups, indicating that OC with secondary endophthalmitis rarely invaded extraocular muscles (29.4%). Furthermore, in comparing the preoperative and postoperative LogMAR BCVA among the three groups, we concluded that patients in group 3 had poorer visual outcomes than any other group because all patients ended up with the BCVA of NLP. Endophthalmitis is a severe disease that can result in serious visual impairment and even blindness. Therefore, we concluded that the poorer vision in group 3 is attributable to endophthalmitis.

In our study, bacterial and fungal blood cultures were performed. Three patients were positive with bacteria (11.5%), while the other patients were negative. Fungal infections are common in adult OC patients with diabetes [10]. However, in the present study, the results of fungal cultures were all negative, even in the patients combined with systemic diseases, such as diabetes, leukemia, T-cell lymphoma, sepsis. Similarly, in a study by Hsu J et al., blood cultures were the most frequently collected but were the least likely to be positive (17.6%) [20]. We speculated that the results were negative due to the antibiotic treatment prior to blood collection. In addition, leukocyte counts are still a suitable parameter for diagnosing infection. However, the relationship between the prognosis of infection and leukocyte has rarely described [21]. In our study, the routine blood tests showed evidence of elevated leukocyte count in all the patients except for 2; one complicated with acute lymphocytic leukemia, the other with T-cell lymphoma. The leukocyte counts returned to normal when the patients recovered. However, the counts of the two patients with acute lymphocytic leukemia and T-cell lymphoma remained abnormal. This finding is consistent with the deterioration of their disease, so we concluded that the leukocyte counts might indicate the recovery or deterioration of the disease.

There were several limitations to this study. Firstly, this retrospective study had a small sample size. Secondly, the patient had been treated with antibiotics at the time of blood culture collection. As a result, the positive rate is relatively low. Thirdly, the patients included were all adults, so this study is unable to describe the differences in clinical characteristics and prognosis between adults and children with OC.

**Conclusion**

We confirmed that the OC could be well controlled if timely treatments are given. The prognosis of orbital cellulitis patients combined with severe systemic diseases, however, was generally poor. While patients with orbital cellulitis secondary to endophthalmitis infrequently experience ophthalmoplegia; these patients still have poor visual outcomes. Furthermore, the leukocyte levels may indicate the condition of the disease. More data by multiple centers are required to understand the clinical characteristics and prognosis of OC better.

**Abbreviations**
BCVA: best-corrected visual acuity, CT: Computed tomography, LogMAR: minimum resolution angle in logarithm, MRI: magnetic resonance imaging, NLP: no light perception, OC: orbital cellulitis.

**Declarations**

**Ethics approval and consent to participate**

Approval was obtained from the ethics committee of Jiangsu Province Hospital, and informed written consent had been obtained from the patients.

**Consent for publication**

Not applicable

**Availability of data and materials**

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

**Competing interests**

The authors declare that they have no competing interests.

**Funding**

Not applicable.

**Authors’ contributions**

BTY collected the data of the patient and wrote the manuscript; YHD consulted literatures and edited the manuscript; XGZ analyzed the data; BW dealt with the tables, GL and FW established the diagnosis and reviewed the manuscript. All authors read and approved the nal manuscript.

**Acknowledgements**

Not applicable.

**References**

1. Sciarretta V, Demattè M, Fametti P, Fornaciari M, Corsini I, Piccin O, Saggese D, Fernandez LJ. Management of orbital cellulitis and subperiosteal orbital abscess in pediatric patients: A ten-year review. *Int J Pediatr Otorhinolaryngol*. 2017;96:72-6.

2. Tsirouki T, Dastridou AI, Ibáñez Flores N, Cerpa JC, Moschos MM, Brazitikos P, Androudi S. Orbital cellulitis. *Surv Ophthalmol.* 2018;63(4):534-53

3. Gupta R, Patadia D, Velayudhan V, Buchnea D. Orbital cellulitis, cavernous sinus thrombosis, internal jugular vein thrombus, and clival osteomyelitis secondary to acute sinusitis. *Am J Respir Crit Care Med.* 2017;195(4):533-5

4. Jabarin B, Eviatar E, Israel O, Marom T, Gavriel H. Indicators for imaging in peri-orbital cellulitis secondary to rhinosinusitis. *Eur Arch Otorhinolaryngol.* 2010;267(12):1881-6.

5. Siedek V, Kremer A, Betz CS, Tschiesner U, Berghaus A, Leunig A. Management of orbital complications due to rhinosinusitis. *Eur Arch Otorhinolaryngol.* 2010;267(12):1881-6.

6. Decock C, Claerhout I, Kestelyn P, Van Aken EH. Orbital cellulitis as complication of endophthalmitis after cataract surgery. *J Cataract Refract Surg.* 2010;36(4):673-5

7. Hornblass A, To K, Coden DJ, Ahn-Lee S. Endogenous orbital cellulitis and endogenous endophthalmitis in subacute bacterial endocarditis. *Am J Ophthalmol.* 1989;108(2):196-7.

8. Ivanšević M, Ivanšević P, Lešin M. Epidemiological characteristics of orbital cellulitis among adult population in the Split region, Croatia. *Wien Klin Wochenschr.* 2019;131(9-10):205-8

9. Collazos J, de la Fuente B, García A, Gómez H, Menéndez C, Enríquez H, et al. Cellulitis in adult patients: A large, multicenter, observational, prospective study of 606 episodes and analysis of the factors related to the response to treatment. *PLoS One.* 2018;13(9): e0204036.

10. Gupta S, Goyal R, Gupta RK. Clinical Presentation and outcome of the orbital complications due to acute infective rhino sinusitis. *Indian J Otolaryngol Head Neck Surg.* 2013; 65(Suppl 2): 431–4

11. Stammberger H. Complications of inflammatory paranasal sinus diseases including iatrogenically-induced complications. *Eur Arch Otorhinolaryngol Suppl.* 1993; 1:61-102.

12. Guedira G, Taright N, Blin H, Fattoum T, Leroy J, El Samad Y, Milazzo S, Hamdad F. Clostridium perfringens panophthalmitis and orbital cellulitis: a case report. *BMC Ophthalmol.* 2018;18(1):88

13. Kim EC, Kim MS, Kang NY. Fungal corneal ulcer and bacterial orbital cellulitis occur as complications of bacterial endophthalmitis after cataract surgery in an immunocompetent patient. *Semin Ophthalmol.* 2013;28(2):75-8.

14. Decock C, Claerhout I, Kestelyn P, Van Aken EH. Orbital cellulitis as complication of endophthalmitis after cataract surgery. *J Cataract Refract Surg.* 2010;36(4):673-5
15. Kim JM, Megalla M, Howard M, Sinard J, Pointdujour-Lim R. Orbital cellulitis with choroidal detachment following strabismus surgery in an adult. J AAPOS. 2018;22(6):477-80.

16. Nentwich MM, Yactayo-Miranda Y, Schwarzbach F, Wolf A, Kampik A, Mino de Kaspar H. Endophthalmitis after intravitreal injection: decreasing incidence and clinical outcome-8-year results from a tertiary ophthalmic referral center. Retina. 2014;34(5):943-50.

17. Lee KM, Han SC, Ho SY, Kim JT, Kim YH. Blindness resulting from orbital cellulitis following rhinoplasty. J Plast Reconstr Aesthet Surg. 201;66(5): e129-32.

18. Yen CH, Wu SY, Liao YL. Klebsiella pneumoniae Orbital Cellulitis: Clinical manifestations and outcomes in a tertiary medical center in Taiwan. J Ophthalmol. 2018;2018:4237573.

19. Davies BW, Fante RG. Concurrent endophthalmitis and orbital cellulitis from metastatic klebsiella pneumonia liver abscess. Ophthalmic Plast Reconstr Surg. 2016;32(5): e118-9.

20. Hsu J, Treister AD, Ralay Ranaivo H, Rowley AH, Rahmani B. Microbiology of pediatric orbital cellulitis and trends in methicillin-resistant staphylococcus aureus cases. Clin Pediatr (Phila). 2019;58(10):1056-62.

21. Lavoignet CE, Le Borgne P, Chabrier S, et al. White blood cell count and eosinopenia as valuable tools for the diagnosis of bacterial infections in the ED. Eur J Clin Microbiol Infect Dis. 2019;38(8):1523-32.

Tables

Table 1. Clinical data of 6 patients secondary to rhinosinusitis.

| Laterality | Sinuses involved | Clinical presentation | Systemic diseases | Leukocyte count (Initial vs Final) | Blood culture | CT or MRI | Treatment |
|------------|------------------|-----------------------|-------------------|-----------------------------------|---------------|-----------|-----------|
| OD         | Ethmoid, sphenoid, maxillary | Blepharedema, ophthalmoplegia, exophthalmia | T-cell lymphoma | 1.5-2.6 | Negative | CT MRI | endoscopic sinus surgery |
| OS         | Ethmoid, Maxillary | Blepharedema, ophthalmoplegia, exophthalmia | Diabetes Hypertension | 13.5-7.86 | Negative | CT MRI | endoscopic sinus surgery |
| OS         | Ethmoid, Maxillary frontal | Blepharedema, ophthalmoplegia, exophthalmia | N/A | 12.7-7.54 | Negative | CT MRI | endoscopic sinus surgery |
| OD         | Ethmoid, Maxillary | Blepharedema, | N/A | 11.5-5.6 | Negative | CT | conservative |
| OD         | Ethmoid, Maxillary frontal | Blepharedema, ophthalmoplegia exophthalmia | Diabetes | 10.81-8.5 | Negative | CT | conservative |
| OS         | sphenoid | Blepharedema, ophthalmoplegia, exophthalmia | cavernous sinus thrombophlebitis | 3.2-6.9 | Negative | CT MRI | conservative |

NLP: No light perception; BCVA: Best-corrected visual acuity; N/A: Not applicable; COPD: Chronic obstructive pulmonary disease; CT: Computed tomography; MRI: Magnetic resonance imaging; HM: Hand motion.

Table 2. Clinical data of 3 patients secondary to endogenous infection(s) without endophthalmitis.
| No | Laterality | Clinical presentation | Systemic diseases | Leukocyte count (Initial vs Final) | Blood culture | CT or MRI | Treatment | Length of stay (days) | Time of post-operation (days) | Initial BCVA | Final BCVA | P |
|----|------------|-----------------------|-------------------|-----------------------------------|---------------|---------|-----------|---------------------|-----------------------------|-------------|------------|---|
| 1  | OD         | Blepharedema, ophthalmplegia, exophthalmia | Iron-deficiency anemia | 22.85-10.54 | Negative | CT MRI | Abscess incision | 22 | 6 | 20/100 | 20/60 | R |
| 2  | OS         | Blepharedema | Rheumatism | 11.16-10.57 | Negative | CT | Conservative | 16 | N/A | 20/20 | 20/20 | R |
| 3  | OD         | Blepharedema, ophthalmplegia, exophthalmia | Acute lymphocytic leukemia, Sepsis | 1.64-0.24 | Pseudomonas aeruginosa | CT MRI | Conservative | 20 | N/A | 20/40 | 20/60 | D |

BCVA: Best-corrected visual acuity; N/A: Not applicable; CT: Computed tomography; MRI: Magnetic resonance imaging.

Table 3. Clinical data of 17 patients secondary to endophthalmitis.
| No | Laterality | Etiology | Clinical presentation | Systemic diseases | Leukocyte count (Initial vs Final) | Blood culture | CT or MRI | Treatment | Length of stay (days) | Time of post-operation (days) | In Vf |
|----|------------|----------|-----------------------|-------------------|----------------------------------|---------------|-----------|-----------|----------------------|-------------------------------|-------|
| 1  | OD         | Traumatic| Blepharedema, ophthalmoplegia, exophthalmia | N/A | 10.85-6.64 | Negative | CT | Intravitreal injection(twice) | 9 | 4 | Nl |
| 2  | OD         | Endogenous| Blepharedema, exophthalmia | Diabetes | 13.8-8.6 | Negative | CT | Intravitreal injection(twice) | 28 | 12 | LF |
| 3  | OD         | After cataract surgery| Blepharedema, ophthalmoplegia, exophthalmia | Pulmonary embolism | 12.7-5.93 | Negative | CT | evisceration of eye contents | 7 | 7 | Nl |
| 4  | OS         | Endogenous| Blepharedema exophthalmia | Diabetes Hypertension Uremia | 12.1-9.98 | Negative | CT | evisceration of eye contents | 12 | 6 | Nl |
| 5  | OS         | Traumatic| Blepharedema, exophthalmia | Hypertension | 10.09-4.70 | Negative | CT MRI | evisceration of eye contents | 12 | 7 | Nl |
| 6  | OD         | Traumatic| Blepharedema, exophthalmia | N/A | 14.85-5.6 | Negative | CT | Intravitreal injection(once) | 10 | 10 | Nl |
| 7  | OS         | Corneal perforation| Blepharedema | N/A | 10.18-6.2 | Negative | CT | enucleation | 12 | 4 | Nl |
| 8  | OD         | Traumatic| Blepharedema | N/A | 23.08-13.7 | Negative | CT MRI | Intravitreal injection(once) | 16 | 12 | ZC |
| 9  | OD         | Endogenous| Blepharedema, exophthalmia | Diabetes Hypertension Cervical abscess | 12.5-8.7 | Klebsiella pneumoniae | CT MRI | Abscess incision, Vitrectomy, Intravitreal injection | 19 | 4 | Nl |
| 10 | OS         | Endogenous| Blepharedema, ophthalmoplegia, exophthalmia | Pulmonary encephalopathy | 15.4-8.25 | Negative | CT | evisceration of eye contents | 6 | 4 | Nl |
| 11 | OS         | Endogenous| Blepharedema, exophthalmia | N/A | 9.1-7.4 | Negative | CT | Vitrectomy | 9 | 7 | Nl |
| 12 | OD         | Endogenous| Blepharedema, ophthalmoplegia, exophthalmia | COPD Hypertension | 17.4-8.46 | Negative | CT MRI | Abscess incision | 5 | 5 | Nl |
| 13 | OS         | Endogenous| Blepharedema, ophthalmoplegia, exophthalmia | Liver abscess | 21.84-7.8 | Negative | CT | enucleation | 17 | 10 | Nl |
| 14 | OD         | Traumatic| Blepharedema | N/A | 12.46-8.21 | Negative | CT | evisceration of eye contents | 10 | 5 | Nl |
| 15 | OS         | Endogenous| Blepharedema | Liver abscess Hypertension cerebral infarction | 12.92-9.0 | Negative | CT | Conservative | 9 | N/A | Nl |
| 16 | OS         | Endogenous| Blepharedema | Sepsis Hypertension | 13.05-8.91 | Klebsiella pneumoniae | CT | Conservative | 15 | N/A | Nl |
| 17 | OD         | Corneal perforation| Blepharedema | N/A | 12.6-6.94 | Negative | CT MRI | Conservative | 7 | N/A | Nl |

NLP: No light perception; BCVA: Best-corrected visual acuity; N/A: Not applicable; COPD: Chronic obstructive pulmonary disease; CT: Computed tomography;
### Table 4. Demographics and clinical presentation of 26 patients.

| Group | No | Age (years) | Gender | Ophthalmoplegia | Exophthalmia | Leukocyte counts | Blood culture |
|-------|----|-------------|--------|----------------|--------------|------------------|--------------|
|       |    | 18-45       | Male   | Yes            | No           | Normal           | Normal       |
|       |    | 46-59       | Female | Yes            | No           | Abnormal         | Abnormal     |
|       |    | >60         |        |                |              |                  |              |
| 1     | 6  | 3           | 1      | 2              | 4            | 5                | 1            |
| 2     | 3  | 2           | 1      | 0              | 2            | 1                | 2            |
| 3     | 17 | 7           | 0      | 10             | 12           | 5                | 12           |

|                   | Initial | Final |
|                   | Normal  | Abnormal |
|                   | Normal  | Abnormal |

|                   | Positive | Neg |
|                   | 0.136    | 0.231 |
|                   | 0.047    | 0.822 |
|                   | 1.000    | 0.003 |
|                   | 0.425    |      |

P value

|                   | 0.136    | 0.231 |
|                   | 0.047    | 0.822 |
|                   | 1.000    | 0.003 |
|                   | 0.425    |      |

BCVA: best-corrected visual acuity.

### Table 5 The BCVA and length of stay of 26 patients.
| Group | Cases | No | Initial BCVA | Final BCVA | Length of stay (days) | Time of post-operation (days) |
|-------|-------|----|--------------|------------|-----------------------|-----------------------------|
| 1     | 6     | 1  | 20/40        | 20/100     | 32                    | 23                          |
|       |       | 2  | HM           | NLP        | 23                    | 5                           |
|       |       | 3  | 20/50        | 20/50      | 10                    | 9                           |
|       |       | 4  | 20/60        | 20/60      | 4                     | N/A                         |
|       |       | 5  | 20/20        | 20/20      | 15                    | N/A                         |
|       |       | 6  | 20/100       | 20/60      | 19                    | N/A                         |
| 2     | 3     | 7  | 20/100       | 20/60      | 22                    | 6                           |
|       |       | 8  | 20/20        | 20/20      | 16                    | N/A                         |
|       |       | 9  | 20/40        | 20/60      | 20                    | N/A                         |
| 3     | 17    | 10 | NLP          | NLP        | 9                     | 4                           |
|       |       | 11 | LP           | NLP        | 28                    | 12                          |
|       |       | 12 | NLP          | NLP        | 7                     | 7                           |
|       |       | 13 | NLP          | NLP        | 12                    | 6                           |
|       |       | 14 | NLP          | NLP        | 12                    | 7                           |
|       |       | 15 | NLP          | NLP        | 10                    | 10                          |
|       |       | 16 | NLP          | NLP        | 12                    | 4                           |
|       |       | 17 | 20/200       | NLP        | 16                    | 12                          |
|       |       | 18 | NLP          | NLP        | 19                    | 4                           |
|       |       | 19 | NLP          | NLP        | 6                     | 4                           |
|       |       | 20 | NLP          | NLP        | 9                     | 7                           |
|       |       | 21 | NLP          | NLP        | 5                     | 5                           |
|       |       | 22 | NLP          | NLP        | 17                    | 10                          |
|       |       | 23 | NLP          | NLP        | 10                    | 5                           |
|       |       | 24 | NLP          | NLP        | 9                     | N/A                         |
|       |       | 25 | NLP          | NLP        | 15                    | N/A                         |
|       |       | 26 | NLP          | NLP        | 7                     | N/A                         |

**P value**

| 1 VS 2: 1.000 | 1 VS 2: 1.000 |
| 1 VS 3: 0.000 | 1 VS 3: 0.000 |
| 2 VS 3: 0.006 | 2 VS 3: 0.005 |

NLP: no light perception; BCVA: best-corrected visual acuity; N/A: not applicable.