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Prognostic factors in severely traumatized eyes with posterior segment involvement

Arka segment tutulumlu ciddi göz travmalarında prognostik faktörler

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BACKGROUND
To determine the prognostic indicators of functional outcome in eyes with severe posterior segment trauma managed with pars plana vitrectomy.

METHODS
One hundred and six eyes of 101 patients were retrospectively reviewed to determine the accuracy of a number of factors in predicting functional outcome after surgery. These potential prognostic indicators included initial visual acuity (VA), retinal detachment (RD), type of trauma, presence of intraocular foreign body (IOFB), type of IOFB, posttraumatic endophthalmitis, hyphema, choroidal detachment, initial hypotonia, accompanying lens subluxation/dislocation, and severe vitreous hemorrhage. In our study, functional success was defined as VA ≥5/200. Fisher's exact and chi-square tests were used for statistical analysis.

RESULTS
The mean follow-up time was 12.8±0.52 (8-18) months. Thirty-three eyes (31.13%) had functional success. Forty-four (68.7%) of 64 eyes with preoperative RD had anatomical success (total retinal reattachment). Predictors of poor visual outcome (VA ≤5/200) were found to be poor initial VA ($p<0.0001$), presence of RD ($p<0.001$), and presence of endophthalmitis ($p<0.05$). No statistically significant correlation was found between the other predictors surveyed and visual outcome ($p>0.05$).

CONCLUSION
Vitreoretinal surgery can improve anatomical and functional success in eyes with severe posterior segment trauma. Poor initial VA, RD, and posttraumatic endophthalmitis are poor predictors of visual outcome.

Key Words: Ocular trauma; pars plana vitrectomy; prognostic factors; visual outcome.

AMAÇ
Pars plana vitrektomi ile tedavi edilen, arka segmenti içeren şiddetli göz yaralanmalarında fonksiyonel sonuçlara etki eden prognostik etkenler değerlendirildi.

GEREÇ VE YÖNTEM
Cerrahi sonrası fonksiyonel sonucu belirleyen faktörlerin sayısını belirlemek için 101 hastanın 106 gözü geriye dönük olarak değerlendirildi. Bu olası prognostik faktörler şöyleydi: Başlangıç görme keskinliği, retina dekolmanı, travma tipi, göz içi yabancı cisim varlığı ve tipi, travma sonrası endoftalmi, hifema, koroid dekolmanı, başlangıç hipotonisi, eşlik eden lens disloksasyonu veya subluksasyonu ve yoğun vitre içi kanama. Çalışmamızda görme keskinliğinin 5/200'den büyük ya da eşit olması fonksiyonel başarı olarak kabul edildi. İstatistiksel analiz için Fischer kesin ve ki-kare testleri kullanıldı.

BULGULAR
Ortalama takip süresi 12,8±0,52 ay (dağılım 8-18) idi. Otuz üç gözde (%31,33) fonksiyonel başarı sağlandı. Ameliyat öncesi retina dekolmanı olan 64 gözün 44 tanesinde (%68,7) anatomik başarı (total retinal yapışıklık) sağlandı. Kötü görme prognozuna (≤5/200) neden olan belirleyici faktörler; düşük başlangıç görme keskinliği ($p<0,0001$), retina dekolmanı varlığı ($p<0,001$) ve travmaya bağlı endoftalmi varlığı ($p<0,05$) olarak saptandı. Diğer olası belirleyici faktörlerle sonuç görmeleri arasında istatistiksel olarak anlamlı korelasyon bulunamadı ($p>0,05$).

SONUÇ
Vitreoretinal cerrahi ile ağır arka segment travması olan gözlerde anatomik ve fonksiyonel başarı artırılabilir. Başlangıçtaki düşük görme keskinliği, retina dekolmanı ve postravmatik endoftalmi kötü prognostik faktörlerdir.

Anahtar Sözcükler: Oküler travma; pars plana vitrektomi; prognostik faktörler, görsel sonuçlar.

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Ocular trauma is the leading cause of blindness in children and young adults, and a significant cause of blindness in older individuals.[1] Approximately 75% of people with trauma-induced visual impairment are monocularly blind.[2] Previous studies have described various[3-5] aspects of penetrating ocular traumas, including demographics, prognostic variables,[6-8] histologic characteristics[9,10] and the role of vitrectomy.[11-17]

In this retrospective study, we evaluated the predictors that affect final visual acuity in eyes with severe posterior segment trauma.

MATERIALS AND METHODS

Records of 106 eyes of 101 patients with severe posterior segment trauma who underwent vitreoretinal surgery (VRS) in Beyoglu Eye Education and Research Hospital between April 2001-April 2003 were retrospectively reviewed to determine which predictors would affect final visual outcome. Demographic and clinical features of patients including age, sex, the eye involved, ocular history, type of injury, and ocular findings like initial visual acuity (VA), presence of intraocular foreign body (IOFB), posttraumatic endophthalmitis, retinal detachment (RD), choroidal detachment (CD), hyphema, initial hypotonia, lens injury, vitreous hemorrhage, type of IOFB (metallic or nonmetallic), follow-up time, final VA, and the results of imaging studies (B-scan USG, CT) were obtained. Only eyes with a minimum follow-up time of six months were included in this study. Data recording the anatomical and functional status of the eye prior to initial management were summarized on the basis of findings recorded during the initial examination and at the time of the primary surgery when applicable.

In accordance with the Birmingham Eye Trauma[18] Terminology (BETT) proposed classification scheme, injuries were defined as follows:

1. Contusion: No full-thickness wound of the eyeball.

2. Rupture: A full-thickness injury caused by a blunt object that increased intraocular pressure.

3. Penetrating injury: Single, full-thickness wound of the eye wall, usually by a sharp object.

4. Perforating injury: Two (entrance and exit) wounds caused by the same object.

5. IOFB injury: Retained foreign objects causing lacerations. Open globe injuries refer to rupture, penetrating, perforating injuries and IOFB.

We used Ryan and Allen's[19] definition of anatomical success in our analysis of results. This was defined as successful reconstruction of the globe without VA meeting the criteria for functional improvement for reasons other than successful surgery. Functional success was defined as postoperative final VA equal to or greater than 5/200. The indications of pars plana vitrectomy (PPV) in this series were to remove damaged lens material, remove vitreous hemorrhage, relieve vitreous traction on the retina and the resultant RD, and to treat posttraumatic endophthalmitis to achieve the anatomical goals. The physiological goal was to remove the vitreous blood, which appears to act as a powerful stimulant for intraocular proliferation and scarring.

Surgical techniques

Surgical intervention varied depending on the kind of involvement, but certain general principals were followed. With the exception of the patients who initially presented with posttraumatic endophthalmitis and disrupted, displaced lens material, or IOFB, vitrectomy was delayed from 4 to 10 days. The lens was salvaged if possible, but pars plana lensectomy (PPL) was performed in eyes with lens opacity or subluxation/dislocation. A core vitrectomy was performed to remove media opacity, and posterior hyaloid was stripped from the retinal surface in eyes without posterior hyaloid separation. The vitreous base was trimmed as thoroughly as possible in conjunction with scleral indentation. There was a general tendency to place a scleral buckle when the anatomical status of the traumatized eye did not permit complete removal of the vitreous base. Retinal breaks were treated with cryopexy or photocoagulation delivered with endolaser.

The effects of the following intraocular factors on the final visual results were studied:

1. Initial visual acuity
2. Type of trauma
3. Retinal detachment
4. Posttraumatic endophthalmitis
5. Hyphema
6. Choroidal detachment
7. Initial hypotonia
8. Severe vitreous hemorrhage
9. Lens subluxation/dislocation

10. Presence of IOFB

11. Type of IOFB

Fisher's exact and chi-square tests were used to determine the functional success. The results were considered to be statistically significant if p value was ≤0.05.

RESULTS

The mean age of the 101 patients was 35.6±0.03 (1.5-88) years. Eighty-one patients were male and 20 were female (Right/Left: 51/55). The patients were followed for a mean period of 12.8±0.52 (8-18 m) months. Cataract surgery had been performed in one eye 10 years ago; otherwise, there was no specific ocular history.

Preoperative diagnoses were RD in 64 eyes (59.3%), hypotonia in 47 eyes (43.5%), vitreous hemorrhage in 40 eyes (37%), traumatic cataract in 27 eyes (25%), hyphema in 16 eyes (14.8%), CD in 12 eyes (11%), lens dislocation/subluxation in 10 eyes (8.95%), IOFB in 26 eyes (24%), and endophthalmitis in 14 eyes (13%). In our study, all eyes underwent three port PPVs (Table 1). PPL was performed in 42 eyes, and in 72 eyes scleral buckle was used to encircle the eye, creating a buckle of moderate height; anterior sutures were placed 2 mm posterior to the ora serrata. IOFB extraction was performed in 26 eyes using foreign body forceps. Temporary keratoprosthesis and corneal graft (performed in the same session) were used in one eye with severe corneal haze. Prolonged intraocular gas tamponade was performed. Either sulfur hexafluoride (SF6)/perfluoropropane (C3F8) in 37 eyes (34%) or silicone oil in 76 eyes (70%) was used. Types of injury in 106 eyes included contusion in 13 eyes (12.26%), penetrating injury in 46 eyes (42.6%), perforating injury in 11 eyes (10.2%), rupture in 7 eyes (6.4%), IOFB in 26 eyes (24%), and mixed (2.7%) in 3 eyes; IOFB was metallic in 19 eyes (73%) and non-metallic in 7 eyes (27%). Initial VA was less than 5/200 in 88 eyes (83.01%) (Table 2).

Anatomical success

In 44 of 64 eyes (68.75%) with preoperative RD, retinas remained completely attached. In five severely injured eyes, which were considered to have a very poor prognosis, evisceration was performed when the eyes were determined to be unsalvageable during PPV. At the last examination, two eyes (3.2%) were phthisic. Thirteen eyes (20.3%) were partially or totally detached.

Functional success

Visual acuity was 5/200 or better in 16 eyes (14.8%) preoperatively (Table 2). After PPV, 33 (31.13%) eyes had 5/200 or better VA. Only 6 eyes (5.6%) had no light perception after VRS and 5 of them were eviscerated. We found that initial VA was

Table 1. Surgical interventions

Surgical intervention	n (%)
Pars plana vitrectomy	154
Scleral buckling	77 (71%)
IOL implantation	12 (11%)
IOL explantation	5 (4.5%)
Pars plana lensectomy	42 (39.6%)
IOFB removal	26 (24%)
Relaxing retinotomy	50 (46%)
Iris restoration	11 (10%)
Silicone oil	76 (70%)
Long-acting gas	37 (34%)
Keratoplasty/keratoprosthesis	1 (1%)
Evisceration	5 (4.5%)

IOL: Intraocular lens; IOFB: Intraocular foreign body.

Table 2. Preoperative and postoperative visual acuities (VA)

VA	Preop VA n (%)	Postop VA n (%)
≥ 20/40	7 (6.6%)	9 (8.5%)
20/100 < VA ≤ 20/50	5 (4.7%)	12 (11.3%)
5/200 < VA ≤ 19/100	4 (3.8%)	12 (11.3%)
LP(+) ≤ VA ≤ 4/200	88 (83.01%)	67 (63.2%)
LP(-)	–	6 (5.6%)
Not obtained	2 (1.88%)	2 (1.88%)

HM: Hand motion; LP: Light perception.

Table 3. Predictor for postoperative functional outcome

Predictors	No (%)	p
Initial visual acuity (VA <5/200)	16 (15.1%)	p<0.0001
Traumatic cataract	27 (25%)	p>0.05
Retinal detachment	64 (59.3%)	p<0.001
Posttraumatic endophthalmitis	14 (13%)	p<0.05
Hyphema	16 (14.8%)	p>0.05
Choroidal detachment	12 (11%)	p>0.05
Initial hypotonia (≤5 mmHg)	47 (43.5%)	p>0.05
Severe vitreous hemorrhage	40 (37%)	p>0.05
Lens dislocation/subluxation	10 (8.9%)	p>0.05
IOFB	26 (24%)	p>0.05
Type of IOFB	–	p>0.05

IOFB: Intraocular foreign body.

a statistically significant predictor of functional success ($p<0.0001$) (Table 3).

Retinal detachment, which was present in 64 (59.3%) eyes in this series, was successfully repaired with VRS in 44 (68.7%) eyes. We found traumatic RD to be a statistically significant poor predictor of functional success ($p<0.001$).

Endophthalmitis, which is usually an uncommon finding, was present in 14 eyes (13%) in this study, and it was found to be a statistically significant poor predictor ($p<0.05$) of functional success. Of 14 endophthalmitic eyes, we were able to save 11 eyes (78.5%). Final VA was ≥5/200 in only 3 eyes. Three eyes, which had no light perception, were eviscerated to minimize the risk of sympathetic ophthalmia. Two eyes became phthisic.

In this series, 154 PPVs were performed for the treatment of posterior segment injuries. We found that type of trauma, preoperative hyphema, hypotonia, vitreous hemorrhage, CD, lens dislocation/subluxation, IOFB and type of IOFB were statistically insignificant predictors ($p>0.05$ for all factors) of functional success.

DISCUSSION

One important aspect of the evaluation of the results of vitrectomy in traumatized eyes is the detection of predictors that influence the prognosis. Some authors[12,20-25] have studied the results of vitrectomy in their reports, attempting to determine the factors that predict the outcome in these eyes. In this report, we confined our analysis to only severely injured eyes to assess the predictors for final visual outcome after open or closed injury.

Visual acuity before surgery has been described as the strongest predictor of visual outcome by some authors.[6,7,22,25,26] In our series, eyes with better VA before surgery tended to obtain good VA after the surgery.

The development of RD in open globe injuries is a poor predictor.[12,14,21,23,27-29] However, it is not common to display RD immediately after open globe injuries. Instead, as described by Cleary and Ryan,[17] traumatic RD is often the result of fibrous and fibrovascular proliferation along vitreous scaffolding, with resultant tractional RD occurring weeks to months after injury. In our study, we found that the presence of preoperative RD is a statistically significant predictor of poor visual outcome.

Traumatic endophthalmitis is a devastating consequence of open globe injuries.[29-39] The incidence of endophthalmitis after open globe injury is 5-14%.[36-38] The relatively poor prognostic value of traumatic endophthalmitis is based on several factors: 1) the high frequency of more virulent microorganisms than those in postoperative cases, 2) associated trauma, 3) frequent delay in diagnosis, and 4) frequent delay in initiation of treatment.[25,29-37] Endophthalmitis may develop 24-72 hours after open globe injury and may not be present at the time of initial examination. Clinical signs and symptoms of endophthalmitis may be masked by the anatomic changes of the injury itself.[40] In our series, the incidence of endophthalmitis was 13%, and we found the presence of preoperative traumatic endophthalmitis to be a statistically significant predictor of poor functional and anatomical outcome.

In our study, vitreous hemorrhage alone had no negative effect on visual outcome. In previous studies,[6,12,17,20,22,27,35,41-44] severe vitreous hemorrhage was reported to be a predictor of poor visual outcome and associated with IOFB and tractional detachment of retina.[17,41-43] In our study, the presence of preoperative vitreous hemorrhage was not a statistically significant predictor of visual outcome.

Brinton et al.[12] found that the presence of IOFB was a more reliable prognosticator of VA; others[6,21] have determined that the presence of IOFB did not affect the visual prognosis when compared to cases with no foreign body. Ahmadieh et al.[26] found that IOFB was a poor predictor of visual outcome. IOFBs located in the lens, vitreous, or pars plana are associated with better visual outcome than those located in the retina or choroid. In addition, removal of a foreign body located in the retina is technically difficult and has a high risk of retinal break formation and subsequent RD.[45] Our series revealed that the presence or type of IOFB has no prognostic value regarding visual outcome.

When we considered the type and mechanism of trauma, we found that contusion, rupture of the globe, and perforating injuries have statistically significantly poor prognostic success.[6,21] Experimental studies[17,46,47] explained the reason for the devastating course in those eyes. Immediate condensation of the vitreous occurs across the vitreous cavity from the entrance site to the exit wound, rapidly followed by cellular proliferation. Combined tractional and rhegmatogenous RD occurs later. Some experimental

and clinical studies[6,14,22] have shown the beneficial effect of vitrectomy in such eyes. Ramsay et al.[22] demonstrated that surgical success in cases of perforating injury was related to the ability of the surgeon to isolate and totally excise the vitreous strands from the exit wound. In our study, we could not find a statistical correlation between the type of trauma and visual outcome; however, rupture and perforating injuries had poorer prognostic accuracy regarding clinical outcome. We considered the possibility that a statistical correlation may not have been obtained because the spectrum of our cases was not homogeneous.

Hyphema was found to be a poor predictor by some authors.[38,48] Chiquet et al.[49] revealed that hyphema was not correlated with poor visual outcome. In our study, we also found that hyphema is a poor predictor of visual outcome.

De Juan et al.[6] demonstrated that the prognosis was not statistically different whether the lens was clear or cataractous at initial examination. We also found that traumatic cataract is not a predictor of visual outcome.

The prognosis was significantly worse if the lens was expelled through the corneal or scleral wound or was associated with retinal injury. In our study, lens dislocation/subluxation was not found to be a predictor of visual outcome. However, in our cases with lens dislocation/subluxation, no associated rupture or lens expulsion through the wound was present.

In our study, only 12 eyes had CD, which was not found to be a significant predictor of visual outcome. Nevertheless, we have to keep in mind that the number of cases with CD was small. A statistically significant result may have been found if our sample had been larger.

In this retrospective study, poor initial VA, the presence of RD, and traumatic endophthalmitis were found to be correlated with poor visual outcome. Larger series are needed for more accurate results.

In conclusion, as a result of our findings, the surgeon should consider initial VA, the presence of RD and endophthalmitis as predictors of postoperative functional outcome when counselling patients and their families before obtaining consent for primary repair of penetrating ocular injuries. It may be necessary in some cases to inform the family about the intraoperative findings if the extent of the wound can not be determined before the surgical exploration. Establishment of guidelines based on ocular function and survival will help the ophthalmologist in determining the visual prognosis and selecting an appropriate course of action.

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