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POST-TRAUMATIC PARS PLANA VITRECTOMY
Indications, Timing of Surgery and Outcomes

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ABSTRACT • Objective : To improve vision prognosis after ocular trauma by evaluating the indications for pars plana vitrectomy (PPV), the appropriate timing for surgery, and to find the key predictors of outcomes. **Methods**: This is a retrospective study. The medical charts of 48 patients presenting with blunt or penetrating eye injury and necessitating a PPV between 2009 and 2016 were reviewed. We studied the indications to operate and the timing of the surgery. The outcome depended on the comparison of the best corrected visual acuity (BCVA), evaluated according to the logMAR scale before surgery and at 1 week and 6 months post surgery. **Results**: Forty-eight patients (42 males, 6 females) with mean age 32.4 ± 17.3 years were recruited ; 42 subjects had a penetrating eye injury out of which 21 presented with an intraocular foreign body (IOFB), and 6 had a blunt trauma. Mean preoperative BCVA was at 2.35 (logMAR), 2.25 at 1 week postoperatively, and 1.45 at 6 months. An epiretinal membrane (ERM) and drop of lens material in the vitreous were more likely to develop after blunt traumas. Initial assessment of retinal detachment (RD) was associated with the need to perform a 2nd vitrectomy ($p = 0.011$), poorer BCVA at 6 months ($p = 0.001$), and lower postoperative intraocular pressure (IOP) ($p = 0.014$). Moreover, preoperative BCVA was worse in eyes with posterior scleral perforation ($p = 0.008$). Shorter intervals between the trauma and the 1st PPV predicted a more frequent need to perform a 2nd vitrectomy ($p = 0.045$). Patients who developed proliferative vitreoretinopathy (PVR) had poorer vision preoperatively and at 1-week post-op ($p = 0.04$ and $p = 0.01$ respectively). The BCVA preoperatively, at 1 week, and at 6 months were positively correlated. Preoperative BCVA could be regarded as an important forecaster of outcome at 6 months ($p = 0.009$); whereas the timing of PPV and of IOFB removal did not show any significant correlation with the final BCVA ($r = 0.358$, $p = 0.132$). **Discussion**: The major indications for post-traumatic PPV are RD, IOFB, vitreous hemorrhage, retinal tear, ERM, and PVR. An initial RD resulted in poorer visual outcome at 6 months and increased the need for a 2nd PPV. Posterior scleral perforation caused inferior vision at presentation. The existence of a PVR lowered the vision initially and at 1 week post-op. **Conclusion**: The shorter the delay between the trauma and the 1st PPV, the more often a 2nd PPV was needed. The BCVA at the 3 points in time were positively correlated. Finally, the initial BCVA is a key predictor of outcome, contrarily to the timing of PPV or of the foreign body removal.

Keywords : ocular trauma; pars plana vitrectomy; BCVA

Abi Karam M, El Rayess S, Arej N, Ibrahim D, Farhat R, Shakal A, Samaha A, Jalkh A, Nehme J, Hanna NG, Sahyoun M, Chelala E, Azar G. Vitrectomie post-traumatique par pars plana: Indications, timimg, résultats de la chirurgie. J Med Liban 2018 ; 66 (2) : 86-91.

RÉSUMÉ • Objectif : Évaluer les indications de la vitrectomie par la pars plana (VPP) post-traumatique, le timing approprié de la chirurgie et déterminer les autres facteurs prédictifs du pronostic visuel. **Méthodes** : Étude descriptive rétrospective, portant sur les patients qui se sont présentés entre les années 2009 et 2016 à l'hôpital Eye and Ear International de Beyrouth suite à un traumatisme oculaire à globe fermé ou un traumatisme pénétrant et qui ont nécessité une VPP. Les indications chirurgicales, le timing de la chirurgie ainsi que la meilleure acuité visuelle corrigée (MAVC) en logMAR mesurée en préopératoire, à 1 semaine et à 6 mois postopératoires, ont été évalués. **Résultats** : Quarante-huit patients (42 hommes et 6 femmes) ont été sélectionnés, avec une moyenne d'âge de 32,4 ± 17,3 ans : 42 patients avaient un traumatisme pénétrant – dont 21 présentant un corps étranger intraoculaire (CEIO) –, et 6 un traumatisme fermé. La MAVC moyenne était de 2,35 à l'admission, 2,25 à 1 semaine postopératoire et 1,45 à 6 mois. Une membrane épirétinienne était plus fréquemment retrouvée dans les traumatismes fermés. Les facteurs affectant négativement la MAVC à 6 mois étaient la présence à l'admission d'un décollement rétinien (DR), d'une rupture sclérale postérieure et d'une prolifération vitréorétinienne (PVR) ($p = 0{,}001$, $p = 0{,}008$ and $p = 0{,}01$ respectivement). Un intervalle court entre la présentation et la première vitrectomie était plus associé à la nécessité de réaliser une vitrectomie ultérieure ($p = 0{,}045$). Le timing de la VPP et de la chirurgie destinée à enlever le CEIO n'a montré aucune corrélation avec la MAVC finale ($p = 0{,}132$). La MAVC initiale est un facteur prédictif essentiel de la vision finale à 6 mois ($p = 0{,}009$). **Discussion** : Les indications principales de la VPP post-traumatique dans notre étude sont la présence d'un DR, un CEIO, une hémorragie vitréenne, une déchirure rétinienne, une MER et une PVR. Un DR, la présence d'une PVR et d'une rupture sclérale postérieure constituent un facteur prédictif d'un mauvais pronostic visuel. La MAVC finale dépend essentiellement de la MAVC initiale. **Conclusion** : Un intervalle court entre le traumatisme initial et la VPP augmente la nécessité d'une deuxième VPP. La MAVC initiale est positivement corrélée avec la MAVC à 1 semaine et à 6 mois postopératoires. Finalement, la MAVC initiale est un facteur prédictif essentiel du pronostic visuel, contrairement au timing de la PPV et de l'extraction du CEIO.

Mots-clés : traumatisme oculaire; vitrectomie par la pars plana; MAVC

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INTRODUCTION

Eye injury is a significant yet preventable cause of blindness and visual morbidity; hence, it contributes to elevated public health, household, and economic burdens [1]. According to the World Health Organization (WHO) Program for Blindness Prevention, approximately fifty-five million cases of ocular traumas are recorded every year, out of which more than half a million necessitate a hospital admission [2]. Blindness occurs in 1.6 million of the cases, along with bilateral low vision in 2.3 million subjects, and unilateral in 19 million [2,3]. Adult males, the main source of domestic income, are subjected to these injuries, thus sustaining the burdens [4].

Generally, open globe traumatisms affect the anterior zones of the eye; however, posterior traumas have a worse prognosis and they are usually associated with retinal detachment (RD), vitreous haemorrhage (VH), and infections [4,5]. On one hand, the presence of a RD along with a big intraocular foreign body (IOFB) has a major negative effect on visual outcome [6]. On the other hand, good prognosis is associated with the initial best corrected vision since it was found to be linked to the final one [5,7].

Pars plana vitrectomy (PPV) is the favorable management for open globe injuries and IOFB [8,9]. Globe rupture, which can occur after blunt trauma, has a poorer prognosis than lacerations [10]. Moreover, blunt injuries affect deeper ocular structures and may lead to eventual inferior vision [10]. Little is known about the best timing for PPV and the major predictable factors that play a role in the final best corrected visual acuity (BCVA). Up until now no proper algorithms were established as references for the management of such injuries. For example, in 2016, Mansouri *et al*. mentioned the ongoing disagreement of whether to operate within 48 hours or wait one to two weeks and the lack of parameters to depend on [7].

The main aim of the present paper was to study the major indications and evaluate the best timing for PPV when needed. On the other hand, the main key factors at presentation that may predict the ophthalmological status outcome, and the final best corrected visual acuity, were also studied.

METHODS

Study design

This is a retrospective designed study where the medical charts of 48 patients presenting with blunt eye trauma or penetrating eye injury between 2009 and 2016 and necessitating a PPV were reviewed. PPV was performed by the same surgeon (AJ). Specific variables were acknowledged.

The study adhered to the tenets of the Declaration of Helsinki and the International Conference of Harmonization Good Clinical Practice guidelines.

Data collection

At presentation, all patients had a detailed ocular and medical history, as well as a thorough bilateral ocular evaluation. The ocular examination included careful testing of best corrected visual acuity; a thorough anterior segment examination; intraocular pressure (IOP) recording with a Goldmann aplanation tonometer (Haag-Streit, Bern, Switzerland) when this could be done in the absence of a penetrating eye injury; pupillary reflex status; and detailed fundus evaluation by indirect and direct ophthalmoscopy.

The indications to operate, which were the presence of retinal tear, RD, vitreous haemorrhage, IOFB, proliferative vitreoretinopathy (PVR), vitreoretinal traction, lens material in the vitreous, subretinal haemorrhage, choroidal haemorrhage, subchoroidal haemorrhage, and epiretinal membrane (ERM), were noted. We also evaluated the timing of the intervention with respect to the trauma and the development of RD, the delay between the removal of IOFB and the development of a secondary RD, the occurrence of the trauma and the RD development interval, as well as the need for a second vitrectomy. Associated injuries such as orbital fractures, corneal and scleral lacerations along with anterior segment changes were also reviewed. The IOP was taken within the week before the surgery and within the first week after the intervention. Patients underwent B-scan, spectral-domain optical coherence tomography (SD-OCT), or CT scans to validate surgical indications and other associated harms.

The surgery performed was PPV with silicone oil (SO), endolaser, cryoapplication, peeling, or removal of IOFB contingent to the indications.

The outcome depended on the comparison of the BCVA (evaluated according to the logMAR scale) at 3 time points: the day before the surgery, at 1 week, and at 6 months after the surgery. The study resulted in descriptive data.

Statistical analysis

The data were entered into a computer and managed by a database program.

Statistical analysis was performed using commercially available software (SPSS Version 20.0, Inc., Chicago, Illinois). The demographic characteristics and results were tabulated. Student's t-test and Chi-square test were used to evaluate continuous and categorical data, respectively. Fischer's test was used for low occurrences. Statistical significance was set at p values ≤ 0.05 at 95% confidence levels.

RESULTS

Baseline findings

Forty-eight patients with a mean age of 32.4 ± 17.3 standard deviation (SD) years [range, 1-74 years] were recruited. Six subjects (12.5%) were females and 42 (87.5%), were males. The baseline characteristics of

TABLE I

PATIENTS' CHARACTERISTICS, TYPES OF TRAUMA & MAJOR EXAMINATION FINDINGS (N = 48)

Characteristic	Value
Mean age (years) ± SD	32.42 ± 17.32
Sex ratio M:F	7:1
Open-globe injury	42 (87.5%)
Intraocular foreign body	21 (43.8%)
Retinal detachment	32 (66.7%)
Vitreous haemorrhage	31 (64.6%)
Retinal tear	11 (22.9%)
Proliferative vitreoretinopathy	9 (18.8%)
Retinal traction	6 (12.5%)
Posterior scleral perforation	6 (12.5%)
Epiretinal membrane	3 (6.3%)
Dropped lens material	2 (4.2%)
Mean delay to PPV (days) ± SD	25.08 ± 19.75
Need for a second PPV	18 (37.5%)

PPV: pars plana vitrectomy

the patients and the findings at presentation are mentioned in Table I. Overall, 42 subjects (87.5%) had a penetrating eye injury out of which 21 (43.8%) presented with an IOFB and 6 subjects (12.5%) had a blunt, intact globe, trauma.

The aftermaths of the trauma were distributed as follows: • 11 subjects (22.9%) presented with a retinal tear • 32 (66.7%) with a RD • 31 (64.6%) with vitreous haemorrhage • 8 (16.7%) with subretinal haemorrhage • 2 (4.2%) with subchoroidal and • 1 (2.1%) with choroidal haemorrhage. Nine patients (18.8%) developed a PVR, 3 (6.3%) an ERM, and 6 (12.5%) a vitreomacular traction. Finally, 6 subjects (12.5%) presented with posterior scleral laceration and 2 (4.2%) with dropped lens material in the vitreous cavity.

None of the eyes developed endophthalmitis or post-traumatic glaucoma during the evolution. The mean IOP preoperatively was 12.6 mmHg and 14.18 mmHg after the surgery. The presence of RD at presentation was associated with a significantly lower IOP at 6 months ($p = 0.014$).

The mean preoperative BCVA was 2.35 logMAR, 2.25 logMAR at one week postoperatively, and 1.45 logMAR at 6 months postoperatively.

The mean delay between the trauma and the first PPV was 25 ± 19.7 SD days. Out of 48 operated patients, only 18 (37.5%) necessitated a second PPV.

In case of late RD, the mean interval between the trauma and the RD development was 77 ± 78.5 SD days [range, 11-300 days]. In the majority of these cases the RD was operated the next day. The average delay between the removal of IOFB and the development of a secondary RD was 55.1 ± 82.65 SD days [range, 0-258 days].

Organic consequences of the trauma did not seem to be significantly affected by gender. Comparing to open-eye injuries, blunt injuries were more likely to cause drop of lens material in the vitreous (0% and 33.33% respectively, $p = 0.013$) and were more associated to ERM development (2.38% vs. 33.33%, $p = 0.038$). Otherwise, both types of trauma had similar presentations in terms of ophthalmological lesions.

Prognostic factors

A multivariate analysis was performed in order to evaluate the different parameters that may predict the need for a secondary PPV during follow-up (Table II). We divided the cases into patients who underwent a second PPV and those who did not in order to compare the different variables involved. Notably, the presence of RD at presentation and a shorter interval time between the trauma and the first PPV were both significantly associated with the need to perform a second PPV during follow-up ($p = 0.011$ and 0.045, respectively). On the contrary, mean age at presentation, mean delay from RD to first PPV, as well as the presence of an IOFB, of

TABLE II PARAMETERS PREDICTING THE NEED TO PERFORM A SECOND PARS PLANA VITRECTOMY (PPV)

	Second PPV in a 6-month interval		
	Performed (n = 18)	**Not performed (n = 30)**	***p* value**
Mean age (years)	30.33	33.67	*0.483*
Mean delay from trauma to 1st PPV (days)	17.39	29.70	***0.045****
Presence of RD at presentation (%)	88.89%	53.33%	***0.011****
Mean delay from RD to 1st PPV (days)	5.22	12.50	*0.583*
Presence of an IOFB	61.11%	33.33%	*0.060*
Presence of a vitreous haemorrhage	61.11%	66.67%	*0.697*
Presence of PVR	22.22%	16.67%	*0.711*

RD: retinal detachment **IOFB**: intraocular foreign body

TABLE III MEAN BCVA EXPRESSED IN logMAR, AT THREE TIME POINTS

	Best corrected visual acuity (logMAR)		
	At presentation	**1 week postoperatively**	**6 months postoperatively**
Presence of an open-globe injury	2.37	2.26	1.48
Absence of an open-globe injury	2.27	2.27	1.28
p-value	*0.821*	*0.982*	*0.748*
Presence of RD at presentation	2.52	2.45	1.89
Absence of RD at presentation	2.04	1.89	0.62
p-value	*0.137*	*0.081*	***< 0.001****
Presence of a posterior scleral perforation	2.73	2.17	2.05
Absence of a posterior scleral perforation	2.30	2.27	1.39
p-value	***0.008****	*0.838*	*0.372*
Presence of PVR	2.76	2.71	2.04
Absence of PVR	2.26	2.16	1.33
p-value	***0.04****	***0.001****	*0.172*

RD: retinal detachment **PVR**: proliferative vitreoretinopathy

a vitreous haemorrhage or a PVR are all factors that did not have a significant predictive value to assess the need for a second PPV.

Factors predicting final BCVA

Another multivariate analysis was performed to study the different factors that may affect the final BCVA; hence, the physician is able to predict the visual outcome of the patient on the long run. The results are presented in Table III.

The type of the trauma (blunt eye versus penetrating eye injury) did not affect significantly the BCVA at 6 months (1.28 logMAR vs. 1.48 logMAR with $p = 0.748$). However, the presence of RD at presentation was significantly associated with a poorer BCVA at 6 months ($p = 0.001$).

Although the presence of posterior scleral perforation was accompanied with a poorer BCVA at presentation (2.73 log MAR, $p = 0.008$), this finding did not seem to affect the visual outcome at 1 week and 6 months (2.17 logMAR and 2.05 logMAR, $p = 0.838$ and 0.372 respectively).

Patients who developed PVR had poorer vision preoperatively and at 1 week post-op (2.76 logMAR and 2.71 logMAR, $p = 0.04$ and $p = 0.01$ respectively), but not at 6 months (2.04 logMAR, $p = 0.172$).

Noteworthy, the preoperative BCVA can be regarded as an important forecaster of outcome at 6 months ($p = 0.009$). In patients having an IOFB, a correlation exists between the baseline BCVA and BCVA at 1 week ($r = 0.938$, $p < 0.001$) and at 6 months ($r = 0.580$, $p = 0.009$), as shown in Table IV. However, the timing of PPV for IOFB removal did not show any significant correlation with the final BCVA ($r = 0.358$, $p = 0.132$).

DISCUSSION

The topic of pars plana vitrectomy has been an area of focus for researchers who are interested in identifying interventions for managing and reducing the adverse effects of the growing cases of eye injury. While the approaches and methodologies in the studies vary, there seems to be a census that the intervention can help manage adverse outcomes of eye injuries and improve visual acuity among patients. In this study, we attempted to evaluate the key predictors of visual outcome at presentation in a case of eye trauma, and tried to find the best timing of PPV when indicated. Some results in what follows are in concordance with ones in the literature, while others add to it.

TABLE IV
PEARSON CORRELATIONS BETWEEN PPV TIMING, BCVA AT PRESENTATION, AT 1 WEEK & AT 6 MONTHS POSTOPERATIVELY IN EYES HAVING IOFBs

Correlated variables	**Correlation coefficient**	***p* value**
Timing of PPV & BCVA at presentation	0.318	*0.161*
Timing of PPV & BCVA at 1 week	0.252	*0.284*
Timing of PPV & BCVA at 6 months	0.358	*0.132*
BCVA at presentation & BCVA at 1 week	0.938	***< 0.001****
BCVA at presentation & BCVA at 6 months	0.580	***0.009****
BCVA at 1 week & BCVA at 6 months	0.523	***0.021****

PPV: pars plana vitrectomy **BCVA**: best corrected visual acuity **IOFB**: intraocular foreign body

The majority of the subjects were males, similarly to the literature [4]. All interventions performed were legitimate with indications within the norms [11,12]. According to Öztaş *et al*., the timing of intervention as well as that of the ablation of the IOFB was found to have no repercussions on the final visual acuity [13]. Thus, caregivers and surgeons can delay vitrectomy to achieve the desirable visual and anatomical outcomes. However, these conclusions are counter argued by Cornut *et al*. who found that the sooner the retina is reattached, the better the visual recovery, especially in no light perception eyes [14]. The studies in the literature could not reach a consensus on the appropriate timing to perform a PPV after a traumatism. In our study, no specific time was found to be optimal for the PPV. Interestingly, our finding that an early PPV correlates with the need for another surgery, may direct us towards augmenting the delay between trauma and intervention. Hence, the suitable time to perform the operation should be tailored according to the severity of each case and the experience of the physician while considering that an early PPV may lead to another PPV.

In the literature, allies for delayed post-traumatic vitrectomy argue that this time interval (10 days to 3 weeks) allows a better visibility of the posterior segment and superior surgical conditions [15]. There is a lower risk of complications such as haemorrhage during the surgery. Moreover, it gives enough time for a posterior wound to heal, for posterior vitreous detachment to take place, and for the liquefaction of any choroidal haemorrhage.

After analysis of the research findings, it was concluded that the only parameter positively affecting the visual capacity is the BCVA at presentation. This idea was also elaborated in the Cornut *et al*. study where the findings qualify the conclusions of this study which showed that the BCVA preoperatively, at 1 week post-operation and 6 weeks post-op are positively correlated [14]. As such, these results suggest that if the initial BCVA (BCVA at presentation) is poor, then it is likely that prognostic results of BCVA would also be poor. In such a case, the poor BCVA cannot be associated with the PPV.

In our study, an initial RD presented the worst effect on the visual outcome, once more identifying with the literature [6,16]. Yang and Jiang revealed that severe RD is one of the perioperative factors of poor visual acuity [16]. Additionally, we found that this initial RD may predict the need for another PPV but it might spare the patient the need for anti-glaucomatous drops due to its association with lower post-op IOPs.

It is noted in the reviews that an ERM can develop after a trauma or procedure to the eye [17]; however, in our study we were able to prove that this occurrence is more common with blunt injuries. Similarly, dropped lens material, which may cause serious granulomatous endophthalmitis is more common with blunt injuries [18].

According to the literature, PVR commonly results after eye trauma and leads to low acuity [19]; however, we were able to prove that on the long run it does not seem to affect the visual prognosis. The posterior scleral perforation also disclosed analogous results.

CONCLUSION

Overall, in this study, the major indications for post-traumatic PPV are retinal detachment, intraocular foreign body, vitreous haemorrhage, retinal tear, epiretinal membrane, and PVR.

An initial RD resulted in poorer visual outcome at 6 months and increased the need for a second PPV. Posterior scleral perforation caused inferior vision at presentation; however, it did not affect the visual outcome on the long run. The existence of a PVR lowered the vision initially and at 1 week after surgery.

Interestingly, the shorter the delay between the trauma and the first performed PPV, the more commonly a 2nd PPV was needed. The BCVA at the three points in time were positively correlated. Finally, the initial BCVA is a key predictor of outcome, contrarily to the timing of PPV or that of the foreign body removal.

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