Posterior Vitreous Detachment after Intravitreal Injection of Triamcinolone Acetonide for Macular Edema

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Abstract:

Purpose: To assess the vitreoretinal interface for the occurrence of posterior vitreous detachment after intravitreal injection of triamcinolone acetonide.

Methods: This prospective interventional study included 40 eyes of 30 patients, all of them had macular edema due to different underlying diseases: Diabetic Macular edema (n = 29) Retinal vein occlusion (n = 5), Uveitis (n = 6). All eyes were indicated to receive one or more intravitreal injections of Triamcinolone Acetonide (IVTA). Mean injections were 2 (range 1-3). Each eye was injected in a separate session with the same dose (4 mg / 0.1 ml) and same surgical technique. Additional injections were given according to the clinical improvement and resolution of macular edema. Then they were followed for six months after the last injection by fundus biomicroscopy, B-mode ultrasonography and OCT to detect posterior vitreous detachment. All patients completed the study at the six-month visit

Results: Posterior vitreous detachment occurred in 13 eyes out of total 40 eyes. It occurred after one month in 5 eyes, after 2 months in 3 eyes, after 3 months in 4 eyes and after 4 months in 1 eye. A significant correlation was found to older age (p=0.008), higher spherical equivalent (p<0.001) and higher number of injections (p=0.006), There was no statistical significance as regards gender or the underlying disease.

Conclusion: Intravitreal injection of triamcinolone acetonide induces posterior vitreous detachment, which affects the outcome of the underlying disease. Older age, myopic eyes and higher number of injections are correlated with higher incidence of posterior vitreous detachment.

Keywords: Posterior vitreous detachment; Retina; macular edema; intravitreal injection, triamcinolone acetonide.
1. Introduction

Intravitreal injection of corticosteroids has become an important method for management of several retinal diseases and conditions. It is also noted that the changes that occur in the vitreoretinal interface may influence the progression of some diseases as shown in previous studies. \[1, 2\] In some studies, it was found that macular edema decreased after posterior vitreous detachment (PVD) took place. \[3\] Similarly, macular edema that occurs in age-related macular degeneration (ARMD) and retinal vein occlusion decreases after PVD. \[3\, 4\]

Intravitreal triamcinolone acetonide (IVTA) is still used for the treatment of many diseases including clinically significant macular edema (CSME) in diabetes mellitus, in uveitic macular edema and in macular edema secondary to retinal vein occlusion. \[5\]

The purpose of our study is to detect the occurrence of posterior vitreous detachment (PVD) after intravitreal injection of triamcinolone acetonide (IVTA), and any correlation between PVD and the number of injections, age of the patient, the refractive state of the eye - as presented by spherical equivalent - and to detect the timing of PVD after the last injection.

2. Design

This was a prospective interventional study. The postoperative evaluation and follow-up period was six months.

3. Setting

This study was conducted in the Ophthalmology Department of Benha University Hospital, Benha, Egypt

4. Patients and methods

This study included 40 eyes of 30 patients (20 male, 20 female) with mean age of 56 ±8 years. Indications for intravitreal injection were diabetic macular edema (n = 29), Retinal vein occlusion (n = 5) and uveitis (n = 6).

**Inclusion criteria:**

Eyes having macular edema with pre-existing attached posterior hyaloid. All eyes were indicated to receive intravitreal injections of Triamcinolone Acetonide (IVTA).

**Exclusion criteria:**

- Patients who were unwilling to give consent.
- Patients with pre-existing posterior vitreous detachment.
- Patients with vitreoretinal traction.
- Patients who had intraocular surgeries before the start of the study.
- Patients who received ocular trauma or had undergone any form of intraocular surgeries other than intravitreal injection of Triamcinolone Acetonide during the six-month follow-up period.
- Patients with ocular infection.
- Patients with pre-existing glaucoma.
Preoperatively, all patients were subjected to:

- Full history taking including demographic data recording, history of ocular diseases, history of trauma, drug intake, previous operations, smoking and systemic workup.
- Best Corrected Visual Acuity (BCVA)
- Slit lamp biomicroscopy, IOP measurement using Goldmann Applanation Tonometer (GAT), Gonioscopy using Volk 3 mirror gonioscopy lens
- Examination of pupillary reflexes, color perception, adequacy of red reflex using co-axial illumination. Examination of the crystalline lens for cataract.
- Dilated fundus examination using binocular indirect ophthalmoscope.
- Examination of the macula using +90D Volk lens

Pre-operative investigations to assess the condition of vitreoretinal interface included:

- Posterior Segment Spectral Domain OCT (SD-OCT) using Topcon™ 2000 3D OCT TOPCON CORPORATION™, Japan
- B-mode ultrasonography using SONOMED Ophthalmic Ultrasound device SonomedEscalon™, USA

Treatment technique:

Informed consent: After discussing the nature of surgery with the patients including the potential risks and complications, all subjects have signed a written informed consent document before surgery.

Surgical steps

Anesthesia: Topical Anesthesia using Benoxinate Hydrochloride 0.4% Eye drops (Benox® 0.4% Eye Drops Manufactured by: EGYPTIAN INT. PHARMACEUTICAL INDUSTRIES CO. (E.I.P.I.CO.) - Egypt).
- The periorcular skin was sterilized with 10% povidone iodine painting.
- Draping of the eye.
- Conjunctival sac was sterilized using 5% povidone-iodine solution.
- Application of sterile drapes and wire speculum to provide good exposure to cornea and conjunctiv.
- AC paracentesis was performed prior to the injection, using 20 Gauge (20G) MVR blade in all cases in the study.
- Castroviejo caliper was used to measure 4 mm distance from the limbus in the inferotemporal quadrant.
- A 27 gauge needle was used to inject a clear amount of 0.1 ml of triamcinolone acetonide (Kenacort-A™ 40 mg/ml SmithKline Beecham Egypt LLC, an affiliated co. to Glaxo Smith Kline) through the intended site, directed towards the mid-vitreous, under visualization of the operating microscope.
- A sterile cotton-tip applicator was placed over the injection site to stop the reflux of the injected drug and vitreous just after removal of the needle.
- Administration of topical antibiotic Moxifloxacin hydrochloride 0.5% (Vigamox® 0.5%, Alcon®).
- Immediately after the injection, the perfusion of optic disc, as well as the retina, were assessed by the binocular indirect ophthalmoscope.
- Eye patched.
**Postoperative instructions:**
All patients were instructed about the symptoms of posterior vitreous detachment as well as the symptoms of possible retinal breaks and were informed to return for urgent clinical examination if any of these symptoms occurred, irrespective of the given dates for postoperative visits. In addition, they were told that the floaters encountered in the early days after the procedures are due to the floating drug particles.

**Follow up:**

Early postoperative evaluation was carried on the first post operative day to detect and manage temporary IOP spikes and to exclude early postoperative signs of infection or reaction. Then other follow up visits were scheduled at the 7th post-op day, 1 month, 3 months and 6 months. Follow up included evaluation of:

1) Best Corrected Visual Acuity (BCVA) using Topcon ACP-8 chart projector (Topcon Co. Japan), Decimal measurements were converted later to LogMar measurement system.
2) Slit lamp biomicroscopy.
3) Posterior segment examination using binocular indirect ophthalmoscope
4) Examination of the macula and optic nerve head using slit lamp biomicroscopy with the use of +90D Volk Lens.
5) Intraocular pressure measurement using Goldmann Applanation Tonometer (GAT).

**Post-operative investigations to assess the changes of vitreo-retinal interface included:**

1- Posterior Segment Spectral Domain OCT (SD OCT) using Topcon™ 2000 3D OCT TOPCON CORPORATION™, Japan
2- B-mode ultrasonography using SONOMED Ophthalmic Ultrasound device Sonomed Escalon™, USA

The decision for giving additional injections was taken when there was a recurrence of macular edema which manifested clinically or by OCT imaging during the follow up visits. Clinically, it manifested by a decrease in BCVA of one line or more, with exclusion of other causes of diminution of vision such as cataract and vitreous hemorrhage. In OCT, we searched for evidence of increased intra-retinal or subretinal fluid. The interval between injections was no less than three months. In general, no further injections were attempted when one or more of the deferral criteria is found, including (1) BCVA is 0.8 or better in decimal unit, (2) substantial improvement in macular edema since the last treatment (e.g., ≥ 50% decrease in OCT central subfield thickening (3) clinically significant adverse effect from prior treatment.

**The primary outcome measures:**

- Anatomical outcomes: occurrence of PVD.
- Functional outcome: BCVA and reduction of macular thickness.
- PVD was detected by three methods: observing Weiss ring during biomicroscopy, posterior segment SD-OCT and by B-US. However, we combined these techniques for searching for PVD in each case to increase the sensitivity and specificity.
Secondary outcome measures:

- Intraoperative complications as subconjunctival hemorrhage, crystalline lens injury or lens capsule injury, iatrogenic retinal breaks, IOP rise and optic disc pulsations abnormality.
- Post-operative complications as IOP rise, subconjunctival hemorrhage, endophthalmitis, noninfective-endophthalmitis, steroid induced glaucoma, cataract progression or formation of new cataract, retinal detachment or epiretinal membranes.

In cases with postoperative elevated IOP, we used antiglaucoma medications (timolol maleate 0.5% or dorzolamide hydrochloride 2% or a combination of both).

3- Data management:

Data management and statistical analysis were performed using the IBM Statistical Package for Social Sciences (SPSS) vs. 23. Numerical data were summarized using means and standard deviations or median and ranges, categorical data were summarized as numbers and percentages. Comparisons between two groups were done using Mann-Whitney U test. Paired data were analyzed using Wilcoxon signed ranks test or Freidman test according to number of pairs. For categorical variables, differences were analyzed with $\chi^2$ (chi-square) test or fisher exact test when appropriate.

4- Results

The mean age was 56 ±8 years, they were (20 male, 20 female). Indications for intravitreal injection were diabetic macular edema ($n=29$), Retinal vein occlusion ($n=5$) and uveitis ($n=6$).

Overall, Posterior vitreous detachment occurred in 13 out of 40 eyes. PVD was found significant ($p=0.008$) in older patients (Mean ±SD 60 ±6) as compared to younger patients (Mean ±SD 54 ±9). There was no statistical significance regarding gender ($p=0.736$), or the underlying disease. ($p=0.356$).

Comparing different age groups of the patients, PVD occurred in only 1 out of 12 patients (8.3%) among the youngest age group (40-50 years) and in 3 out of 12 patients (25%) of patients aged between 51 and 60. Patients above 60 showed the highest percentage of PVD (56.3%), 9 out of 16 patients showed PVD.

All eyes enrolled in the study received one or more injections. The mean injections was 2 (SD 0.7 injections). There was a significant correlation between PVD and higher number of injections ($p = 0.006$). Eyes that showed PVD were related to a higher mean number of injections with a mean of 2.5 (SD=0.7) while eyes that didn’t encounter PVD were related to a lower mean (1.8 ± 0.6.)

Concerning the time interval between the last injection and the occurrence of PVD. The interval was as follows: one month in 5 eyes, two months in 3 eyes, 3 months in 4 eyes and 4 months in 1 eye. The mean time from the last injection to PVD was 4.7 (4.1 - 5.3) months. With 95% confidence interval.

In general, the spherical equivalent (SE) of eyes enrolled in the study ranged from -3.75 to +0.75 diopters (dpt) (Mean ±SD -1.43 ±1.08).
Eyes that showed PVD were found to have higher range of SE (-3.75 - -0.5 dpt) as compared to eyes that did not show PVD (-2.25 - 0.75 dpt). Eyes that had SE above (-2 dpt) showed the highest percentage of PVD (66.7%) whereas eyes with SE below -1 dpt showed the least percentage (9.1%). *p* value was found significant (*p* <0.001).

Concerning the complications of the procedure, the most common encountered complication was postoperative elevation of IOP. It occurred in 17.5%. Cataract was seen in (12.5%). Subconjunctival hemorrhage occurred in (12.5%). The least complication was pseudo-endophthalmitis in 3 eyes (7.5%). No cases showed postoperative infectious endophthalmitis, retinal breaks, retinal detachment, or crystalline maculopathy.

Regarding IOP, the mean preoperative (baseline) IOP was 17 mmHg (SD = 2 mmHg). The baseline IOP was compared to IOP measurements along the six-month follow up period, there was an elevation of IOP reaching a mean of 21 mmHg (SD = 3 mmHg) in day 1 postoperative, and a mean of 22 mmHg (SD = 2 mmHg) in day 3, then mean ± SD 20 ± 2 on 1st week visit. At the end of the follow up period the mean IOP reached 18 mmHg (SD = 2mmHg).

Best corrected visual acuity (BCVA) was measured in decimal form then converted to LogMAR units. The mean pre-operative LogMAR BCVA was 0.9 (SD = 0.1). It improved significantly to reach a mean of 0.6 (SD =0.2) at the end of the six-month follow up period. *p*-value was found significant (*p* <0.001).
DISCUSSION

Corticosteroids have been used since the early 1950s to suppress intraocular inflammation by reducing inflammatory exudation, inhibiting proliferation of fibroblasts and formation of granulation tissue. They were administered either topically, subconjunctival, subtenon, retrobulbar or systemically. **Graham and Peyman, 1974[1]** studied the possibility of injecting cortisone directly into the eye in experimental settings in animals as well as in selected clinical situations in human patients. It was noted that the procedure of intravitreal injection can lead to posterior vitreous detachment which affects the progression of several diseases of the macula with resultant reduction in macular edema.

The purpose of our study is to detect the occurrence of posterior vitreous detachment (PVD) after intravitreal injection of triamcinolone acetonide (TA), and any correlation with the number of injections, age of the patient, the refractive state of the eye - as presented by spherical equivalent - and to detect the timing of PVD after the last injection.

This study was conducted on 40 eyes of 30 patients retrieved from Ophthalmology Department in Benha University Hospital, Egypt. All the enrolled eyes had pre-operative attached posterior hyaloid with no vitreoretinal traction. None of the eyes had any previous intraocular surgery. None of them had preoperative infection, preoperative elevated IOP or any major ocular trauma along the study time.

All eyes received one or more injections of triamcinolone acetonide of the same dose (4 mg / 0.1 ml), and same technique. Then each eye was followed for six months after the last injection for the occurrence of PVD.

Overall, It was noted that PVD occurred in 13 out of 40 eyes (32.5%). The timing of PVD after the last injection was recorded, the interval was: one month in 5 eyes, two months in 3 eyes, 3 months in 4 eyes and 4 months in 1 eye. The mean time from the last injection to PVD was 4.7 months (Range: 4.1 - 5.3 months).

As regards the prevalence of posterior vitreous detachment in general, **Weber-Krause and Eckardt, 1996[2]** found that data in the literature differ widely as for the incidence and age at which posterior vitreous detachment happens. They investigated the incidence of PVD in elderly patients and compared eyes with and without AMD in patients aged 51 to 89 years. A total of 251 eyes were examined by B-US for the occurrence of PVD. 119 eyes showed normal macula. The other 132 eyes had AMD. B-US revealed complete posterior vitreous detachment in only 19% of normal eyes (without AMD) and 15% of eyes with AMD. Eyes with macular degeneration, had a significantly higher ($p = 0.0059$) incidence of incomplete vitreous detachment than healthy eyes. It was unclear whether PVD was a cause or a consequence of the macular degeneration. Their results showed that complete posterior vitreous detachment in the elderly is rarer than previously assumed.

**Geck et al, 2013[3]** observed a correlation between the age of patient and incidence of PVD. A significant increase in incidence of PVD was noted ($p = 0.0075$) while comparing the age groups of patients who were under and over 70 years old.
In our study, we found a significant correlation between PVD and increasing age of the patient \( (p=0.008) \). Eyes that showed PVD was related more to older patients with mean age of 60 years \( (SD = 6) \). Eyes that didn’t encounter PVD was related to younger individuals with mean age of 54 years \( (SD = 9) \). However, there was no statistical significance as regards gender or underlying disease.

Concerning the effect of intravitreal injection procedure on the vitreo-retinal interface, Veloso et al, 2015 [4] conducted a study to evaluate the incidence of posterior vitreous detachment induced by intravitreal injections of anti-VEGF agents in cases of neovascular age-related macular degeneration. The study included patients with neovascular AMD who presented vitreomacular adhesion (VMA) classified as focal or diffuse adhesions \(<1500\) microns and \(>1500\) Microns respectively). All patients received at least 3 monthly intravitreal injections of anti-VEGF agents. Follow-up visits were performed 1 month after each intravitreal injection and included OCT analysis to evaluate the incidence of PVD.

The mean follow-up period was 21.3 months \((range, 3-59\) months\). The mean number of intravitreal injections was 8.3 \((range, 3-29\) injections\). Intravitreal drugs used in the study were ranibizumab \((51.5\%)\), bevacizumab \((33.5\%)\), and aflibercept \((15.0\%)\). Seven eyes \((5.6\%)\) Seven eyes \(5.6\%)\) developed PVD after intravitreal drug injection \(3\) eyes after the first intravitreal injection: bevacizumab in 1 and ranibizumab in 2; \(2\) eyes after the second injection: ranibizumab in 1 and bevacizumab in 1; \(1\) eye after the fourth injection: ranibizumab; and \(1\) eye after the sixth injection: aflibercept). A total of 118 eyes remained with persistent VMA. All 7 eyes that developed PVD were classified as having focal VMA, with the diameter of vitreous attachment ranging from 210 to 1146 \(\mu m\) \((mean, 600 \mu m)\). However in our study, all cases had preoperative attached vitreous.

Concerning the relation between PVD and the refractive state of the eye, it is stated in the literature that PVD is more likely to occur in myopic patients at a younger age \((Sebag, 1987)\) [5].

In our study, A significant correlation between PVD and SE was detected \((p <0.001)\). Spherical equivalent of the enrolled eyes ranged from -3.75 to +0.75 dpt \((Mean \pm SD -1.43 \pm 1.08)\). PVD occurred more in eyes with higher SE \(-3.75 -0.5\) dpt) as compared to lower SE \((-2.25 - 0.75\) dpt). We found that eyes with SE above \(-2\) dpt showed the highest percentage of PVD \((66.7\%)\).

Our study has a number of limitations, one limitation is the relatively small number of enrolled patients. A further limitation is a mixture of different underlying diseases \((DME, RVO and uveitis)\), which might have an influence on the development of a posterior vitreous detachment. We included 29 eyes with diabetic macular edema, 5 eyes with macular edema secondary to RVO and 6 eyes with macular edema due to uveitis, all of which received the same dose \((4 mg / 0.1 ml)\) of intravitreal triamcinolone acetonide.

Geck et al, 2013[3] have conducted a prospective observational study in which different drugs were injected intravitreally for treatment of macular edema due to different underlying diseases. And compared occurrence of PVD after each drug. The study included 61 eyes with different diseases, 47 eyes had wet ARMD, 8 eyes had CME after retinal vein occlusion and 6 eyes had CME from other diseases. The drugs used were Bevacizumab \((1.25 mg)\) which was injected into 25 eyes, ranibizumab \((0.5 mg)\) was injected into 27 eyes , TA \((4 mg)\) was injected into six eyes, and a combination of bevacizumab and TA into three eyes. The study showed that 15 of 61 eyes developed PVD after intravitreal injection \(n = 6\) after ranibizumab, \(n = 7\) after bevacizumab and \(n = 2\) after triamcinolone) within a mean follow-up period of 11.1 weeks. As regards number of injections, PVD
occurred in three eyes after the first injection, in three eyes after the second injection, and in seven eyes after the third injection. Also, incidence of PVD was correlated with increasing age.

However, in our study, we used only triamcinolone acetonide (Kenacort) for treatment of macular edema due to different diseases.

We found a significant correlation between PVD and number of injections ($p = 0.006$), the range of injections in our study was (1-3 injections) (Mean ± SD 2 ± 0.7). Eyes that showed PVD were related to mean injections of 2.5 (SD = 0.7 injections) while eyes that didn’t encounter PVD had a lower mean which was 1.8 injections (SD = 0.6).

As stated in literature, the assessment of the vitreo-retinal interface by different methods could be misleading in some cases causing a potential source of error. For example, during dilated fundus examination, vitreous lacunae or extensive liquefaction may be misleading for PVD. *(Foos, 1982)*.

Therefore, in our study, we used multiple methods to detect PVD including: dilated fundus examination, posterior segment OCT, and B-US to achieve maximum sensitivity and to minimize diagnostic errors as much as possible. posterior segment OCT delivered more accurate data about detachments or adhesions near the retina, It also helped in follow up of the progression of the underlying disease. However, it is noted that in some cases, highly-detached posterior hyaloid can be easily missed if it presents outside the area of imaging by OCT. To overcome this problem, we implemented B-US along with OCT imaging in all cases.

Our study suggests that the procedure of intravitreal injection itself may induce a PVD. Raised incidence of PVD was seen in eyes that received more injections. Moreover, a potential influence of the induced PVD on the underlying macular disease must be considered.

As suggested in the literature, PVD is found to be associated with better regression of edema, fewer recurrences of CME, and can influence age-related macular degeneration. To exactly determine this influence, more studies addressing this issue are needed. *(Geck et al, 2013)*[3]

All the complications which occurred in our study were previously stated in the literature, It is well established that intravitreal injection of steroids is associated with a significant risk of elevated IOP and cataract formation or progression, particularly posterior subcapsular cataract.

*Bartlett, 1993* [7] found that elevated IOP was encountered in approximately 30% of patients using steroids and in 60% of those using steroids whose first relative has primary open-angle glaucoma.

In the retrospective, consecutive case series by *Rhee et al, 2006*,[8] 570 eyes received a single IVTA injection (4 mg/0.1 ml) and a second set of 43 eyes received a second injection. The study found that elevated IOP after IVTA is common and patients should be monitored beyond 6 months post-injection. Patients with a baseline IOP more than 16 mm Hg or patients who need a second injection should be carefully monitored for an elevated IOP. However, in our study, we observed the patients for six months post injection and all patients with elevated IOP above 21 mmHg were successfully controlled on topical IOP lowering drugs. No cases needed filtering or laser glaucoma surgeries.
Yang et al, 2005[9] published a case report that showed two patients who encountered secondary intractable ocular hypertension two months after a single (4 mg / 0.1 ml) intravitreal injection of triamcinolone acetonide for macular edema. Both patients required trabeculectomy to control intraocular pressure. The study recommended cautious monitoring of IOP for several months after the surgery and suggested that the risks of this complication need to be weighed against the benefits of intravitreal triamcinolone in the individual patient.

In our study, the mean preoperative (baseline) IOP was 17 mmHg (SD = 2). None of the enrolled eyes had preoperative elevated IOP. During the follow up period, we noted that seven out of 40 eyes (17.5%) encountered postoperative elevated IOP. There was a significant postoperative rise of IOP (p <0.001) reaching a mean of 21 mmHg (SD = 3) in day 1 after the injection. And a mean of 22 mmHg (SD = 2 mmHg) in day 3, then mean ± SD 20 ± 2 on 1st week visit. At the end of the follow up period the mean IOP reached 18 mmHg (SD = 2mm). All cases with postoperative elevated IOP above 21 mmHg were successfully managed by topical antiglaucoma medications.

Steroid-induced cataract is another common complication of intravitreal injection of TA. Jonas et al, 2004.[10] concluded that eyes with an elevation of IOP after intravitreal TA injection have a very high risk of rapidly experiencing posterior subcapsular lens opacities.

Detry-Morel et al, 2004/11]reported that high-dose intravitreal injections of TA in the elderly population can lead to clinically significant cataract with eventual cataract surgery in about 15–20% of the eyes within about one year after the intravitreal injection.

In our study, 5 out of 40 eyes (12.5%) showed the formation of posterior subcapsular cataract during the six-month follow up period. The cataract was not visually significant and none of the patients underwent cataract surgery till the end of the follow up period.

Regarding pseudo-endophthalmitis (sterile endophthalmitis), several studies described noninfectious endophthalmitis after intravitreal injection of TA. (Scott, Flynn, 2007)(Jonas et al, 2003). [12][13]

Jonas et al, 2006[14], reported post injection pseudo-endophthalmitis in 0.2%–6.7% of the eyes following treatment.

In our study, pseudo-endophthalmitis occurred in only 3 out of 40 eyes (7.5%). These eyes showed anterior vitreous haze just after the injection. In all cases, there was impaired vision immediately after the injection. On examination, the view of retina was precluded by heavy particulate infiltration but there was no pain or swelling, and the anterior chamber remained quiet. The vitreous haze cleared spontaneously in all cases without treatment.

Sutter and Gillies, 2003[15] reported four cases of postoperative pseudo-endophthalmitis after intravitreal injection of TA, all cases resolved spontaneously without treatment. However, Sutter and Gillies recommended that caution should be taken during managing these cases because the clinical course of a true infectious endophthalmitis may be masked by the presence of steroids in the vitreous.
Özkiriş and Erkiliç, 2005[16] injected intravitreal triamcinolone acetonide in a total of 212 eyes of 180 patients for various indications and found that pseudo-endophthalmitis occurred in one eye (0.5%), and pseudo-hypopyon was observed in two eyes (0.9%).

Concerning postoperative infectious endophthalmitis, no cases in our study showed this complication. Mishra et al, 2018[17] conducted a retrospective study by reviewing medical records from January 2009 to June 2016, and evaluated the incidence, risk factors, clinical and bacteriological characteristics of endophthalmitis after intravitreal injection of various agents, including TA and other Anti-VEGF drugs. The total number of intravitreal injections was 20,566. only 27 cases developed endophthalmitis, giving an overall incidence of 0.131%. In the triamcinolone acetonide group in particular, the incidence was 0.26%.

Park et al, 2013[18] evaluated the incidence, causative organism, clinical features, and visual outcome of acute endophthalmitis following intravitreal injection of various intravitreal drugs as well as gas injection. And reported the clinical outcome of patients receiving antibiotics before the injection for prevention of endophthalmitis. The total number of intravitreal injections was 17,332. The incidence of acute endophthalmitis for all intravitreal injections was 0.000% (0/849) for triamcinolone acetonide, 0.022% (2/9,125) for bevacizumab, 0.000% (0/7,061) for ranibizumab, and 0.337% (1/297) for C3F8 gas injections. The overall rate of intravitreal injection-related endophthalmitis with the use of topical antibiotics given 3 days before injection was no less statistically significant compared with that of no antibiotics.

In our study, no eyes showed infectious endophthalmitis after intravitreal injection of TA. And no patients used preoperative prophylactic topical antibiotics.

Another complication of intravitreal injection of triamcinolone is crystalline maculopathy. Sarraf D et al, 2010[19] described a condition of crystalline maculopathy associated with a history of intravitreal triamcinolone injections. The crystals were refractile, multicolored, located in the posterior pole, and were not associated with obvious visual deficits. The predominantly white color and superficial location of the crystals indicated that they may result from aggregation and clumping of insoluble components of triamcinolone.

Fine et al, 2017[20] conducted a retrospective, interventional, noncomparative, single-center case series of patients who received IVTA and developed subsequent crystalline retinopathy lasting greater than 1 year after injection. They found that macular crystals can persist for years after IVTA. The crystals localize to the preretinal or subhyaloid space, are angiographically silent, can exhibit slow dissolution and movement, may be distributed in a circular fashion. However, in our study, no eyes showed crystalline maculopathy during the follow up period.

Concerning the improvement of visual acuity after injection, Jonas et al, 2006[14] conducted a study to report the improvement of BCVA after repeated IVTA injections as a treatment of diffuse DME. They included a study group of 19 patients (22 eyes) with DME, who showed an improvement in visual acuity after an intravitreal injection of approximately 20 mg TA, and who received a second intravitreal injection 10.0+/3.8 months after the first injection. A control group consisted of 31 patients with diffuse diabetic macular edema without treatment during follow-up.
Follow-up after the second injection was 9.1+/−4.9 months. Four patients received a third injection at 9.7+/−3.7 months after the second injection, with a follow-up after the third injection that was at 7.9+/−11.5 months. After the second and third injections, visual acuity increased significantly (P = 0.002 and P = 0.068, respectively) by 1.8+/−2.1 and 4.0+/−2.6 Snellen lines, respectively. Eleven eyes (50%) showed an improvement in visual acuity by at least 2 Snellen lines after the second injection, and 3 patients (75%) experienced a gain in visual acuity by at least 2 Snellen lines after the third injection. Improvement in visual acuity lasted approximately 6 to 8 months after each injection. The study concluded that Intravitreal injection of approximately 20 mg triamcinolone acetonide may repeatedly lead to an improvement in visual acuity in DME. The duration of the effect after each injection is approximately 6 to 8 months.

In another study by Chieh et al, 2005 [21], included 210 eyes of 174 patients who received an intravitreal injection of 1 or 4 mg of triamcinolone acetonide for treatment of DME. Mean follow-up time ± SD was 6.6 ± 3.1 months. The study found significant improvement in BCVA (P < 0.001). Baseline mean logMAR was 0.92, improved to mean logMAR 0.82 at 6 months.

In our study, we found a significant improvement in BCVA at the end of follow up period (p <0.001). The mean baseline LogMAR BCVA was 0.9 (SD = 0.1). It improved significantly to reach a mean LogMAR BCVA of 0.6 (SD = 0.2) at the end of the six-month follow up period.

CONCLUSION

Intravitreal injection of triamcinolone acetonide induces posterior vitreous detachment, which affects the outcome of the underlying disease. advanced age, myopic eyes and increased number of injections seem to increase the occurrence of posterior vitreous detachment.

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