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ORIGINAL PAPER

Analysis of clinical features and visual outcomes of pars planitis

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Abstract
Purpose To evaluate the demographic characteristics, clinical features, treatment and outcomes of patients with pars planitis in a tertiary referral center in Turkey.
Methods Medical records of patients with pars planitis were retrospectively reviewed. The data including demographic and ocular features and treatment outcomes were recorded. The distribution of clinical findings and complications were evaluated according to age and gender groups. The changes in final BCVA compared to the initial BCVA were noted. Statistical analysis was performed using SPSS software (Version 18.0, SPSS Inc., Chicago, USA).
Results Twenty-seven patients (54 eyes) were included in this study. 16 patients were male (59.3%), and 11 were female (40.7%). Mean age at diagnosis was 12.84 ± 8.26 (range 4–36) years. Mean follow-up period was 61.3 ± 52.15 (range 9–172) months. Mean BCVA was 0.58 ± 0.36 (range 0.03–1.00) (0.40 ± 0.45 logMAR) at presentation, and 0.81 ± 0.28 (range 0.10–1.00) (0.14 ± 0.27 logMAR) at final visit ($P = 0.001$). Vitreous inflammation (100%), vitreous haze (92.6%), snowballs (74.1%), snowbanks (66.7%), anterior chamber cells (66.7%) and peripheral retinal vascular sheathing (48.1%) were the most common presentations. Ocular complications included vitreous condensation (51.9%), cystoid macular edema (22.2%), cataract (18.5%), inferior peripheral retinal detachment (11.1%), glaucoma (5.6%) and vitreous hemorrhage (3.7%). Treatments included topical, periocular, intravitreal and systemic corticosteroids, immunosuppressives, peripheral laser photocoagulation and pars plana vitrectomy when needed.
Conclusions Pars planitis is an idiopathic chronic intermediate uveitis mostly affecting children and adolescents. In spite of its chronic nature with high potential of causing ocular complications, adequate treatment and close follow-up lead to favorable visual outcomes.

Keywords Pars planitis · Intermediate uveitis · Pediatric uveitis · Treatment

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Introduction

Pars planitis is an idiopathic chronic intermediate uveitis with an unknown etiology. It is characterized by chronic inflammatory aggregates on pars plana (snowbanks) and within the vitreous (snowballs) in the absence of any infectious or systemic diseases [1]. Pars planitis predominantly affects children and adolescents. The common presenting symptoms are

floaters, blurred vision, pain and photophobia; however, it may also be asymptomatic and diagnosed incidentally during routine ophthalmologic examination, especially in young and preverbal children [2, 3]. The most common clinical findings of pars planitis include anterior segment inflammation, diffuse vitreous haze, snowballs, snowbanks, peripheral retinal venous sheathing, glial fibrovascular traction on pars plana and associated retinal elevation [3–9]. Intraocular inflammation leads to a number of ocular complications if not treated promptly [3, 5, 9–13]. In this retrospective study, we reported and reviewed the clinical features, treatment modalities, and visual outcomes of the patients with pars planitis.

Methods

Medical records of 27 patients with pars planitis who were referred to our Uveitis Clinic between July 2002 and July 2016 were fully evaluated. All the patients included in this study had been diagnosed as pars planitis based on the diagnostic criteria defined by The Standardization of Uveitis Nomenclature (SUN) Working Group in 2005. According to SUN Working Group Criteria, the diagnostic term pars planitis was only used for the subset of intermediate uveitis with snowball and snowbank formation in the absence of associated infection or systemic disease [1].

The study was approved by the Ethical Committee of Ankara Numune Training and Research Hospital.

The diagnosis of pars planitis based on the patients with a follow-up period of at least 9 months was included in the study, while the ones lost to follow-up or incompatible to regular visits, treatments, as well as the ones with systemic, infectious diseases and secondary ocular diseases were excluded.

The data including demographic features, best corrected visual acuities (BCVA), ophthalmologic findings of anterior and posterior segments, ocular imaging results, treatment strategies and ocular complications were recorded. The distribution of clinical findings and complications were evaluated according to age and gender groups. The changes in final BCVA compared to baseline BCVA were noted. Statistical analysis of the data was performed using SPSS software (Version 18.0, SPSS Inc., Chicago, USA). Paired sample *t* test was used to evaluate the difference between initial and final BCVA.

Results

Of the 27 patients with pars planitis, 16 (59.3%) were male and 11 (40.7%) were female. The mean age at presentation was 12.84 ± 8.26 (range 4–36) years. All the patients were affected bilaterally. Both right and left eyes were included in the study since there was no significant correlation regarding baseline visual acuity between the eyes ($P = 0.535$, $r = 0.125$, Pearson correlation test). The mean follow-up period was 61.3 ± 52.15 (range 9–172) months (Table 1).

Initial BCVA was 0.5 or better in 33 (61.1%), eyes 0.1–0.5 in 15 (27.8%), and less than 0.1 in 6 (11.1%), while final BCVA was 0.5 or better in 46 (85.2%) eyes and 0.1–0.5 in 8 (14.8%). Mean BCVA was 0.58 ± 0.36 (range 0.03–1.00) snellen lines (0.40 ± 0.45 logMAR) at presentation and significantly improved to 0.81 ± 0.28 (range 0.10–1.00) lines (0.14 ± 0.27 logMAR) at final visit ($P = 0.001$, paired *t* test) (Table 2).

The most common presenting symptoms were floaters and decreased vision. Varying degrees of vitreous inflammation were present in all eyes. Vitreous haze (92.6%), snowballs (74.1%), snowbanks (66.7%), anterior chamber cells (66.7%) and peripheral retinal vascular sheathing (48.1%) were the most common presenting clinical features. The common ocular complications were vitreous condensation (51.9%), cystoid macular edema (22.2%), cataract (18.5%), inferior peripheral retinal fibrovascular traction and detachment (11.1%), glaucoma (5.6%) and vitreous hemorrhage (3.7%) (Table 3).

Treatment modalities of the eyes during inflammatory episodes included topical corticosteroid drops in 66.7%, cycloplegic drops in 100%, posterior subtenon corticosteroid injections in 16.6%, intravitreal dexamethasone implant injection (Ozurdex, Allergan, Irvine, CA, USA) in 3.7%, oral corticosteroids in 63%, methotrexate in 22%, cyclosporine in 22%, azathioprine in 11%, peripheral laser photocoagulation in 18.5%. Pars plana vitrectomy was performed in two eyes because of non-clearing vitreous hemorrhage (3.7%). Phacoemulsification cataract extraction and intraocular lens implantation were performed in four eyes with cataracts (7.4%). Glaucoma was not present initially; however, it developed in 3 (5.6%) eyes as a complication of posterior subtenon steroid injections. It was successfully managed by topical antiglaucomatous agents.

Table 1 Demographic characteristics of the patients

Patient demographics	
Number of patients (eyes)	27 (54)
Gender (%)	
Female	11 (40.7)
Male	16 (59.3)
Mean age (years) at diagnosis of pars planitis (±SD)	12.84 (8.26)
Mean follow-up time (months) (±SD)	61.3 (52.15)

Table 2 Best corrected visual acuity at initial and final examinations

BCVA (decimals)	Number (percent)	
	Initial	Final
≥0.5	33 (61.1)	46 (85.2)
0.1–0.5	15 (27.8)	8 (14.8)
<0.1	6 (11.1)	0 (0)
Mean (±SD)*	0.58 (0.36)	0.81 (0.28)
Total (%)	54 (100)	54 (100)

* $P = 0.001$, paired sample t test

Table 3 Ocular features at presentation and complications during follow-up period

Ocular findings	Number of eye (%)
Presenting findings	
Vitreous inflammation	54 (100)
Anterior chamber cells	36 (66.7)
Snowball	40 (74.1)
Snowbank	36 (66.7)
Vitreous haze	50 (92.6)
Peripheral retinal vascular sheathing	26 (48.1)
Complications	
Cataract	10 (18.5)
Glaucoma	3 (5.6)
Cystoid macular edema	12 (22.2)
Vitreous condensation	28 (51.9)
Inferior peripheral retinal detachment	6 (11.1)
Vitreous hemorrhage	2 (3.7)

Discussion

Pars planitis is a particular subset of intermediate uveitis that consists of inflammation of peripheral retina, ciliary body and anterior vitreous, in the absence of infectious or systemic diseases. Snowbanks and snowballs are the pathognomonic clinical features of pars planitis [1].

Pars planitis contains the major part of uveitis in children and adolescents. It has been reported to account for 5–26.7% of pediatric uveitis in different series [10, 11, 14–17]. Ozdal et al. reported pars planitis as the leading cause of pediatric uveitis in Turkey (24%), while Soylu et al. reported it as the third most common cause (13.6%) following toxoplasmosis (39%) and Behçet's disease (17%) [14, 16]. Approximate rates of pars planitis have also been reported by Smith et al. (17.1%) and Rosenberg et al. (14.9%) [11, 15].

According to the data reported in most series, pars planitis was commonly diagnosed at the ages 6–14 years [7, 10, 13–15]. Arellanes-Garcia et al. reported that 85% of patients in their series were 14 years of age or younger at presentation, while the mean age at diagnosis was 6 years [6]. In our series, the mean age at diagnosis was found 12.84 ± 8.26 (range 4–36) years. 77.8% of the patients were 16 years of age or younger, while 22.2% were adults. Moreover, nearly half of the patients were 10 years of age or younger at disease onset (48.1%).

Pars planitis has been reported to have a male predominance in most series [2, 3, 10]. Paroli et al. and Romero et al. found a male predominance of 62 and 68.8%, respectively [2, 3]. Nikkhah et al. reported even a more marked tendency to male gender with a male to female ration of 5–1 [10]. Although not so marked in our series, we also found a male predominance (59.3 vs. 40.7%).

The severity of the disease has been reported to differ according to gender and age of onset [2, 18]. Kalinina et al. [18] reported that children 7 years of age or younger at initial diagnosis had worse visual prognosis compared to older ones. Nikkhah et al. [10] described age of onset older than 5 years and female

gender as good prognostic factors. We observed no statistically significant difference of severity related to gender and age. However, a statistical significance was observed regarding retinal complication rates. Such as, all of our patients with peripheral retinal detachment were male ($P = 0.035$), and this complication developed in 25% of patients under 8 years of age ($P = 0.046$).

Pars planitis is usually a bilateral disease, although the severity of inflammation may be asymmetrical. High rates of bilateral involvement up to 92% have been reported in various studies [2, 3, 10, 12]. In our study, all the patients had bilateral involvement. Asymmetrical involvement was present at disease onset; however, the course and severity of the inflammatory episodes and the complications gained similarity in both the eyes in progressive stages.

Patients with pars planitis usually suffer from floaters and decreased vision at presentation. Pain, photophobia and redness may also occur in some patients. In our study, the most frequent complaints of the patients were floaters and decreased vision, followed by red eye and ocular pain (85.2, 66.7, 37, 18.5%, respectively). Similarly, Donaldson et al. reported high rates of floaters and blurred vision (61 and 74%, respectively) [5]. In the study by Prieto et al., blurred vision was also marked; however, floaters were reported rarely (81.8 and 9%, respectively) [9].

Pars planitis may also be asymptomatic especially in young children. Preverbal children with pars planitis are usually diagnosed incidentally since the disease symptoms are quiet and the eyes are white leading to delayed diagnosis and ocular complications. As a consequence, leukocoria, amblyopia and strabismus may be the presenting symptoms in young children [2–4]. In our series, 4 children under 6 years of age were diagnosed incidentally during routine eye examination (14.8%). This is a significant issue that should be taken into account by eye specialists. Despite a benign disease, delays in diagnosis and treatment may lead to blinding complications in children.

Pars planitis affects both the anterior and posterior segments of the eye. The common anterior segment manifestations are inflammatory cells in the anterior chamber and small, round, white keratic precipitates on corneal endothelium which may occur up to 50% of eyes [3–5, 8]. Peripheral corneal endotheliopathy is another specific anterior segment finding, which is thought to indicate the autoimmune nature of the disease. It is characterized by peripheral corneal edema, and linearly arranged mutton fat keratic precipitates on the border of edematous and normal cornea [4]. Chronic inflammation and delayed diagnosis may cause anterior segment complications such as posterior synechiae, band keratopathy and cataract [4]. Cataract and band keratopathy are of great importance in children due to the risk of amblyopia [19, 20]. In previous studies, cataract was reported as a frequent complication affecting 30.4–47.5% of patients [4, 5, 11, 21]. However in our series, we found the rate of cataract formation as 18.5%. None of the eyes developed band keratopathy. The reason of the low complication rates in our series may be the early diagnosis and treatment with monthly follow-up visits.

Posterior segment involvement is the prominent clinical feature of pars planitis. The characteristic signs are snowbanks, snowball opacities and vitreous inflammation with cells in anterior and mid-vitreous. Snowbanks are defined as the exudates on pars plana, which are the most frequent findings of pars planitis. Snowballs are also common findings seen as yellow-white inflammatory aggregates in the mid-vitreous and inferior vitreous. In the study by Donaldson et al., the occurrence rate of snowbanks and snowballs was reported as 97.8 and 67.4%, respectively [5]. In our study, snowbanks were detected in 66.7% of eyes, and snowballs in 74.1% (Fig. 1).

In cases with retinal complications, fundus fluorescein angiography (FFA) is a diagnostic tool in demonstrating peripheral retinal vasculitis with staining and leakage of retinal venules, cystoid macular edema with petaloid leakage in the macular region and optic disk edema [22–24]. Peripheral retinal vasculitis has been reported with a variable frequency, ranging from 17 to 90% in previous studies [3, 5–7, 9]. Optic disk edema has also been frequently reported as disk staining in FFA [8, 22]. In our series, FFA was performed in adolescents and adults. The common findings during the inflammatory episodes were staining of the optic disk, hyperfluorescence due to dye leakage in the macular area, and staining and leakage of peripheral retinal vessels (Fig. 2).

Chronic vitreous inflammation may lead to complications including cystoid macular edema, vitreous condensation, cyclitic membranes, retinal neovascularizations, vitreous hemorrhage and peripheral retinal

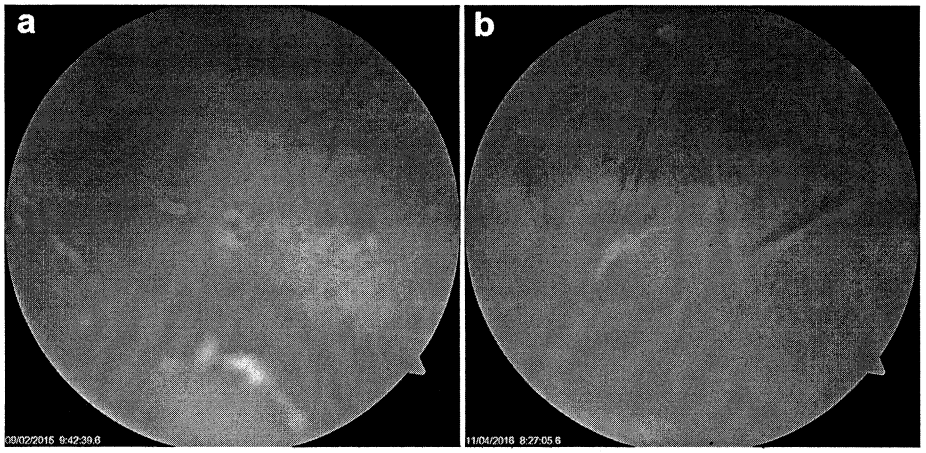


Fig. 1 Colored fundus photos of two patients with snowballs (**a**) and snowbanks (**b**) due to pars planitis

detachment and retinoschisis in progressive cases [3–9]. Cystoid macular edema has been found to be the major cause of vision loss in children. It can be quantitatively demonstrated by optical coherence tomography (OCT). OCT is also helpful in evaluating the response of macular edema to treatment (Fig. 3). The characteristic appearance in OCT includes cystoid spaces with a large cyst located in central fovea, surrounded by numerous smaller ones. The central foveal thickness is increased. In chronic cases, IS/OS junction may be damaged leading to unfavorable visual prognosis [25, 26]. Epiretinal membranes may accompany cystoid macular edema causing mechanical traction on the macula in some cases. The rate of cystoid macular edema has been reported as 26% by Donaldson et al., 39% by Kump et al., and 25.7% by Paroli et al. [2, 5, 13]. The rate of cystoid macular edema was found to be 22.2% in our series. Although not statistically significant, it was more frequently seen in adult patients compared to children and adolescents (41.7 and 16.7%, respectively) (Fig. 5).

Retinal neovascularizations may occur as a consequence of chronic vitreous inflammation, leading to vitreous hemorrhages [4, 27]. Lauer et al. [27] reported vitreous hemorrhage in 28% of their pediatric patients. We observed vitreous hemorrhage in 2 eyes of the same patient (3.7%) with 2 years interval in between. He underwent pars plana vitrectomy surgeries (PPV) achieving final BCVA of 1.0 snellen lines in both sides (Fig. 4). The operative steps included 25-gauge three-port PPV, endolaser photocoagulation of peripheral retina and air tamponade with a few days face-down positioning.

Inferior peripheral retinal detachments were detected in 11.1% of eyes. The detached area was demarcated by a few rows of laser photocoagulation posterior to the borders of detached retina. None of the cases progressed to total retinal detachment, and the

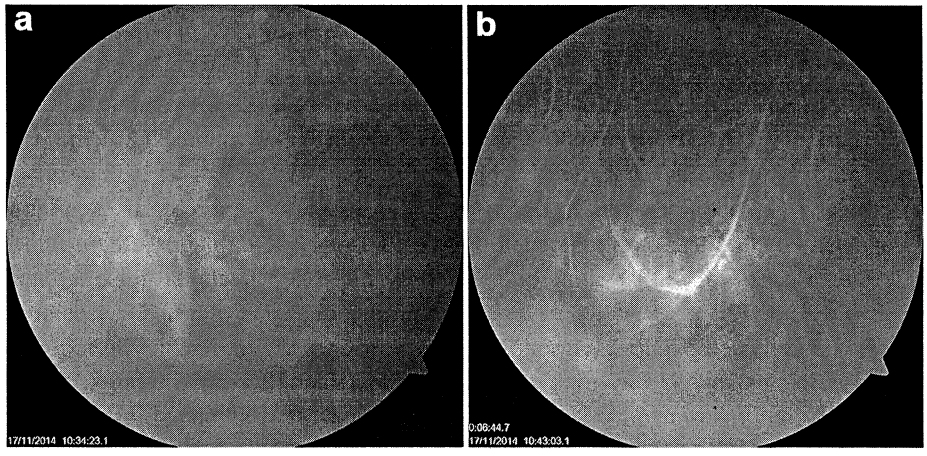


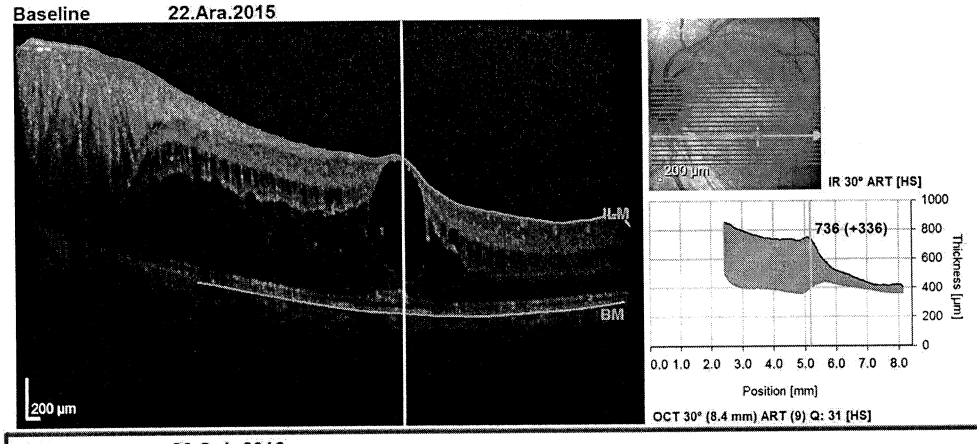
Fig. 2 Colored fundus photo of a 21-year old patient with snowbanks and peripheral retinal vasculitis (**a**), FFA image of the same eye demonstrating perivascular leakage and staining in late phase (**b**)

Retina Change Report, All Follow-Ups
SPECTRALIS® Tracking Laser Tomography

HEIDELBERG ENGINEERING

Patient: DERICI , ARDA **DOB:** 12.May.2011 **Sex:** M **OS**
Patient ID: ---
Diagnosis: --- **Comment:** ---

Baseline 22.Ara.2015



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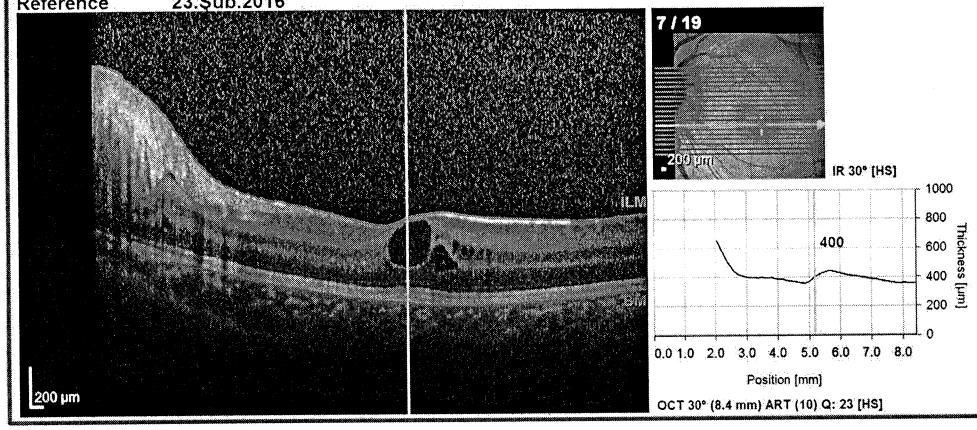
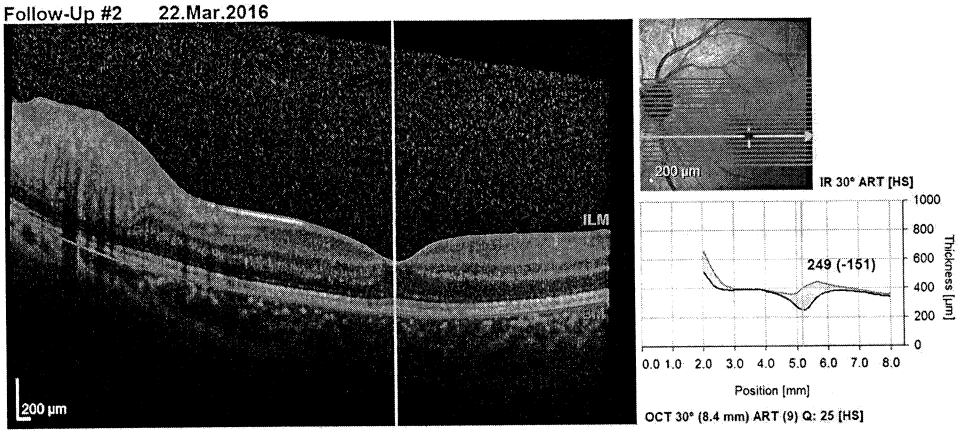


Follow-Up #2 22.Mar.2016



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◀**Fig. 3** OCT images of 5-year old male patient with pars planitis. Cystoid macular edema and recovery process after posterior subtenon corticosteroid injection is demonstrated

visual prognosis was favorable in all eyes. Inferior peripheral retinal elevations have been frequently reported in other studies ranging from 10 to 54.5% [3–5, 28] (Fig. 5). As in our patients, they were also reported to be stable and limited, rarely progressing to total retinal detachment [28].

Glaucoma has been reported as a rare complication of pars planitis, with a rate of 6–8% [8, 10]. We detected glaucoma in 3 (5.6%) eyes after posterior subtenon corticosteroid injections. They were successfully managed by topical instillations of antiglaucomatous drops, and none of them required filtering surgery.

The treatment of pars planitis has been controversial. In the guidelines described by Forrester et al., treatment has been suggested for patients with a visual acuity worse than 20/40 [29]. However, the novel approach is somewhat different, suggesting treatment in early stages before the complications develop, irrespective of the visual acuity levels [30, 31]. Kaplan described a four-step approach in 1984 including periocular corticosteroid injections followed by oral corticosteroids, cryotherapy or laser photocoagulation, pars plana vitrectomy and immunosuppressive treatment, respectively [32]. However, this treatment strategy has been modified as five steps by adding the nonsteroidal anti-inflammatory drugs (NSAİD) as the second step [31].

In our study, the patients with anterior uveitis were given hourly instillations of topical methylprednisolone drops and cycloplegic agents. Prompt treatment of anterior uveitis is very important since delayed treatment initiates the cascade of numerous intraocular complications [19, 20]. In children, anterior uveitis may be overlooked because the eyes are often quiet and asymptomatic. Because of that, anterior segment complications have been reported more often in children compared to adults. In our series, the rate of cataract was found to be 18.5%. In patients with cataract secondary to pars planitis, phacoemulsification surgery has been reported to be a safe surgical procedure [33, 34]. In the study by Ganesh et al., visual improvement was achieved in 91% of eyes after cataract surgery (33). Cataract surgery was performed in 7.4% of eyes in our series. The BCVA after cataract surgery improved to 0.6 snellen lines or better in all patients and no complications were recorded. Precautions should be taken through cataract surgery in eyes with uveitis. Preoperative careful evaluation, initiation of systemic corticosteroids or immunosuppressive agents prior to the surgery in required cases, atraumatic phacoemulsification surgery with intracapsular hydrophobic acrylic intraocular lens implantation, and postoperative close follow-up are mandatory to achieve good postoperative results in uveitis [30, 33–35].

The management of vitreous inflammation and posterior segment complications in our patients were as follows: The eyes with vitreous haze and inflammation were firstly treated by posterior subtenon

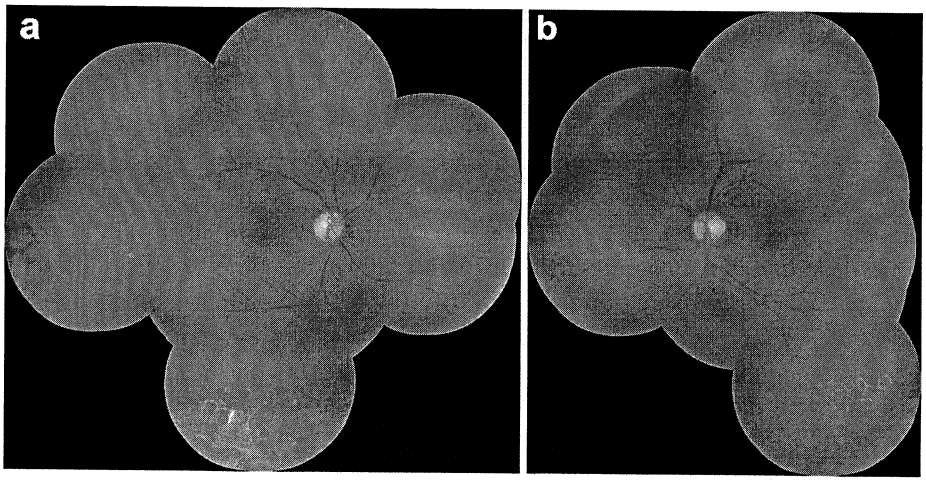

Fig. 4 *Right* (**a**), and *left* (**b**) fundus appearances of 16-year old patient after pars plana vitrectomy and endolaser photocoagulation of peripheral retina

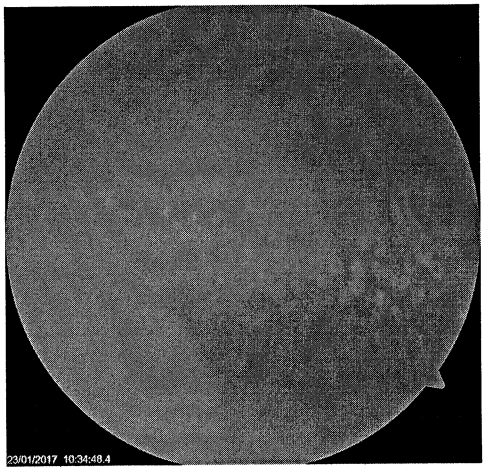

Fig. 5 Inferior peripheral retinal detachment and laser photocoagulation scars posterior its borders are seen in 15-year old patient with pars planitis

steroid injections (16.6%). The procedure was performed under general anesthesia in children. Adult patients were injected 40 mg/ml triamcinolone acetonide, while the children were injected half doses in order to avoid glaucoma. In children with bilateral vitreous condensations, the injections were performed bilaterally with half doses. Intravitreal dexamethasone (Ozurdex, Allergan, Irvine, CA, USA) was implanted in 3.6% of the eyes. Dexamethasone implant has been reported to be an effective treatment in eyes with noninfectious intermediate and posterior uveitis [36, 37]. It has a lower tendency of causing glaucoma or cataract compared to intravitreal triamcinolone acetonide.

In children who could not have general anesthesia, or have high intraocular pressures due to previous injections, oral corticosteroids were given with a dosage of 1 mg/kg/day (63% of patients). None of our patients required intravenous pulse steroids.

In cases with frequent inflammatory episodes requiring long-term treatment, steroid sparing agents were initiated. Methotrexate (22%), cyclosporine (22%) and azathioprine (11%) were the choice of treatment in our patients. In the literature, methotrexate has been reported as the most widely used immunosuppressive agent, followed by cyclosporine and azathioprine [30, 38, 39]. However, as immunosuppressive agents require 4–8 weeks to take action, they should be used in combination with corticosteroids during that interval.

Peripheral retinal elevations including fibrovascular traction, localized retinal detachment or retinoschisis frequently develop in pars planitis. These elevations usually do not progress to total retinal detachment since they develop secondary to the glial traction caused by snowbanks over ora serrata, in the absence of peripheral vitreous traction [28]. However, considering the activity and life expectancy in this age group, we preferred to take precautions by performing peripheral laser photocoagulation to demarcate and limit retinal elevation in such cases (18.5%). None of our cases developed progressive retinal detachment, and the elevations remained limited to inferior peripheral retina.

Peripheral laser photocoagulation has also been reported to be effective in the treatment of peripheral retinal neovascularization by decreasing release of angiogenic factors [40–42]. However, in spite of laser photocoagulation, non-clearing vitreous hemorrhages may still develop leading to PPV surgeries. In this study, the rate of non-clearing vitreous hemorrhage was recorded as 3.7%. PPV is considered as the last step of treatment in cases with retinal complications including vitreous condensation, hemorrhage, retinal detachment, epiretinal membranes and macular edema refractory to medications. The advantages of PPV include both surgical clearance of inflammatory mediators and debris and releasing the tractional forces on the peripheral retina and macula [43–45]. According to our opinion, PPV is also an effective way of terminating or diminishing the inflammatory episodes in selected cases. In eyes with refractory vitreous condensation obscuring the visual axis or with non-clearing vitreous hemorrhage, PPV is an effective way of recovering vision. However owing to the young age of patients, lens sparing surgery should be done if cataract is not present. Also iatrogenic lens trauma should be avoided during surgery.

Conclusions

Although pars planitis is often expected to be a benign and age-limited ocular inflammation, it may lead to serious vision deteriorating complications if treatment is delayed. This fact is even more important considering the young age and long life expectancy of the population affected by the disease. Our study revealed that high rates of treatment success, favorable final

visual acuity levels and low complication rates could be achieved with timely diagnosis, close follow-up and adequate treatment in patients with pars planitis. This study also lays emphasize on the dynamicity of the order of therapeutic steps according to the requirements and severity of each eye.

Compliance with ethical standards

Conflict of interest Authors Nilufer Berker, Emine Sen, Ufuk Elgin, Cemile Ucgul Atilgan, Erdem Dursun and Pelin Yilmazbas declare that they have no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards. This study was approved by the Ethical Committee of Ankara Numune Training and Research Hospital.

Informed consent Informed consent was obtained from all individual participants included in the study.

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