Published in final edited form as:

Ocul Immunol Inflamm. 2019 ; 27(3): 389–395. doi:10.1080/09273948.2017.1386791.

Clinical Characteristics of Ocular Sarcoidosis: A Population Based Study 1976–2013

Patompong Ungprasert, MD, MS^{1,2,*}, Andrea A. Tooley, MD³, Cynthia S. Crowson, MS^{1,4}, Eric L. Matteson, MD, MPH^{1,5}, and Wendy M. Smith, MD³

¹Division of Rheumatology, Department of Internal Medicine, Mayo Clinic College of Medicine and Science, Rochester, MN 55905, USA ²Division of Clinical Epidemiology, Siriraj Medical Research Center, Faculty of medicine Siriraj hospital, Mahidol University, Bangkok 10700, Thailand

³Department of Ophthalmology, Mayo Clinic College of Medicine and Science, Rochester, MN 55905, USA ⁴Division of Biomedical Statistics and Informatics, Department of Health Sciences Research, Mayo Clinic College of Medicine and Science, Rochester, MN 55905, USA ⁵Division of Epidemiology, Department of Health Sciences Research, Mayo Clinic College of Medicine and Science, Rochester, MN 55905, USA

Abstract

PURPOSE—To characterize the epidemiology and clinical characteristics of ocular involvement in patients with systemic sarcoidosis.

METHODS—An inception cohort of patients with systemic sarcoidosis in 1976–2013 in Olmsted County, Minnesota, was identified based on comprehensive individual medical record review. Medical records of those patients were then reviewed for ocular involvement.

RESULTS—A total of 345 incident cases of systemic sarcoidosis were identified. Ocular involvement occurred in 23 patients (7%). The most common ocular disease was uveitis (61%) followed by dry eye disease, conjunctival nodule, episcleritis, anterior scleritis and conjunctivitis. Anterior uveitis was the most common type of uveitis (71%). Visual outcome of uveitis was

*Corresponding author; P.U.: P.Ungprasert@gmail.com; Division of Rheumatology, Mayo Clinic, 200 First Street SW, Rochester, MN 55905, USA. Tel 507-284-8450 Fax 507-284-0564.

b. Financial disclosure by every author: No financial disclosure

Author contribution:

Patompong Ungprasert: 1. Conception and design 2. Acquisition, analysis and interpretation of data 3. Drafting of the manuscript 4. Statistical analysis

Andrea A. Tooley: 1. Conception and design 2. Acquisition and interpretation of data 3. Critical revision of the manuscript for important intellectual content

Cynthia S. Crowson: 1. Conception and design 2. Analysis and interpretation of data 3. Critical revision of the manuscript for important intellectual content 4. Statistical analysis

Eric L. Matteson: 1. Conception and design 2. Acquisition and interpretation of data 3. Critical revision of the manuscript for important intellectual content 4. Supervision

Wendy M. Smith: 1. Conception and design 2. Acquisition and interpretation of data 3. Critical revision of the manuscript for important intellectual content 4. Supervision

Patompong Ungprasert and Cynthia S. Crowson had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

favorable with only 1 patient lost 3 or more lines of VA during follow-up and had VA of less than 20/200 at last visit.

CONCLUSION—Ocular involvement occurred in 7% of sarcoidosis patients. Uveitis was the most common type of ocular disease.

Keywords

sarcoidosis; uveitis; epidemiology; granuloma; cohort study

Introduction

Sarcoidosis is a chronic granulomatous disease of unknown etiology characterized by the presence of non-necrotizing granulomas. Sarcoidosis typically affects the lungs and hilar lymph nodes even though any organ system may be affected, sometimes posing a great diagnostic challenge. The reported incidence of sarcoidosis varies from 6 to 70 per 100,000 persons per year, depending on the ethnic background of the population.^{1–3} The prognosis of the disease is generally favorable but progressive organ dysfunction may occur.^{4–6}

Ocular involvement is a well-recognized extra-thoracic complication of systemic sarcoidosis. Uveitis is the most common ocular disease, although any eye structure may be affected. The reported prevalence of ocular disease among patients with systemic sarcoidosis varies from 12% to 50%.^{7–10} However, most of the available studies are referral-based, which may potentially capture only more severe cases and not represent the true spectrum of the disease in the community. The objective of this study was to describe the epidemiology of ocular sarcoidosis, with an emphasis on clinical characteristics, in a geographically well-defined population of patients.

Methods

Data source and study population

Through the resources of the Rochester Epidemiology Project (REP), the population of Olmsted County, Minnesota, is well suited for investigation of the epidemiology and clinical characteristics of ocular sarcoidosis because of the availability and accessibility to medical records from all residents who have sought medical care for over 6 decades from all local health care providers, which include the Mayo Clinic, the Olmsted Medical Center, local nursing homes and a few private practitioners. This system allows a virtually complete ascertainment of all clinically recognized cases of ocular sarcoidosis among the residents of Olmsted County, Minnesota. The population of Olmsted County is predominately Northern European although it has become increasingly more diverse in recent years (98.0% White, 0.4% African-American and 1.1% Asian in 1980; 85.7% White, 4.8% African-American and 5.5% Asian in 2010). The potential of the REP record linkage system for use in population-based studies has previously been described.^{11, 12}

Approval for this study was obtained from the Mayo Clinic and Olmsted Medical Center institutional review boards and the need for informed consent was waived.

Study design

A cohort of Olmsted County, Minnesota residents diagnosed with systemic sarcoidosis between January 1, 1976 and December 31, 2013 was identified based on comprehensive medical record review. Potential cases were initially identified using diagnostic codes related to sarcoid, sarcoidosis, and contextual non-caseating granuloma. Diagnosis of sarcoidosis was then verified by individual medical record review. Inclusion required physician diagnosis supported by histopathologic evidence of non-caseating granuloma without evidence of mycobacterial or fungal infection, radiographic features of intrathoracic sarcoidosis and compatible clinical presentations, without evidence of other granulomatous diseases. The only exception to the requirement of pathological confirmation was stage I pulmonary sarcoidosis that required only radiographic evidence of symmetric bilateral hilar adenopathy. Biopsy-proven isolated granulomatous disease of a specific organ except for the skin was also included, if there was no better alternative diagnosis. Cases with a diagnosis of sarcoidosis prior to residency in Olmsted County were excluded.

The medical records of these patients were then reviewed for ocular involvement. A standardized data extraction form was utilized to record the following information: age at diagnosis; sex; ethnicity; duration of follow up; type of ocular involvement which included scleritis, episcleritis, conjunctivitis, conjunctival nodule, uveitis, optic neuritis, orbital pseudotumor, eyelid lesion and lacrimal gland disease; ophthalmologic presentations; laterality; visual acuity at diagnosis and at last follow-up; angiotensin converting enzyme (ACE) level and serum calcium level at diagnosis; treatment and response to treatment. Descriptive statistics (means, percentages, etc.) were used to summarize the data.

Results

From 1976 to 2013, 345 incident cases of systemic sarcoidosis were identified. The mean age was 45.6 years; 50% were female; 90% were Caucasian and 5% were African-American. A total of 151 patients (44%) had at least 1 visit with an eye care provider during the follow-up period. Among 18 African-American patients with sarcoidosis, 15 (83%) had at least 1 visit for an ophthalmologic examination. Referral to an ophthalmologist was at the discretion of clinicians who evaluated the patients. Therefore, there were patients who were referred or presented to ophthalmologists because of ophthalmologic symptoms and patients who were asymptomatic but were referred to ophthalmologists for screening.

Ocular involvement occurred in 40 eyes of 23 patients, 7% of all sarcoidosis patients in this cohort and 15% of those with at least 1 ophthalmologic examination. The mean age at diagnosis of eye disease was 51.8 years; 65% were female, 78% Caucasian, 17% African-American and 4% Native-American. The median duration of follow up was 6.3 years (Interquartile range [IQR], 3.6 – 10.5 years). The most common ocular disease was uveitis (14 cases) followed by dry eye disease (4 cases) and conjunctival nodule (3 cases). Other types of ocular involvement observed in this cohort included episcleritis, anterior scleritis, conjunctivitis, lacrimal gland involvement, eyelid lesion and optic neuritis. Table 1 describes the demographics, type of ocular disease, fulfillment of the International Workshop on Ocular Sarcoidosis criteria¹³, visual acuity, treatments and ophthalmic complications of the 23 patients with ocular sarcoidosis.

Among 14 cases with uveitis, 79% were female; 86% were Caucasian, 7% were African-American and 7% were Native-American. Mean age at diagnosis of uveitis was 56.5 years. The mean duration of follow up was 6.7 years (IQR, 3.6 – 10.5 years). Anterior uveitis was the most common classification (71%) followed by intermediate uveitis (21%), posterior uveitis (7%) and panuveitis (7%). One patient had anterior uveitis and intermediate uveitis. Uveitis was bilateral in all but one patient (93%). In 8 cases (57%), uveitis preceded the diagnosis of systemic sarcoidosis, with a median duration of 2.5 months (IQR, 1.4 – 11.1 months) from the onset of uveitis to the sarcoidosis diagnosis. The other 6 patients were diagnosed with uveitis after the diagnosis of systemic sarcoidosis was established with the longest duration from systemic sarcoidosis to uveitis of 6 years.

Visual acuity (VA) of patients with uveitis was generally good at diagnosis with the majority of eyes having VA of 20/20 to 20/25 in each eye. Visual outcome was also good; only 4 of 24 affected eyes with adequate follow-up lost more than or equal to 3 lines of VA (define as losing more than or equal to 0.3 logMAR) during follow-up due to uveitis, and only 1 eye had VA worse than 20/200 at last visit (Table 1). ACE level was elevated in 83% of patients (10 out of 12 tested patients) while hypercalcemia was found in 46% of patients (6 out of 13 tested patients) in whom these tests were obtained. All patients had intrathoracic involvement of sarcoidosis (hilar adenopathy and/or interstitial infiltration).

The majority of patients with sarcoid uveitis in this cohort were treated with topical glucocorticoids for the eyes (78%) and/or oral glucocorticoids (64%). Disease modifying anti-rheumatic agents (DMARDs) and biologic agents were infrequently required (only 1 case with methotrexate and 1 case with hydroxychloroquine). It should be noted that the treatment was generally dictated by non-ocular involvement of sarcoidosis and some of the medications were not prescribed for uveitis per se. Ocular complications associated with inflammation and/or treatment included 50% posterior synechiae, 43% cataract, 36% glaucoma/ocular hypertension, and 36% macular edema (Table 1).

Dry eye syndrome (4 cases) and conjunctival nodule (3 cases) were the second and third most common type of ocular involvement, respectively. Most of patients with conjunctival nodule presented with red eyes and eye irritation without significant visual impairment. Biopsy was performed in 2 cases and granulomatous inflammation was observed in both. All patients received systemic glucocorticoids but the treatment was primarily dictated by non-ocular involvement of sarcoidosis (Table 1).

Similar to those with uveitis, all but 1 patient with non-uveitis ocular sarcoidosis, which included patients with conjunctival nodule, conjunctivitis, episcleritis, lacrimal gland involvement, eyelid lesion and optic neuritis, had intrathoracic involvement of sarcoidosis (hilar adenopathy and/or interstitial infiltration). ACE level was elevated in 33% of patients (3 out of 9 tested patients) while hypercalcemia was found in 46% of patients (1 out of 8 tested patients). All had baseline VA at diagnosis between 20/20 and 20/40. No eyes lost more than 1 line of VA during follow-up (define as losing more than 0.1 logMAR).

Discussion

This study provides the first comprehensive data on the clinical characteristics of ocular involvement of sarcoidosis using a population-based cohort. Ocular involvement was a relatively infrequent manifestation of sarcoidosis in this cohort as only 7% of patients ever had any ocular disease during follow-up. Since this is a retrospective study, not all of the patients in this cohort were referred for an ophthalmic evaluation; less than half had an eye examination. Thus, cases with subclinical ocular disease could have been missed. Among those who had an ophthalmic examination, the frequency of ocular involvement was 15%. It is possible there was a selection bias since patients with eye complaints are more likely to be referred for ophthalmic evaluation and probably more likely to have ocular involvement. Therefore, the true frequency of ocular involvement is probably somewhere between 7% and 15%.

The prevalence of ocular involvement in sarcoidosis varies considerably in previous studies, ranging from 12% to 50%.^{7–10} The prevalence in our cohort was at the lower end of this range. Differences in study populations and the methodologies to define the sarcoidosis cohort and ocular involvement may explain the wide prevalence range. The current population-based cohort might capture a more complete spectrum of the disease (including less severe cases) in comparison to previous referral-based cohorts. Another possible explanation is related to the different ethnic compositions of the studies. The previous U.S. cohort that reported ocular involvement in up to one-fourth of sarcoidosis patients consisted of approximately 65% African-Americans⁸, while the majority of the current cohort is Caucasian. The frequency of ocular involvement in this study is somewhat similar to another U.S. study that utilized the predominantly Caucasian Veterans Health Administration (VHA) National Patient Care Database.¹⁴ The VHA study found ocular involvement in 8% of the entire cohort and 37% of those who were evaluated at least once in ophthalmology clinic.

Uveitis was the most common ocular disease among our sarcoidosis patients. Anterior uveitis was the most common subtype of uveitis, consistent with findings from other predominantly Caucasian cohorts.^{14, 15} Posterior uveitis and panuveitis were less common and diagnosed in only 7% of patients. Nevertheless, among non-Caucasian patients, posterior uveitis and panuveitis may be more prevalent as a cohort study of predominantly African-American patients reported that posterior uveitis occurred in approximately one-third of the patients, whereas a study of a non-Caucasian population found that panuveitis was the most common subtype of uveitis, occurring in approximately half of the patients.^{16, 17} In this study, the majority of the patients with sarcoid uveitis were female (79%) which is consistent with a previous study that found male sex was a protective factor against development of uveitis (odds ratio of 0.76).¹⁴

Patients with sarcoid uveitis frequently presented with blurred vision, eye pain and floaters, similar to uveitis from other etiologies. Interestingly, eye symptoms were the first presentation that led to the eventual diagnosis of systemic sarcoidosis in more than half of these patients, highlighting the important role of ophthalmologists in establishing the diagnosis of this multi-system disorder. On the other hand, uveitis can occur long after the initial diagnosis of systemic sarcoidosis (up to 6 years in the current cohort).

Approximately one-fifth of the patients with sarcoid uveitis and over half of patients with non-uveitis ocular sarcoidosis had normal ACE levels. Thus, ACE level is not a reliable screening test to rule out sarcoidosis. These results are in line with previous studies reporting 62–84% sensitivity of elevated ACE level.^{17, 18} On the other hand, chest imaging was very helpful to determine the presence of systemic sarcoidosis, as all 14 patients with uveitis and all but 1 patient with non-uveitis ocular sarcoidosis had intrathoracic involvement.

Visual outcome of sarcoid uveitis was favorable in this cohort. The majority of patients had very good VA at diagnosis and only 1 patient lost 3 or more lines of VA during follow-up and had VA of less than 20/200 at last visit. The visual outcome of patients with non-uveitis ocular sarcoidosis was also good as no eye lost more than 1 line of VA during follow up and none had VA worse than 20/50 at the last visit. The visual outcome from this cohort differed from older studies that found VA at last follow of less than 20/200 in 15% of patients in one cohort¹⁹ and last VA of less than 6/36 in 16% of patients in another.²⁰ A more recent study from France demonstrated VA outcomes similar to those in the current cohort; only 2 of 83 patients with sarcoid uveitis had VA of less than 20/200 at the last visit.²¹ There are several possible explanations for the discrepancies in long-term prognosis including population-based variation in clinical phenotype of ocular sarcoidosis and different approaches to sarcoidosis management across healthcare systems and over time.

The major strength of this study is that it is a population-based cohort with a long duration of follow-up. The comprehensive record-linkage system allows capture of virtually all clinically recognized cases of ocular sarcoidosis in the community. The population-based approach also demonstrates the complete spectrum of the disease in community and minimizes referral bias. Moreover, the diagnosis of sarcoidosis was verified by medical record and histopathology report review, minimizing the likelihood of misclassification, a common concern in coding-based studies. The long duration of follow-up also provides data on long-term visual outcomes.

The major limitations are those inherent in the retrospective nature of the study. Patients were not systematically evaluated and clinical information was not systematically obtained. Less than half of patients in this cohort were evaluated by ophthalmologists. As a population-based study, eye examinations performed in the medical facilities participating in the REP were captured; eye examinations done outside the catchment or performed by independent optometrists not reported or provided to treating physicians in REP facilities may not have been captured.

Another potential limitation of this study is related to the predominantly Northern European ancestry of the population of Olmsted County, Minnesota. While this study does provide unique data on the ocular involvement of sarcoidosis among a predominantly Caucasian population, the results might not be generalizable to more ethnically diverse populations. For instance, African-American patients in this cohort appeared to have more non-uveitis ocular sarcoidosis and were male-predominant although the number of patients was small, and larger cohorts of African-American patients are needed to better describe the clinical characteristics and outcomes of ocular sarcoidosis in that population. The healthcare system in Olmsted County is relatively unified, and the population has a higher proportion of health-

care workers and a higher education level, factors that might affect the pattern of healthcare utilization and adherence/response to treatment.

Conclusion

Among this predominantly Caucasian cohort of sarcoidosis patients, ocular involvement occurred in 15% of those who had at least 1 ophthalmologic examination. Uveitis was the most common type of ocular disease. The long-term visual outcome was favorable. Eye symptoms were the first presentation that led to the diagnosis of systemic sarcoidosis in more than half of the patients with uveitis, highlighting the importance of the ophthalmologic assessment in the diagnosis of this systemic disorder.

Acknowledgments

a. Funding: This study was made possible using the resources of the Rochester Epidemiology Project, which is supported by the National Institute on Aging of the National Institutes of Health under Award Number R01 AG034676, and CTSA Grant Number UL1 TR000135 from the National Center for Advancing Translational Sciences (NCATS), a component of the National Institutes of Health (NIH). The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

c. Other acknowledgment: None

References

1. Cozier YC. Assessing the worldwide epidemiology of sarcoidosis: challenges and future directions. *Eur Resp J*. 2016; 48(6):1545–1548.
2. Cozier YC, Berman JS, Palmer JR, Boggs DA, Serlin DM, Rosenberg L. Sarcoidosis in black women in the United States: Data from the black women's health study. *Chest*. 2011; 139(1):144–150. [PubMed: 20595459]
3. Henke CE, Henke G, Elveback LR, Beard CM, Ballard DJ, Kurland LT. The epidemiology of sarcoidosis in Rochester Minnesota: A population-based study of incidence and survival. *Am J Epidemiol*. 1986; 123(5):840–845. [PubMed: 3962966]
4. Gideon NM, Mannino DM. A sarcoidosis mortality in the United States, 1979–1991: An analysis of multiple-cause mortality data. *Am J Med*. 1996; 100(4):423–427. [PubMed: 8610729]
5. Liu D, Birnbaum D. Update on sarcoidosis. *Curr Opin Ophthalmol*. 2015; 26(6):512–516. [PubMed: 26448043]
6. Pereira CA, Dornfeld MC, Baughman R, Judson MA. Clinical phenotypes in sarcoidosis. *Curr Opin Pulm Med*. 2014; 20(5):496–502. [PubMed: 25035964]
7. Baughman RP, Teirstein AS, Judson MA, et al. Case Control Etiologic Study of Sarcoidosis (ACCESS) research group. Clinical characteristics of patients in a case control study of sarcoidosis. *Am J Respir Crit Care Med*. 2001; 164(10 Pt 1):1885–1889. [PubMed: 11734441]
8. Judson MA, Boan AD, Lackland DT. The clinical course of sarcoidosis: presentation, diagnosis, and treatment in a large white and black cohort in the United States. *Sarcoidosis Vasc Diffuse Lung Dis*. 2012; 29(2):119–127. [PubMed: 23461074]
9. Jabs DA, Johns CJ. Ocular sarcoidosis in chronic sarcoidosis. *Am J Ophthalmol*. 1986; 102(3):297–301.
10. Jamilloux Y, Kodjikian L, Broussolle C, Seve P. Sarcoidosis and uveitis. *Autoimmun Rev*. 2014; 13(8):840–849. [PubMed: 24704868]
11. Rocca WA, Yawn BP, St Sauver JL, Grossardt BR, Melton LJ III. History of the Rochester Epidemiology Project: Half a century of medical records linkage in a U.S population. *Mayo Clin Proc*. 2012; 87(12):1202–1213. [PubMed: 23199802]
12. Melton LJ 3rd. History of the Rochester Epidemiology Project. *Mayo Clin Proc*. 1996; 71(3):266–274. [PubMed: 8594285]

13. Herbort CP, Rao NA, Mochizuki M. International criteria for the diagnosis of ocular sarcoidosis: Results of the first International Workshop on Ocular Sarcoidosis (IWOS). *Ocul Immunol Inflamm.* 2009; 17(3):160–169. [PubMed: 19585358]
14. Birnbaum AD, French DD, Mirsaeidi M, Wehrli S. Sarcoidosis in the national veteran population: Association of ocular inflammation and mortality. *Ophthalmology.* 2015; 122(5):934–938. [PubMed: 25687027]
15. Heiligenhaus A, Wefelmeyer D, Wefelmeyer E, Rosel M, Schrenk M. The eye as a common site for the early clinical manifestation of sarcoidosis. *Ophthalmic Res.* 2011; 46(1):9–12. [PubMed: 21099232]
16. Evans M, Sharma O, LaBree L, Smith RE, Rao NA. Differences in clinical findings between Caucasians and African Americans with biopsy-proven sarcoidosis. *Ophthalmology.* 2007; 114:325–333. [PubMed: 17123620]
17. Febvay C, Kodjikian L, Maucourt-Boulch D, et al. Clinical features and diagnostic evaluation of 83 biopsy-proven sarcoid uveitis cases. *Br J Ophthalmol.* 2015; 99(10):1372–1376. [PubMed: 25837608]
18. Baarsma GS, La Hey E, Glasius E, et al. The predictive value of serum angiotensin converting enzyme and lysozyme levels in the diagnosis of ocular sarcoidosis. *Am J Ophthalmol.* 1987; 104(3):211–217. [PubMed: 2820230]
19. Dana MR, Merayo-Llodes J, Schaumberg DA, Foster CS. Prognosticators for visual outcome in sarcoid uveitis. *Ophthalmology.* 1996; 103(11):1846–1853. [PubMed: 8942880]
20. Edelsten C, Pearson A, Joynes E, Stanford MR, Graham EM. The ocular and systemic prognosis of patients presenting with sarcoid uveitis. *Eye (Lond).* 1999; 13(Pt 6):748–753. [PubMed: 10707138]
21. Rochepeau C, Jamilloux Y, Kerever S, et al. Long-term visual and systemic prognoses of 83 cases of biopsy-proven sarcoid uveitis. *Br J Ophthalmol.* 2016

Table 1

Clinical characteristics, treatment and complications of 23 sarcoidosis patients with ocular involvement

Patient number	Sex, ethnicity and age in years	IWOS criteria	Type of ocular involvement	Presenting symptoms	Laterality of ocular involvement	Snellen VA OD at first visit (logMAR)	Snellen VA OS at first visit (logMAR)	Snellen VA OD at last visit (logMAR)	Snellen VA OS at last visit (logMAR)	Other involved organs	Duration of follow up (years)	Treatment**	Complications
1	Female, Caucasian, 76	Definite	Anterior Uveitis	Eye pain and blurred vision	Bilateral	20/20 (0.00)	20/20 (0.00)	20/50 (0.40)	NLP	Lung and extra-thoracic lymph node	7.1	Topical and oral glucocorticoids	Posterior synechiae, peripheral anterior synechiae, cataract, glaucoma and iris neovascularization
2	Female, Caucasian, 64	Definite	Anterior Uveitis	Floater and blurred vision	Bilateral	20/30 (0.18)	20/60 (0.48)	20/25 (0.10)	20/20 (0.00)	Lung	7.1	Topical NSAIDs, topical, intra-ocular and peri-ocular glucocorticoids	Posterior synechiae, cataract, glaucoma, macular edema, peripheral chorioretinal scars and epiretinal membrane
3	Female, Caucasian, 52	Definite	Anterior Uveitis	Red eye and blurred vision	Bilateral	20/20 (0.00)	20/20 (0.00)	20/30 (0.18)	20/25 (0.10)	Lung and heart	5.7	Topical and oral glucocorticoids	Posterior synechiae
4	Female, Caucasian, 53	Definite	Anterior Uveitis	No symptoms, found on screening examination	Bilateral	20/25 (0.10)	20/25 (0.10)	$\frac{1}{2}$ 0/100 (0.70)	20/30 (0.18)	Lung and skin	23.4	Topical and oral glucocorticoids	Cataract
5	Female, Caucasian, 50	Definite	Anterior Uveitis	Eye pain and blurred vision	Bilateral	20/20 (0.00)	20/20 (0.00)	20/25 (0.10)	20/25 (0.10)	Lung and liver	4.5	Topical glucocorticoids	Posterior synechiae in both eyes (later lysed)
6	Male, Native American, 27	Definite	Anterior Uveitis	Blurred vision	Bilateral	20/20 (0.00)	20/20 (0.00)	N.A.	N.A	Lung, liver, spleen and kidney	0.02	Topical and oral glucocorticoids	None
7	Female, Caucasian, 53	Definite	Anterior Uveitis	Floater and blurred vision	Bilateral	20/20 (0.00)	20/20 (0.00)	20/20 (0.00)	20/20 (0.00)	Lung, upper respiratory tract and bone	3.6	Topical and inhaled glucocorticoids	Posterior synechiae and ocular hypertension
8	Female, Caucasian, 50	Definite	Anterior Uveitis and dry eye syndrome	Eye pain and blurred vision	Bilateral	20/20 (0.00)	20/20 (0.00)	20/25 (0.10)	20/25 (0.10)	Lung, skin, spleen, kidney and extra-thoracic lymph node	2.8	Topical and oral glucocorticoids	Posterior synechiae and cataract
9	Male, African-American, 41	Definite	Anterior Uveitis and conjunctivitis	Eye pain, red eye and blurred vision	Bilateral	20/20 (0.00)	20/20 (0.00)	20/20 (0.00)	20/20 (0.00)	Lung, skin, upper respiratory tract and extra-thoracic lymph node	6.3	Oral glucocorticoids, topical glucocorticoids cream for cutaneous sarcoidosis and HCQ	None

Patient number	Sex, ethnicity and age in years	IWOS criteria	Type of ocular involvement	Presenting symptoms	Laterality of ocular involvement	Snellen VA OD at first visit (logMAR)	Snellen VA OS at first visit (logMAR)	Snellen VA OD at last visit (logMAR)	Snellen VA OS at last visit (logMAR)	Other involved organs	Duration of follow up (years)	Treatment**	Complications
10	Female, Caucasian, 77	Presumed	Anterior and Intermediate Uveitis	Floater and blurred vision	Bilateral	20/60 (0.48)	20/40 (0.30)	20/50 (0.40)	20/40 (0.30)	Lung	8.3	Topical, intraocular, and oral glucocorticoids and topical NSAIDs	Posterior synechiae, cataract, glaucoma, epiretinal membrane and macular edema
11	Male, Caucasian, 61	Presumed	Intermediate Uveitis	Blurred vision	Bilateral	20/20 (0.00)	20/20 (0.00)	20/60 (0.50)	20/50 (0.40)	Lung	20.5	Peri-ocular glucocorticoids	Cataract, macular edema and epiretinal membrane
12	Female, Caucasian, 37	Presumed	Posterior Uveitis	No symptoms, found on screening examination	Unilateral	*20/20 (0.00)	20/20 (0.00)	N.A.	N.A.	Lung and joint	0.0	Oral NSAIDs	None
13	Female, Caucasian, 80	Definite	Panuveitis	Eye pain, floater and blurred vision	Bilateral	20/25 (0.10)	20/50 (0.40)	20/40 (0.30)	20/40 (0.30)	Lung	10.5	Oral glucocorticoids and MTX	Macular edema and ocular hypertension
14	Female, Caucasian, 45	Definite	Intermediate uveitis	Blurred vision	Bilateral	20/20 (0.00)	20/20 (0.00)	20/20 (0.00)	20/20 (0.00)	Lung	1.9	Topical, subconjunctival and oral glucocorticoids	Macular edema
15	Female, Caucasian, 57	N.A.	Anterior scleritis	Red eye and eye pain	Unilateral	20/20 (0.00)	*20/25 (0.10)	20/20 (0.00)	*20/20 (0.00)	Lung, skin and joint	13.5	Oral NSAIDs	None
16	Female, Caucasian, 43	N.A.	Episcleritis and conjunctival nodule	Red eye	Unilateral	*20/20 (0.00)	20/20 (0.00)	*20/25 (0.10)	20/20 (0.00)	Lung and skin	12.9	Topical and oral glucocorticoids and oral NSAIDs	None
17	Male, Caucasian, 41	N.A.	Conjunctival nodule	Red eye and lesions on sclera	Unilateral	20/20 (0.00)	*20/20 (0.00)	20/20 (0.00)	*20/20 (0.00)	Lung and liver	3.4	Oral glucocorticoids, MTX and oral NSAIDs	None
18	Male, African-American, 64	N.A.	Conjunctival nodule and dry eye syndrome	Blurred vision and itching	Bilateral	20/40 (0.30)	20/40 (0.30)	20/40 (0.30)	20/50 (0.40)	Lung and skin	10.4	Oral and intralesional (cutaneous) glucocorticoids	None
19	Male, African-American, 51	N.A.	Dry eye disease	Blurred vision, itching, eye pain and epiphora	Bilateral	20/30 (0.18)	20/30 (0.18)	20/30 (0.18)	20/30 (0.18)	Brain	3.6	Oral glucocorticoids, MTX and MMF	None
20	Female, Caucasian, 56	N.A.	Conjunctivitis	Red eye and eye pain	Bilateral	20/20 (0.00)	20/20 (0.00)	20/20 (0.00)	20/20 (0.00)	Lung	10.3	Topical glucocorticoids	None
21	Male, Caucasian, 33	N.A.	Dry eye disease	Red eye, blurred vision and photophobia	Bilateral	20/20 (0.00)	20/20 (0.00)	20/20 (0.00)	20/20 (0.00)	Lung, liver and parotid gland	12.6	Oral glucocorticoids	None
22	Female, Caucasian, 45	N.A.	Optic neuritis	Floater, blurred vision,	Unilateral	*20/20 (0.00)	20/20 (0.00)	*20/20 (0.00)	20/20 (0.00)	Lung and liver	6.0	Oral glucocorticoids	Optic nerve atrophy

Patient number	Sex, ethnicity and age in years	IWOS criteria	Type of ocular involvement	Presenting symptoms	Laterality of ocular involvement	Snellen VA OD at first visit (logMAR)	Snellen VA OS at first visit (logMAR)	Snellen VA OD at last visit (logMAR)	Snellen VA OS at last visit (logMAR)	Other involved organs	Duration of follow up (years)	Treatment**	Complications
				photopsia and headache									
23	Male, African-American, 38	N.A.	Subcutaneous eyelid mass and dacryo-adenitis	Eyelid lesion and peri-orbital swelling, red eye, pain with eye movement, blurred vision, diplopia	Bilateral (eyelid lesion on one side, bilateral lacrimal gland involvement)	20/25 (0.10)	20/25 (0.10)	20/25 (0.10)	20/30 (0.18)	Lung, skin, upper respiratory tract and parotid gland	4.8	Oral glucocorticoids, minocycline, doxycycline, MTX, HCQ, topical tacrolimus cream for cutaneous sarcoidosis and topical NSAID	None

VA OD, visual acuity of right eye; VA OS, visual acuity of left eye; N.A., not applicable; NSAIDs, non-steroidal anti-inflammatory drugs; NLP, no light perception; LogMAR, logarithm of the Minimum Angle of Resolution; HCQ, hydroxychloroquine; MTX, methotrexate; IWOS, International Workshop on Ocular Sarcoidosis

* Affected eye (for cases with unilateral involvement)

** Treatment is primarily dictated by the severity of non-ocular sarcoidosis activity

[†] VA decreased mainly because of macular degeneration