Special Focus, Uvea, Original Article

LV Prasad Eye Institute EyeSmart electronic medical record-based analytics of big data: LEAD-Uveitis Report 1: Demographics and clinical features of uveitis in a multi-tier hospital based network in Southern India

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Purpose: To describe the demographics and epidemiology of uveitis presenting to a multi-tier ophthalmology hospital network in Southern India. **Methods:** Cross-sectional hospital-based study of 19,352 patients with uveitis presenting between March 2012 and August 2018. **Results:** In total, 1,734,272 new patients were seen across the secondary and tertiary centers of our multi-tier ophthalmology hospital network during the study period. Among them, 25,353 eyes of 19,352 patients were diagnosed with uveitis and were included in the study. Uveitis constituted 1.11% of all cases. The majority of patients were male (60.33%) and had unilateral (68.09%) affliction. The most common age group was 21–50 years with 12,204 (63.06%) patients. The most common type of uveitis was anterior uveitis, which was seen in 7380 (38.14%) patients, followed by posterior uveitis in 5397 (23.89%) patients. Among the infectious causes, tuberculosis was the most common etiology (2551 patients, 13%) followed by toxoplasmosis (1147 patients, 6%). **Conclusion:** Uveitis constituted 1.11% of all cases presenting to our clinics. It was more common in the age group of 21–50 and was predominantly unilateral. Anterior uveitis was the most common subtype seen in 38%.

Key words: Big data, electronic medical records, epidemiology, tuberculosis, uveitis

Access this article online

Website: www.ijo.in

DOI: 10.4103/ijo.IJO_1122_21

Quick Response Code:

Uveitis is an important cause of ocular morbidity worldwide. Around 5%–20% of cases of legal blindness in developed countries, and 25% of blindness in the developing world are due to uveitis.[1]

Epidemiology of uveitis can be a valuable guide for developing differential diagnoses and clinical investigations. However, it varies considerably around the world, and various factors, such as host factors, environmental, genetic, ethnic, and demographic factors, can cause such variations. The diversity of uveitis observed in the Asia–Pacific region is different compared with Europe, the US, and other parts of the world.[1-5] There are various reports available from different regions of India regarding the epidemiology of uveitis.[1-5] However, most of these reports are limited by a small sample size and by the heterogeneity of various uveitic entities. The inability of traditional studies to generate larger databases can be surmounted by the use of big data analysis and electronic medical record (EMR)-based systems.

EMR systems today are increasingly replacing paper-based records, with benefits in increasing efficiency and standardizing quality while reducing costs of health care.[6,7] The use of digitized data entry enables the analysis of large datasets of clinical information as compared with the challenges faced with manual records. The various applications of EMR assisting population health management include quantifying treatment outcomes,[8] quantifying and stratifying the severity of disease,[9,10] collecting patient-reported outcomes,[11] documenting lifestyle patterns,[12] and offering the potential to guide medicines regulation.[13] The use of large datasets can also help in understanding the factors influencing health, such as geographical location, nutrition, lifestyle, and their temporal evolution.

Though there are a few large population-based reports characterizing the epidemiology of uveitis,[12-18] there is no large EMR based study from the Indian subcontinent.

In this study, we aim at describing the demographic details, epidemiology distribution of uveitis presenting to a multi-tier ophthalmology hospital network in India by using the data collected from an indigenously developed EMR system (eyeSmart.)

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Received: 17-May-2021 Revision: 07-Oct-2021
Accepted: 07-Dec-2021 Published: 22-Mar-2022

Cite this article as: Tyagi M, Das AV, Kaza H, Basu S, Pappuru RR, Pathengay A, *et al*. LV Prasad Eye Institute EyeSmart electronic medical record-based analytics of big data: LEAD-Uveitis Report 1: Demographics and clinical features of uveitis in a multi-tier hospital based network in Southern India. Indian J Ophthalmol 2022;70:1260-7.

Methods

Study Design, Period, Location, and Approval

This cross-sectional observational hospital-based study included all patients presenting between March 1, 2012 to August 31, 2018 to a multi-tier ophthalmology network located in India.[19] The three-tier eye care model of our network includes 176 vision centers that provide primary care in the districts and villages of Andhra Pradesh, Telangana, Odisha, and Karnataka. These are linked to 18 secondary eye care centers, which are, in turn, linked to tertiary centers in Visakhapatnam, Vijayawada, Bhubaneswar, and Hyderabad. The medical records of all patients who presented to any of these secondary centers and the tertiary centers during August 2012 to August 2018 were reviewed retrospectively using the eyeSmart EMR database.

The patient or the parents or guardians of the patient filled out a standard consent form for electronic data privacy at the time of registration. None of the identifiable parameters of the patient were used for the analysis of the data. The clinical data of each patient who underwent a comprehensive ophthalmic examination was entered into a browser-based electronic medical records system (eyeSmart EMR) by uniformly trained ophthalmic personnel and supervised by an ophthalmologist using a standardized template.[20]

The study adhered to the Declaration of Helsinki and was approved by the institute's ethics committee (LEC BHR-R-05-20-437).

Cases

A total of 1,734,272 new patients presented to the secondary and tertiary centers of the multi-tier ophthalmology network during the study period. The eyeSmart EMR was initially screened for patients with the keywords related to uveitis in the diagnosis columns. A total of 20,388 patient records were identified using this search strategy and were labeled as cases. All the case records were scrutinized and reviewed by two trained ophthalmologists (AVD and MT). The Standardization of Uveitis Nomenclature (SUN) criteria were used to classify the confirmed cases according to anatomic location of inflammation.[21] A total of 1036 cases were not found to conform to the inclusion criteria and were excluded from the study, leaving 19,352 patients for analysis. A total of 25,353 eyes diagnosed with uveitis in the above patients were further analyzed for clinical information.

Data Retrieval and Processing

The data of 19,352 patients included in this study were retrieved from the electronic medical record database and segregated into an Excel sheet. All the cases that were included had their first diagnosis of uveitis during the study period. The diagnosis of specific etiology or systemic disease associations was based on a detailed history and ophthalmologic examination, including slit-lamp examination and indirect ophthalmoscopy or 90D-based retinal evaluation. Ancillary tests, including ultrasonography, fundus fluorescein angiography, and optical coherence tomography, were performed as needed. The columns included the data on patient demographics, clinical presentation, ocular diagnosis, investigations, and treatment and were exported for analysis. The Excel sheet with the required data was then used for analysis by using the appropriate statistical software. Standardized definitions were used for occupation and socioeconomic status.[22] The visual acuity was classified according to the WHO guidelines.[23] The IOP was classified into the categories of 1–9, 10–21, 21–30, and >30 mm Hg.

Statistical Analysis

Descriptive statistics using mean ± standard deviation and median with inter-quartile range (IQR) were used to elucidate the demographic data. Chi-square test (Stata software, Stata Corp. 2015. College Station, TX: Stata Corp LP) was used for univariate analysis. All tables for age, gender, visual acuity, intraocular pressure, and diagnosis category were drawn using Microsoft Excel.

Results

Patients and Eyes

Of the 1,734,272 new patients who presented across the secondary and tertiary centers during the study period, 25,353 eyes of 19,352 patients were diagnosed with uveitis. Thus, uveitis constituted 1.12% of all cases presenting to our clinics.

Age

The mean age of the patients was 39.74 ± 13.17 years, whereas the median age was 39 (IQR: 28–51) years. The distribution of patients in each age-decade is presented in Table 1.

The most common age group of the patients who presented with uveitis were between 31 and 40 years (4380 patients, 22.63%), followed by between 21 and 30 years (3931 patients, 20.31%). Overall, 82.86% of cases (15,918) were in the age group of 17–60 years. The most common types of uveitis in the age groups of <16, 17–60, and >60 age groups are mentioned in Table 2.

Sex

There were 11,676 (60.33%) male and 7676 (39.67%) female patients. The overall distribution of uveitis was significantly greater ($P < 0.0001$) in males as compared to females. Among the patients diagnosed with uveitis, the mean and median age were 38.3 ± 12.96 and 37 (IQR: 26–49) years for men and 41.9 ± 13.15 and 42 (IQR: 30–54) years for women, respectively. There was a male preponderance in all the types of uveitis in our study population [Table 3].

Urban–Rural Distribution

Of the 19,352 patients with uveitis, 8618 (44.53%) were from an urban locality, 7079 (36.58%) were from a rural locality, and the remaining 3655 (18.89%) patients presented from the metropolitan region.

Geographical distribution

The multi-tier ophthalmology network of our institute predominantly covers the states of Telangana and Andhra Pradesh in South India and the state of Odisha in Eastern India. The types of uveitis presenting in these geographical locations are elaborated in Table 4. Anterior uveitis was the most common type presenting in all of these geographical locations.

The data were also analyzed in terms of differences in presentations between secondary centers that would be providing services to rural and semi-urban areas as compared to the tertiary centers. The geographic categorization of the districts of India was performed in accordance with the National Sample Survey Organization (NSSO), which defines "rural" as an area with a population density of up to 400 per square kilometer.[1] The Constitution (74th Amendment) Act,

Table 1: Distribution of patients in each age-decade

Age Category	Number of uveitis patients	%	Total patients seen	Percentage of uveitis in this age group (Hospital-based prevalence)
0-10 yrs	433	2.24%	129,126	0.34%
11-20 yrs	1759	9.09%	183,947	0.96%
21-30 yrs	3931	20.31%	239,876	1.64%
31-40 yrs	4380	22.63%	209,836	2.09%
41-50 yrs	3893	20.12%	272,500	1.43%
51-60 yrs	2792	14.43%	293,858	0.95%
61-70 yrs	1669	8.62%	287,734	0.58%
71-80 yrs	401	2.07%	99,426	0.40%
81-90 yrs	88	0.45%	16,954	0.52%
91-100 yrs	6	0.03%	1285	0.47%
Grand Total	19,352	100.00%	1,734,272	

Table 2: Common types of uveitis in different age groups

Age Group vs. Uveitis	*N*	%
0-16 yrs	1270	6.56%
Posterior Uveitis	430	33.86%
Traumatic uveitis	322	25.35%
Anterior Uveitis	278	21.89%
Intermediate Uveitis	125	9.84%
Panuveitis	115	9.06%
17-60 yrs	15,918	82.26%
Anterior Uveitis	5825	36.59%
Posterior Uveitis	4613	28.98%
Intermediate Uveitis	2241	14.08%
Panuveitis	1836	11.53%
Traumatic uveitis	1403	8.81%
>60 yrs	2164	11.18%
Anterior Uveitis	1277	59.01%
Posterior Uveitis	354	16.36%
Intermediate Uveitis	214	9.89%
Panuveitis	193	8.92%
Traumatic uveitis	126	5.82%
Grand Total	19,352	100.00%

1992 defines a metropolitan area in India as, an area having a population of one million or more, comprised in one or more districts and consisting of two or more municipalities or panchayats or other contiguous areas, specified by the Governor by public notification to be a metropolitan area. The remaining districts were classified as urban.

Table 5 outlines the types of uveitis presenting to secondary and tertiary centers.

The incidence of anterior uveitis (46.84% in secondary centers vs. 36.40% in tertiary centers, $P < 0.001$) and traumatic uveitis 15.47% in secondary centers vs. 8.33% in tertiary centers, $P < 0.001$) was both significantly higher in secondary centers as compared to tertiary centers.

Occupation

Of the 19,352 patients with uveitis, 5061 (26.15%) were from the government/private service or self-employed, 4592 (23.73%) were homemakers, 2618 (13.53%) were students, 1920 (10.07%) were related to agriculture work, 1590 (8.07%) were manual laborers, and 368 (1.87%) were retired. The occupation status was not available for 2992 (15.19%) patients. No statistical association was noted between any of the uveitides and the occupational status of our patients.

Laterality

Of the 19,352 patients with uveitis, 6773 (35.09%) were affected in the right eye and 6578 (33.99%) were affected in the left eye. In about a third of the cases, that is, 6001 (31.01%), the affliction was bilateral. The disease was predominantly unilateral in nature (13,351 patients, 68.99%). However, while only 18.87% of anterior uveitis cases (1378 patients) had bilateral involvement, the trend for bilateral involvement was more in posterior uveitis (40.43%), intermediate uveitis (40.85%), and panuveitis (63.34%). Table 6 outlines the ocular involvement in various subtypes of uveitis.

Type of Uveitis

The most common type of uveitis was anterior uveitis in 7380 patients (38.14%), followed by posterior uveitis in 5397 patients (27.89%); intermediate uveitis was seen in 2580 (13.33%) patients, panuveitis in 2144 (11.08%) patients, and traumatic uveitis in 1851 (9.56%) patients. Traumatic uveitis was more commonly seen in the age group of <16 years. The most common infectious cause of uveitis was tuberculosis, which accounted for 2545 cases, followed by toxoplasmosis (1147 cases) and cytomegalovirus retinitis (203 cases). Table 7 lists the various infectious uveitis entities and their frequencies.

Among patients with panuveitis (n = 2144, 11.08%), the most common causes were Vogt Koyanagi Harada disease (1368 patients, 63% of all panuveitis cases), followed by tuberculosis in 382 (15.01%) patients and sympathetic ophthalmia in 112 patients. Thus, VKH was the most common cause of panuveitis in our clinics.

Best-Corrected Visual Acuity

In the 25,353 eyes, 14,362 eyes (56.65% had mild or no visual impairment (<20/70), 4346 (17.14%) had moderate visual impairment (>20/70 to 20/200), 1153 (4.55%) had severe visual impairment (>20/200 to 20/400) 3521 eyes (13.89%) had blindness (>20/400 to 20/1200), 751 (2.96%) eyes had blindness (>20/1200 to PL), and 218 (0.586%) eyes had

Table 3: Gender distribution across different age groups

	0-20 yrs		21-40 yrs		41-60 yrs		>60 yrs	
	Male	Female	Male	Female	Male	Female	Male	Female
Anterior Uveitis	275	211	1703	1073	1418	1423	658	619
Posterior Uveitis	501	297	1963	717	1073	492	216	138
Intermediate Uveitis	138	86	632	486	483	541	100	114
Panuveitis	126	87	434	454	347	503	90	103
Traumatic uveitis	420	51	709	140	303	102	87	39
Grand Total	1460	732	5441	2870	3624	3061	1151	1013

Table 4: Types of uveitis presenting in various geographical locations

State	*N*	%
Andhra Pradesh	6763	34.95%
Anterior Uveitis	2447	36.18%
Posterior Uveitis	1784	26.38%
Intermediate Uveitis	1127	16.66%
Traumatic Uveitis	732	10.82%
Panuveitis	673	9.95%
Odisha	4220	21.81%
Anterior Uveitis	1555	36.85%
Posterior Uveitis	1305	30.92%
Panuveitis	495	11.73%
Traumatic Uveitis	445	10.55%
Intermediate Uveitis	420	9.95%
Telangana	6357	32.85%
Anterior Uveitis	2731	42.96%
Posterior Uveitis	1555	24.46%
Intermediate Uveitis	753	11.85%
Panuveitis	698	10.98%
Traumatic Uveitis	620	9.75%

blindness (NPL). In 1002 eyes (3.95%), we could not identify the grade or it was not mentioned in the clinical records. Panuveitis was the cause of most severe visual impairment, with a mean logMAR visual acuity of 1.08 (Snellens equivalent of 20/250), followed by posterior uveitis, which had a mean visual acuity of 0.80 logMAR (Snellens equivalent of 20/80). Tables 8 and 9 list the detailed distribution of the visual acuity in terms of impairment and LogMAR in eyes affected with uveitis.

IOP

In the 25,353 eyes, 20,626 (80.72%) eyes had an IOP of 10–21 mm Hg, 1347 (5.31%) eyes had an IOP of 1–9 mm Hg, 424 (1.67%) eyes had an IOP of 22–30 mm Hg, 277 (1.09%) eyes had >30 mm Hg, 162 (0.68%) eyes were digitally soft, the IOP recording was deferred in 236 (1.04%) eyes, and the IOP was not available for 2281 (9.00%) eyes at the time of diagnosis.

Complications

Complicated cataract was noted in 945 eyes (4.88%). Apart from this, 701 eyes had an IOP of >21 mm Hg, while hypotony was noted in 102 eyes. Band-shaped keratopathy was documented to be present in 25 eyes (0.13%) at the time of presentation.

Discussion

Epidemiology of uveitis can be valuable in developing differential diagnoses and clinical investigations. Understanding the demographics, clinical patterns, and presentations of uveitis can also aid in appropriate therapeutic strategies for effective management. It is also important to realize that epidemiology and presentations may differ considerably around the world. There are various reports available from different regions of India regarding the epidemiology of uveitis.[1-5] However, most of these reports are limited by a small sample size and by the heterogeneity of various uveitic entities. Big data analysis and retrieval from electronic medical record systems can help in a better assessment of disease presentations and patterns.

There have been a few population-based studies on uveitis, such as the Northern California Epidemiology of Uveitis Study, a uveitis study at Veterans Affairs Medical Centers in the Pacific Northwest, the Pacific Ocular Inflammation study, and a Taiwanese population-based study, which have collected general population data.[12-16] The Northern Californian study included 731,898 subjects and reported a uveitis incidence and prevalence of 5.2 per 10,000 person-years and 11.5 per 10,000 persons, respectively.[15]

Another population-based study from South India by Rathinam *et al*.[17] reported rates for all ocular inflammation as 450–467/100,000. According to their study, 0.3% of the general population aged 40 and higher in Tamil Nadu state had episodes of uveitis. A population-based study from the urban population, the Andhra Pradesh Eye Diseases Study (APEDS) calculated uveitis prevalence to be 1070/100,000 (95% CI: 514–1960/100,000) for the age group 40 years and higher.[18]

While cross-sectional population-based studies provide a snapshot of the prevalence, demographics, and risk factors of any disease, they are unable to give detailed clinical information or longitudinal trends. In contrast, clinical studies that describe in detail the presentation or progression of the disease are limited by their sample sizes. Electronic medical records-driven big data analytics can help in bridging this gap between population-based and clinic-based studies by analyzing large data sets of clinical information, which is not possible with conventional methods of manual data collection.

Our EMR based data retrieval of uveitis cases revealed that uveitis constituted 1.11% of all cases presenting to eye care centers. Out of the 1,734,272 patients seen across all centers of our multitier ophthalmology network, 19,352 patients were diagnosed as having uveitis.

Table 5: Types of uveitis presenting to secondary and tertiary centers

Center vs Uveitis	N	%
Tertiary Centers	16,137	83.39%
Anterior Uveitis	5874	36.40%
Intermediate Uveitis	2216	13.73%
Panuveitis	1917	11.88%
Posterior Uveitis	4785	29.65%
Traumatic uveitis	1345	8.33%
Secondary Centers	3215	16.61%
Anterior Uveitis	1506	46.84%
Intermediate Uveitis	364	11.32%
Panuveitis	227	7.06%
Posterior Uveitis	612	19.04%
Traumatic uveitis	506	15.74%
Grand Total	19,352	100.00%

Table 6: Ocular involvement in various subtypes of uveitis

Type of Uveitis	Number of eyes	Percentages
Anterior Uveitis	7380	38.14%
RE	3079	41.72%
LE	2923	29.98%
BE	1378	18.67%
Posterior Uveitis	5397	27.89%
RE	1618	29.98%
LE	1597	29.59%
BE	2182	40.43%
Intermediate Uveitis	2580	13.33%
RE	775	30.04%
LE	751	29.11%
BE	1054	40.85%
Panuveitis	2144	11.08%
RE	413	19.26%
LE	373	17.40%
BE	1358	63.34%
Traumatic Uveitis	1851	9.56%
RE	888	47.97%
LE	934	50.46%
BE	29	1.57%

RE – right eye, LE – left eye, BE – both eyes

Our pyramidal model of eye care delivery has a center of excellence (CoE) at the top catering to a population of 50 million population, with tertiary centers (TC) at the next level, each for 5 million population.[19,24] These are linked to secondary centers (SC) covering 0.5–1 million population mostly in rural locations. Thus, our study was able to cover the presentation patterns of uveitis in rural as well as urban centers. The incidence of anterior uveitis (46.84% in secondary centers vs. 36.40% in tertiary centers, $P < 0.001$) and traumatic uveitis 15.47% in secondary centers vs. 8.33% in tertiary centers, $P < 0.001$) was both significantly higher in secondary centers as compared to tertiary centers.

Uveitis is known to present in all age groups. However, adults aged 20–50 years are known to be more commonly affected. Different studies have reported that 60%–80% of uveitis cases occur in this age group.[1-5,26-28] Our study also confirmed this age group with 12,204 (63.06%) patients within the age group of 21–50. A significant male predominance was seen in our study with 11,676 (60.33%) males and 7676 (39.67%) female patients. Other studies from India have also reported a higher incidence of uveitis in males as compared to female patients.[1-5]

Table 7: Distribution of infectious uveitis

Infectious Uveitis	Number of cases (N)
Tuberculosis	1397
Toxoplasmosis	1147
Cytomegalovirus Retinitis	203
Acute Retinal Necrosis	192
Syphilis	20
Others	30
Total	2649

Table 8: Detailed distribution of the visual acuity in terms of mean LogMAR in eyes affected with uveitis

Disease Category	Mean of LogMAR visual acuity	Snellens Equivalent
Posterior Uveitis	0.80	20/124
Anterior Uveitis	0.62	20/80
Intermediate Uveitis	0.48	20/60
Panuveitis	1.08	20/250
Traumatic uveitis	0.53	20/63

Table 9: Detailed distribution of the visual acuity in terms of impairment in eyes affected with uveitis

BCVA	N	%
Mild or No Visual Impairment 0	14362	56.65%
Moderate Visual Impairment 1	4346	17.14%
Severe Visual Impairment 2	1153	4.55%
Blindness 3	3521	13.89%
Blindness 4	751	2.96%
Blindness 5	218	0.86%
Undetermined or Unspecified	1002	3.95%

0=mild or no visual impairment (>20/70), 1=moderate visual impairment (<20/70 to 20/200), 2=severe visual impairment (<20/200 to 20/400),3=blindness (<20/400 to 20/1200), 4=blindness (<20/1200 to PL), 5=blindness (NPL), 6=undetermined or unspecified

A study by Borde *et al.*[25] describing patterns of uveitis in Central India had reported 51% of male patients. Another study by Dogra *et al.*[3] had also got 56% of male patients.[26] The significant male preponderance in our study may be reflective of the socioeconomic factors in developing countries with more men availing of health services as compared to women. This difference in the presentation was consistent in both rural as well as urban areas.

In our study, the most common presentation was anterior uveitis, which was seen in 38.14% of patients, followed by posterior uveitis in 27.89%, intermediate uveitis in 13.33%, and panuveitis in 11.08%. This was similar to other Indian studies,

which have reported anterior uveitis to be the most common presentation (39%–47%).[1-5,26,30,31]

The anatomical distribution of uveitis in this study was comparable with other regional studies in India.[14,15,24] We also analyzed the incidence of traumatic uveitis in the patients presenting to our clinics. Traumatic uveitis was noted in 25%–35% of all cases in the age group of <16 years of age. In their series of pediatric uveitis, Ganesh *et al*.[29] had described an incidence of 14%.[32] The larger numbers in our series may be because we had also included patients presenting from rural areas and to our secondary centers.

We also noted a higher incidence of posterior uveitis (33.86%) in this age group (patients aged <16 years). Our incidence of higher posterior uveitis in pediatric age groups is similar to the ones reported by Edelsten *et al.* and Kadayilcilar *et al*., who reported posterior uveitis in 30%–31% of their cases of pediatric uveitis.[33,34]

Tuberculosis was the major cause of infectious uveitis in all our groups and constituted 13.15% of all cases of uveitis (2545 cases) A majority of Indian studies had arrived at similar conclusions.[1-3,35,36] A reason for TB being the most incriminated cause of uveitis in the Indian population is its endemicity in India. The estimated incidence of tuberculosis in India is around 2.7 million. India also happens to contribute around 27% of the global burden of TB as per the Global TB report 2018.[30,34] Dogra *et al*.[3] in their report from a tertiary care center in North India had reported that 23% cases of infectious uveitis were attributed to TB. Rathinam and Namperumalsamy[5] in a study from South India reported intraocular tuberculosis in 5.6%, second only to leptospirosis. Venkatesh *et al*.[35] in a study from North India reported that approximately 5% of the overall uveitis was secondary to tuberculosis.[36]

Among the various causes for posterior uveitis, again, tuberculosis was the most common, accounting for 25.88% of all cases. The second most common infectious cause was toxoplasmosis (1147 cases, 21.25%). Das *et al*.[4] had reported toxoplasmosis as a major cause (40.21%) of posterior uveitis, which is much higher than other reports from India.

Among other causes of uveitis, intermediate uveitis and panuveitis were noted in 13.23% and 11.08% of all cases, respectively. The most common cause of panuveitis in our study was VKH, which was seen in 1368 cases (63%). This was significantly higher than what has been reported in other studies (18%–24%).[1,3,4] However, another hospital-based study from Bangladesh had reported a 51% incidence of VKH in their study.[37]

In our study, uveitis was unilateral in 13,351 patients (69%) and bilateral in 6001 patients (31%). However, bilateral involvement was more frequently seen in intermediate uveitis (40.85%), posterior uveitis (40.43%), and panuveitis (63.34%). Similar results were seen in studies by Borde *et al*.[25] in intermediate and panuveitis subgroups. Dogra *et al*.[3] in their series also had a higher incidence of bilaterality in their cases of intermediate uveitis (52.5%), posterior uveitis (58.1%), and posterior uveitis (63.87%). Thus, while overall uveitis has been described to have more unilateral involvement, cases of panuveitis tend to have more bilateral presentation.

We had graded our patients in terms of impairment according to the WHO classification for visual impairment.[23] At the time of presentation, 56.65% of all the eyes in our series (14,362 out of 25,333 eyes) had mild or no visual impairment. However, the data of 1002 eyes could not be retrieved or was not specified to be included in the analysis. Panuveitis was the cause of most severe visual impairment, with a mean logMAR visual acuity of 1.08 (Snellens equivalent of 20/250), followed by posterior uveitis, which had a mean visual acuity of 0.80 logMAR (Snellens equivalent of 20/80). In another study, anterior uveitis was characterized to have the least affected visual acuity at the time of presentation.[37] This was similar to our series where anterior uveitis and traumatic uveitis had a mean presenting visual acuity of 0.6 and 0.5 logMAR, respectively.

In terms of complications at the time of presentation, complicated cataract was noted in 945 eyes (4.88%). Apart from this, 701 eyes had an IOP of >21 mm Hg, while hypotony was noted in 102 eyes. Band-shaped keratopathy was documented to be present in 25 eyes (0.13%) at the time of presentation.

Table 10: Comparison of anterior, intermediate, posterior, and panuveitis with other Indian studies

Study	Venkatesh *et al.*	Sabhapandit *et al.*	Dogra *et al.*	Rahman *et al.*	Biswas *et al.*	Borde P *et al.*	EyeSmart Big Data
Year	2015	2016	2016	2017	2018	2020	2021
Location	North India	South India	North India	Bangladesh	South India	Central India	South and Eastern India
Number (*n*)	980	1123	1912	652	352	210	19,352
Age at presentation (Mean)	34.2±13.9	42.6±15.9	36.6±14.5	32.3±12.4	-	46.6±11.2	39.74±13.1
Sex (M:F)	579:401	561:562	1083:829	340:312	197:155	107:103	11676:7676
Laterality (Unilateral:Bilateral)	Nearly 2/3: 1/3	623:500	1099:813	374:278	107:245	119:91	13351:6001
Anterior uveitis *n* (%)	413 (43.14)	(48.44)	823 (43.04)	256 (39.2)	124 (35.2)	99 (47.14)	7380 (38.14%)
Intermediate uveitis *n* (%)	131 (13.36)	(15.04)	204 (10.66)	145 (22.2)	106 (30.1)	67 (37.90)	2580 (13.33%)
Posterior Uveitis *n* (%)	165 (16.83)	(20.92)	470 (24.58)	144 (22)	88 (25)	27 (12.85)	5397 (27.89%)
Panuveitis	91 (9.2)	(14.42)	310 (16.21)	107 (16.4)	34 (9.65)	17 (8.1)	2144 (11.08%)
Traumatic uveitis *n* (%)	-	-	-	-	-	-	1851 (9.56%)
Idiopathic uveitis *n* (%)	755 (77)	394 (38.6)	754 (39.44)	304 (46.6)	119 (33.8)	101 (48.09)	-
Infectious uveitis *n* (%)	88 (9)	328 (31.1)	639 (33.39)	-	-	54 (25.71)	2649 (13%)
Non-infectious uveitis n (%)	137 (14)	284 (30.3)	519 (27.14)	-	-	55 (26.19)	-

Thus, in our study, we were able to assess the presentations and epidemiology of uveitis across a multi-tier ophthalmology network. The main strength of our study was the data collection from an electronic medical record-based system covering both rural and urban populations and a large cohort of patients with a focused study of demographics and distribution of uveitic disorders in patients seeking eye care in a large three-tier hospital network in India across 6 years. Another strength of our study was the geographic distribution of study sites and the use of standardized outcome variables. This study may help in providing direction for developing healthcare strategies in terms of identifying the patterns in populations and the affected age groups for effective management of uveitis in India and perhaps the rest of the developing world.

The predominant weaknesses of our study include its retrospective nature. We also accept that big data analysis will depend on impeccable and uniform documentation. Apart from this, because this was a hospital-based study, the estimates of severity and complications from academic referral centers are likely to exceed community-based prevalence [Table 10].

Conclusion

This study describes the demographics and epidemiology of uveitis in patients presenting to a multi-tier ophthalmology hospital network in India. Uveitis constituted 1.11% of all cases presenting to our clinics. It was more common in the age group of 21–50 and was predominantly unilateral. Anterior uveitis was the most common subtype and was seen in 38%. Traumatic uveitis was more commonly seen in the pediatric age groups and in rural populations. Tuberculosis was the most common cause of infectious uveitis, and VKH was the most common cause of panuveitis. Panuveitis was the cause of most severe visual impairment with a mean logMAR visual acuity of 1.08 (Snellens equivalent of 20/250).

Acknowledgements

The authors wish to acknowledge the support of our Department of eyeSmart EMR & AEye team, especially Mr. Ranganath Vadapalli and Mr. Mohammad Pasha.

Financial support and sponsorship

Support provided by Hyderabad Eye Research Foundation (SK), Hyderabad, India.

Conflicts of interest

There are no conflicts of interest.

References

1. Biswas J, Narain S, Das D, Ganesh SK. Pattern of uveitis in a referral uveitis clinic in India. Int Ophthalmol 1996;20:223-8.
2. Singh R, Gupta V, Gupta A. Pattern of uveitis in a referral eye clinic in North India. Indian J Ophthalmol 2004;52:121-5.
3. Dogra M, Singh R, Agarwal A, Sharma A, Singh SR, Gautam N, *et al*. Epidemiology of uveitis in a tertiary-care referral institute in North India. Ocul Immunol Inflamm 2017;25:S46-53.
4. Das D, Bhattacharjee H, Bhattacharyya PK, Jain L, Panicker MJ, Das K, *et al*. Pattern of uveitis in North East India: A tertiary eye care center study. Indian J Ophthalmol 2009;57:144-6.
5. Rathinam SR, Namperumalsamy P. Global variation and pattern changes in epidemiology of uveitis. Indian J Ophthalmol 2007;55:173-83.
6. Das AV, Kammari P, Vadapalli R, Basu S. Big data and the eyeSmart electronic medical record system-An 8-year experience from a three-tier eye care network in India. Indian J Ophthalmol 2020;68:427-32.
7. IBM Big Data & Analytics Hub. United States. Available from: https://www.ibmbigdatahub.com/infographic/four.vs.big.data.
8. Cavallo P, Pagano S, De Santis M, Capobianco E. General practitioners records are epidemiological predictors of comorbidities: An analytical cross-sectional 10-year retrospective study. J Clin Med 2018;7:184.
9. Armstrong AW, Foster SA, Comer BS, Lin CY, Malatestinic W, Burge R, *et al*. Real-world health outcomes in adults with moderate-to-severe psoriasis in the United States: A population study using electronic health records to examine patient-perceived treatment effectiveness, medication use, and healthcare resource utilization. BMC Dermatol 2018;18:4.
10. Eggleston EM, Klompas M. Rational use of electronic health records for diabetes population management. Curr Diab Rep 2014;14:479.
11. Zghebi SS, Rutter MK, Ashcroft DM, Salisbury C, Mallen C, Chew-Graham CA, *et al*. Using electronic health records to quantify and stratify the severity of type 2 diabetes in primary care in England: Rationale and cohort study design. BMJ Open 2018;8:e020926.
12. Acharya NR, Tham VM, Esterberg E, Borkar DS, Parker JV, Vinoya AC, *et al*. Incidence and prevalence of uveitis: Results from the Pacific Ocular Inflammation Study. JAMA Ophthalmol 2013;131:1405–12.
13. Hwang DK, Chou YJ, Pu CY, Chou P. Epidemiology of uveitis among the Chinese population in Taiwan: A population-based study. Ophthalmology 2012;119:2371–6.
14. Reeves SW, Sloan FA, Lee PP, Jaffe GJ. Uveitis in the elderly: Epidemiological data from the National Long-term Care Survey Medicare Cohort. Ophthalmology 2006;113:307.e1. doi: 10.1016/j.ophtha.2005.10.008.
15. Gritz DC, Wong IG. Incidence and prevalence of uveitis in Northern California; the Northern California Epidemiology of Uveitis Study. Ophthalmology 2004;111:491–500.
16. Suhler EB, Lloyd MJ, Choi D, Rosenbaum JT, Austin DF. Incidence and prevalence of uveitis in Veteran Affairs Medical Centers of the Pacific Northwest. Am J Ophthalmol 2008;146:890–6.e8. doi: 10.1016/j.ajo.2008.09.014.
17. Rathinam SR, Krishnadas R, Ramakrishnan R, Thulasiraj RD, Tielsch JM, Katz J, *et al*. Population-based prevalence of uveitis in Southern India. Br J Ophthalmol 2011;95:463–7.
18. Dandona L, Dandona R, John RK, McCarty CA, Rao GN. Population based assessment of uveitis in an urban population in southern India. Br J Ophthalmol 2000;84:706-9.
19. Rao GN, Khanna RC, Athota SM, Rajshekar V, Rani PK. Integrated model of primary and secondary eye care for underserved rural areas: The L V Prasad Eye Institute experience. Indian J Ophthalmol 2012;60:396-400.
20. Rao Donthineni P, Kammari P, Shanbhag SS, Singh V, Das AV, Basu S. Incidence, demographics, types and risk factors of dry eye disease in India: Electronic medical records driven big data analytics report I. Ocul Surf 2019;17:250-6.
21. Jabs DA, Nussenblatt RB, Rosenbaum JT; Standardization of Uveitis Nomenclature (SUN) Working Group. Standardization of uveitis nomenclature for reporting clinical data. Results of the First International Workshop. Am J Ophthalmol 2005;140:509–16.
22. Das AV, Podila S, Prashanthi GS, Basu S. Clinical profile of pterygium in patients seeking eye care in India: Electronic medical records-driven big data analytics report III. Int Ophthalmol 2020;40:1553-63.
23. World Health Organization. (2008). Change the definition of blindness. Available from: https://www.who.int/blindness/Change%20the%20Definition%20of%20Blindness.pdf.
24. Rao GN. The Barrie Jones Lecture Eyecare fort neglected population: Challenges and solutions. Eye (London, England) 2015;29:30-45.

25. Borde P, Priyanka, Kumar K, Takkar B, Sharma B. Pattern of uveitis in a tertiary eye care center of central India: Results of a prospective patient database over a period of two years. Indian J Ophthalmol 2020;68:476-81.
26. Al Shakarchi FI. Pattern of uveitis at a referral center in Iraq. Middle East Afr J Ophthalmol 2014;21:29-5.
27. Wakabayashi T, Morimura Y, Miyamoto Y, Okada AA. Changing patterns of intraocular inflammatory disease in Japan. Ocul Immunol Inflamm 2003;11:277-86.
28. Henderly DE, Genstler AJ, Smith RE, Rao NA. Changing pattern of uveitis. Am J Ophthalmol 1987;103:131-6.
29. Ganesh SK, Bala A, Biswas J, Ahmed AS, Kempen JH. Pattern of pediatric uveitis seen at a tertiary referral center from India. Ocul Immunol Inflamm 2016;24:402-9.
30. Govt. of India (2018), TB India 2018, Ministry of Health and Family Welfare, New Delhi.
31. Sabhapandit S, Murthy SI, Singh VM, Gaitonde K, Gopal M, Marsonia K, *et al*. Epidemiology and clinical features of uveitis from urban populations in South India. Ocul Immunol Inflamm 2017;25(Suppl 1):S39–45.
32. Edelsten C, Reddy MA, Stanford MR, Graham EM. Visual loss associated with pediatric uveitis in English primary and referral centers. Am J Ophthalmol 2003;135:676–80.
33. Kadayifcilar S, Eldem B, Tumer B. Uveitis in childhood. J Pediatr Ophthalmol Strabismus 2003;40:335–40.
34. WHO (2018), Global Tuberculosis Report 2018.
35. Venkatesh P, Gogia V, Shah B, Gupta S, Sagar P, Garg S. Patterns of uveitis at the Apex Institute for eye care in India: Results from a prospectively enrolled patient database (2011–2013). Int Ophthalmol 2016;36:365–72.
36. Rahman Z, Ahsan Z, Rahman NA, Majumder PD. Pattern of uveitis in a referral hospital in Bangladesh. Ocul Immunol Inflamm 2018;26:893-6.
37. Barisani-Asenbauer T, Maca SM, Mejdoubi L, Emminger W, Machold K, Auer H. Uveitis—A rare disease often associated with systemic diseases and infections— A systematic review of 2619 patients. Orphanet J Rare Dis 2012;7:57.