Clinical profile and demographic distribution of ophthalmia nodosa: An electronic medical record-driven big data analytics from a multitier eye care network

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Purpose: To describe the demographics and clinical profile of ophthalmia nodosa in patients presenting to a multitier ophthalmology hospital network in India. Methods: This cross-sectional, hospital-based study included 3,082,727 new patients presenting between August 2010 and December 2021. Patients with a clinical diagnosis of ophthalmia nodosa in at least one eye were included as cases. The data were collected using an electronic medical record system. Results: Overall, 434 (0.014%) patients were diagnosed with ophthalmia nodosa. Most of the patients were male (71.43%) and had unilateral (97.7%) affliction. The most common age group at presentation was during the third decade of life with 116 (26.73%) patients. The overall prevalence was higher in patients from a higher socioeconomic status (0.015%) presenting from the urban geography (0.019%) and in professionals (0.027%). The setae were identified and removed at presentation in 287 (66.13%) patients. The most common location of the setae was conjunctiva (45.72%) followed by cornea (39.64%). Most of the eyes (395; 79.95%) had mild or no visual impairment (<20/70). The most documented ocular signs were eye lid edema (35.81%), conjunctival congestion (73.87%), and corneal abrasion (29.05%). Less than one-tenth of the eyes required a surgical intervention for removal of the setae, corneal foreign body removal was performed in 10 (2.25%) eyes and conjunctival foreign body removal in four (0.90%) eyes. Conclusion: Ophthalmia nodosa more commonly affects males presenting during the third decade of life and is predominantly unilateral. The setae are most commonly lodged in the conjunctiva followed by the cornea, and the majority of the eyes have mild or no visual impairment.

Key words: Big Data, electronic medical records, India, ophthalmia nodosa

Ophthalmia nodosa is a rare disease that mostly arises in the dry winter months and is caused by the inflammatory reaction to the hairs of an insect, generally called setae.10 It is a common occupational and seasonal disease that can occur due to the direct toxic effect of the penetrated caterpillar, mechanical effect, or through the plant leaves possessing similar characteristics.11,12 However, the involvement of ophthalmia nodosa leads to several ocular disorders in a broad spectrum, such as conjunctivitis, keratitis, conjunctival nodules, iridocyclitis, iris nodule, nodule formation, corneal abrasions, cataract, endophthalmitis, panophthalmitis, vitritis, and uveitis.13,14 The caterpillar hair embedded in the cornea can remain in the eye for a prolonged period of time without inciting inflammation.15 There are predominantly case reports published in the literature that do not lend to a comprehensive understanding of this condition. There is a paucity of literature on the prevalence and demographic distribution of ophthalmia nodosa in the Indian population. The purpose of the study is to present the clinical and demographic profile of ophthalmia nodosa at a large multitier ophthalmology network in India using electronic medical record-driven analytics.

Methods

Study design, period, location, and approval
This cross-sectional, observational, hospital-based study included all patients presenting between August 2010 and December 2021 to a multitier ophthalmology network located in India.16 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 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.

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using a standardized template.[9] The study adhered to the Declaration of Helsinki and was approved by the Institutional Ethics Committee.

Cases
A total of 3,082,727 new patients presented to the tertiary and secondary centers of the multitier ophthalmology network during the study period. The eyeSmart EMR was screened for patients with a documented ocular diagnosis of ophthalmia nodosa in one or both eyes. A total of 434 patient records were identified using this search strategy and were labeled as cases. A total of 444 eyes diagnosed with ophthalmia nodosa in the above patients were further analyzed for clinical information.

Data retrieval and processing
The data of 434 patients included in this study were retrieved from the electronic medical record database and segregated into an Excel sheet. The columns included the data on patient demographics, clinical presentation, ocular diagnosis, and treatment information and were exported for analysis. The Excel sheet with the required data was then used for analysis using the appropriate statistical software. Standardized definitions were used for occupation and socioeconomic status.[10] The visual acuity was classified according to the World Health Organization (WHO) guidelines.[11]

Statistical analysis
Descriptive statistics using mean ± standard deviation and median with interquartile range (IQR) were used to elucidate the demographic data. All tables for age, gender, visual acuity, and clinical features were drawn by using Microsoft Excel (Microsoft Corporation 2018, Redmond, WA, USA). Chi-square test (StataCorp. 2015, Stata Statistical Software: Release 14; StataCorp LP, College Station, TX, USA) was used for univariate analysis to detect significant differences in the distribution of demographic features between patients with ophthalmia nodosa and the overall population.

Results

Prevalence
Of the 3,082,727 new patients who presented across the eye care network during the study period, 434 patients were diagnosed with ophthalmia nodosa at least one eye, translating into a prevalence rate of 0.014% (95% confidence interval [CI]: ±0.00001%) or 141/million population. An overview of the cohort is presented in Table 1.

Age
The mean age of the patients was 35.29 ± 16.95 years, while the median age was 34 (IQR: 24–46) years. The most common distribution of the age groups of patients was between 21 and 30 years (n = 116; 26.73%), followed by 31 and 40 years (n = 88; 20.28%). The distribution of patients in each age decade is presented in Fig. 1.

Sex
There were 310 (71.43%) male and 124 (28.57%) female patients. The overall distribution of ophthalmia nodosa was significantly greater in males (0.019%; 310/1,659,432) compared to females (0.009%; 124/1,423,295) and was statistically significant (P ≤ 0.01). Among the patients diagnosed with ophthalmia nodosa, the mean and median age were 34.4 ± 16.35 and 32 (IQR: 24–44) years for men and 37.49 ± 18.1 and 39 (IQR: 27–51) years for women, respectively.

Urban–rural distribution
Of the 434 patients with ophthalmia nodosa, 260 (59.91%) were from an urban locality, 156 (35.94%) were from a rural locality, and 18 (4.15%) patients presented from the metropolitan region. The overall prevalence of ophthalmia nodosa in the urban community (0.019%; 260/1,341,267) was higher compared to the rural (0.011%; 156/1,383,026) or metropolitan community (0.005%; 18/358,434) and was statistically significant (P ≤ 0.00001).

| Table 1: Overview of patients diagnosed with ophthalmia nodosum |
|----------------------|-----------------|
| Parameter            | n               | %    |
| Total patients       | 434             | 100  |
| Male                 | 310             | 71.43|
| Female               | 124             | 28.57|
| 0-10 years           | 32              | 7.37 |
| 11-20 years          | 38              | 8.76 |
| 21-30 years          | 116             | 26.73|
| 31-40 years          | 88              | 20.28|
| 41-50 years          | 75              | 17.28|
| 51-60 years          | 52              | 11.98|
| 61-70 years          | 19              | 4.38 |
| 71-80 years          | 12              | 2.76 |
| 81-90 years          | 1               | 0.23 |
| 91-100 years         | 1               | 0.23 |
| Adult                | 388             | 89.40|
| Pediatric            | 46              | 10.60|
| Paying               | 347             | 79.95|
| Nonpaying            | 87              | 20.05|
| Lower class          | 87              | 20.05|
| Lower middle class   | 341             | 78.57|
| Upper middle class   | 4               | 0.92 |
| Upper class          | 2               | 0.46 |
| Urban                | 260             | 59.91|
| Rural                | 156             | 35.94|
| Metropolitan         | 18              | 4.15 |

- Total eyes: 444 (100)
- Mild or no visual impairment: 0 (79.95)
- Moderate visual impairment: 29 (6.53)
- Severe visual impairment: 5 (1.13)
- Blindness 3: 10 (2.25)
- Blindness 4: 3 (0.68)
- Blindness 5: 1 (0.23)
- Undetermined or unspecified: 41 (9.23)
- Conjunctiva: 203 (45.72)
- Cornea: 176 (39.64)
- Eyelid: 50 (11.26)
- Anterior chamber: 9 (2.03)
- Posterior segment: 6 (1.35)
Socioeconomic status

Of the 434 patients with ophthalmia nodosa, there were 87 (20.05%) patients from the lower socioeconomic class, 341 (78.57%) patients from the lower middle class, four (0.92%) patients from the upper middle class, and two (0.46%) patients from the upper class. The overall prevalence of ophthalmia nodosa was slightly higher in the higher socioeconomic strata (0.015%; 347/2,363,156) compared to lower socioeconomic strata (0.012%; 87/719,571), but was statistically not significant ($P = 0.10$).

Occupation

Of the 434 patients with ophthalmia nodosa, 155 (35.71%) were professionals, 80 (18.43%) were students, 76 (17.51%) were homemakers, 65 (14.98%) were agricultural workers, 17 (3.92%) were manual laborers, five (1.15%) were retired individuals, and in the remaining 36 (8.29%) patients, the occupational category was not available/applicable. The overall prevalence of ophthalmia nodosa in professionals (0.027%; 155/575,971) was significantly higher ($P<0.00001$) in comparison to the other occupational groups.

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**Figure 1:** Age-wise distribution of patients with ophthalmia nodosa

**Figure 2:** Slit-lamp photographs showing setae in the (a) bulbar conjunctiva (white arrows), (b) at different depths in cornea, (c) deep in the inferior cornea at the limbus

**Figure 3:** Slit-lamp photographs showing (a) diffuse corneal edema with focal corneal infiltrate at the limbus, (b) decrease in edema with the use of topical corticosteroids and antibiotics, (c) after resolution of infiltrate, setae were noted in the inferior cornea at the limbus (black arrow)
to other professions and was closely followed by agriculture workers (0.023%; 65/284,887).

**Laterality**

Of the 434 patients with ophthalmia nodosa, 218 (50.23%) were affected in the right eye and 206 (47.47%) were affected in the left eye. In 10 (2.3%) patients, the affliction was bilateral in nature.

**Presenting history and complaints**

Among the 434 patients, a history of injury with foreign body was documented in 299 (68.89%) patients and caterpillar hair in 102 (23.5%) patients. The most presenting complaints were redness in 278 (64.06%), pain in 180 (41.47%), foreign body sensation in 172 (39.63%), watering in 151 (34.79%), and photophobia in 24 (5.53%) patients.

**Location**

In the 444 eyes, the most common location of the setae was conjunctiva in 203 (45.72%), cornea in 176 (39.64%), eyelid in 50 (11.26%), anterior chamber in nine (2.03%), and posterior segment in six (1.35%) eyes.

**Presenting visual acuity**

Of the 444 eyes, 355 (79.95%) eyes had mild or no visual impairment (<20/70), 29 (6.53%) eyes had moderate visual impairment (20/70–20/200), five (1.13%) eyes had severe visual impairment (20/200–20/400), 10 (2.25%) eyes had blindness (20/400–20/1200), three (0.68%) eyes had blindness (>20/1200 to Perception of Light [PL]), one (0.23%) eye had blindness (No Perception of Light [NPL]), and in 41 (9.23%) eyes, the visual acuity was undetermined or unspecified.

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**Figure 4:** Slit-lamp photographs showing (a) setae embedded in the upper tarsal conjunctiva (white arrows) with surrounding papillary reaction, (b) multiple vertical corneal abrasions seen because of the erosion of the corneal epithelium by the setae embedded in the upper tarsal conjunctiva.

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**Figure 5:** Month-wise distribution of patients with ophthalmia nodosa.
Slit-lamp findings
Among the 444 eyes, eyelid edema was seen in 159 (35.81%) eyes. Conjunctival signs included congestion in 328 (73.87%) eyes, papillae in 44 (9.91%), chemosis in 14 (3.15%), and pseudo membrane in three (0.68%) eyes. Corneal signs included corneal abrasion in 129 (29.05%) eyes, epithelial defect in 75 (16.89%), superficial punctate keratitis in 73 (16.44%), scar in 53 (11.94%), and infiltrate in 27 (6.08%) eyes. The caterpillar hairs were embedded more commonly in the upper tarsal conjunctiva in 112 (25.23%) eyes, in corneal stroma in 56 (12.61%) eyes, and in the endothelium in 15 (3.38%) eyes. The anterior chamber showed cells and flare in 23 (5.18%) eyes and hypopyon in one (0.23%) eye. Representative pictures of the clinical findings are presented in Figs. 2–4.

Treatment
Among the 434 patients, the setae were identified and removed at presentation in 287 (66.13%) patients. Topical antibiotics were prescribed in 256 (58.99%) patients, topical steroids in 193 (44.47%), and lubricants in 230 (53%) patients. An examination under anesthesia for foreign body removal was performed in 16 (3.6%) patients. Surgical intervention of corneal foreign body removal was performed in 10 (2.25%) eyes, conjunctival foreign body removal in four (0.9%), and wound exploration in three (0.68%) eyes. The average follow-up of the patients was 87 ± 236 days with an average of 1.6 ± 2.4 visits (range 0–19).

Seasonal variation
There was a distinct increasing seasonal pattern seen in the winter months starting from the month of September (14.75%) to December (14.29%). The highest proportion of patients presented in the month of November (20.28%) and the lowest in May (1.61%). The month-wise distribution of the presentation of patients is presented in Fig. 5.

Discussion
This study sought to describe the clinical profile and demographic distribution of ophthalmia nodosa in a large cohort of patients presenting to a multin tier ophthalmology hospital network in India using electronic medical record-driven big data analytics. The primary purpose of the study was to determine the relative proportion and demographic profile of ophthalmia nodosa in the clinical care setup. The overall prevalence of ophthalmia nodosa was 0.014% in patients who presented between 2010 and 2021 (11-year period). The disease is predominantly unilateral and affects males. It causes mild or no visual impairment in many of the affected eyes, and the foreign body is more commonly lodged in the conjunctiva.

There is limited literature related to ophthalmia nodosa and is mostly limited to case reports. Doshi et al.\textsuperscript{[1]} published their experience in 17 patients and found it commoner in males (70.5%) and the mean age was 27.5 years. In our cohort also, we found that the majority of the patients were males (71.43%) and the average age was higher at 35.29 ± 16.95 years. Most of the patients were professionals (35.71%) followed by agricultural workers (14.98%), with the least being retired individuals (1.15%). The nature of the profession predisposes them to be exposed to injury through insects in the external environment as a part of their daily work. Many of the hairs were found in the cornea in their study, while in our cohort the conjunctiva (45.72%) was the most involved location. The proportion of patients with hair in the anterior chamber is comparable in both the studies (3.4% vs. 2.03%). Removal of the foreign body was needed in only a third of the patients (37.03%), while in our study, we were able to identify and remove the foreign body in over two-thirds of the patients (66.13%). The use of anti-inflammatory medications decreases the tissue edema, and thus makes the foreign body more visible. Hence, a close follow-up is warranted to monitor the evolving inflammation and also to check for the visibility of additional foreign bodies which could be amenable for removal. The exposed foreign bodies warrant removal, as they can be potential nidus for secondary infections. A significant number of our patients had resolution of symptoms post removal of the foreign body and with medications in the primary visit and required a maximum of two visits for resolution. The mainstay of treatment post removal of the foreign body is medical management with antibiotics, corticosteroids, and lubricants. The foreign body is amenable for removal at slit lamp in the clinic in a majority of patients, and only a minority of patients require surgical intervention for removal of foreign body located in deep corneal layers, anterior chamber, or the vitreous.

Bishop and Morton,\textsuperscript{[12]} among 103 cases in their study, reported a high incidence of cases in December and January, while Sethi et al.\textsuperscript{[13]} reported that ophthalmia nodosa in India is commoner during the winter months. Our cohort showed a clear distinct pattern when the cases showed an increasing trend from the month of September (14.75%) to December (14.29%) with a peak of cases in the month of November (20.28%). The caterpillars usually emerge after the monsoon showers end in September and October. The caterpillars seek secluded and dark places to pupate and can wander into various places including homes, apart from vegetation. Ophthalmia nodosa is an acute condition that causes tissue inflammation both due to toxic and mechanical effects of the caterpillar hair. Individuals must be cautioned against rubbing the eyes in the event of any foreign body injury to prevent further damage to the ocular tissue and avoid deeper seeding of the hairs and must seek ophthalmic first aid as soon as possible. Timely first aid care and a detailed assessment of the eye, careful removal of the foreign body, and the usage of medications lead to a good outcome for the patients.

This study lends insight into the sociodemographics and clinical presentation of patients with ophthalmia nodosa in a large cohort of patients in India. The study does have a few limitations due to its hospital-based method of selection of subjects, which may have introduced a certain level of ascertainment bias, but the greatest strength is the complete utilization of the digital data entry in a structured manner by trained ophthalmologists and automated extraction methods for analysis.

Conclusion
In conclusion, this study aimed to describe the epidemiology and clinical presentation of ophthalmia nodosa in about 3 million new patients presenting to a multiltier ophthalmology hospital network in India. The findings show that ophthalmia nodosa commonly affects males presenting during the third decade of life and is predominantly unilateral. The setae are
commonly lodged in the conjunctiva followed by the cornea, and the majority of the eyes have mild or no visual impairment.

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Conflicts of interest
There are no conflicts of interest.

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