

Original articles

Assessment of tear secretion and tear film instability in cases with pterygium and normal subjects

Roka N, Shrestha S P

Dr N D Joshi Department of Ophthalmology , Manipal College of Medical Sciences,
Pokhara, Nepal

Abstract

Introduction: Dry eye is a common disorder affecting a significant percentage of the population. **Materials and methods:** This study is a prospective, hospital-based, case-controlled study conducted between January 2009 and May 2010. Seventy-six pterygium cases and 152 age- and sex-matched controls presenting to the OPD of Manipal Teaching Hospital were included. The TBUT Schirmer's test and basal tear secretion were estimated in all patients. A TBUT of less than 10 seconds and a Schirmer's test of less than 10 mm were considered abnormal. **Results:** Pterygium was bilateral in 15 (19.7 %) and unilateral in 61 (80.3 %) patients. Ninety-two (92.1 %) pterygium patients reported either one or more of the six dry eye symptoms. Redness was the most common (67 %) symptom reported. The mean Schirmer's test I, mean basal secretion and mean TBUT values were 16.19 mm, 10.01 mm and 10.56 seconds in pterygium cases and 20.22 mm, 13.25 mm and 26.25 seconds in the control group respectively. There was a statistically significant difference in the dry eye results between the pterygium cases and the control group (p value < 0.05). The odds ratio between pterygium and dry eye was 3.28. Dry eye was present in 26 % of the normal patients and in 54 % of the pterygium cases. **Conclusion:** There is a strong relationship between dry eye and pterygium.

Key-words: pterygium, dry eye, tear secretion, tear film instability, Schirmer's test, tear break up time

Introduction

Pterygium takes its name from the Greek word for wing and was first described by Hippocrates. Its development is unrelated to antecedent injury or inflammation and ninety percent of pterygia are located nasally (Adamis et al, 1990). One of the theories is that the tear film abnormalities causes local drying of the cornea and conjunctiva which in turn predisposes to these new growths (Paton, 1975). The differential diagnosis of pterygium

includes limbal masses which in order of their frequency, are pseudo-ptyerygium, papilloma, squamous cell conjunctival carcinoma, conjunctival melanoma, and pagetoid or sebaceous carcinoma (Char, 1987). There is a worldwide distribution of pterygium, but it is more common in warm, dry climates and after exposure to (both UV-A and UV-B) ultraviolet radiation (Detels et al, 1967; Asokan et al, 2012). Although the prevalence of the lesion increases with age, the highest incidence occurs between the ages of 20 and 49 years (Hilgers, 1960). The management of pterygium includes medical (lubricant, steroids and UV blockage) or surgical (excision or autograft) methods.

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Address for correspondence: Dr Narayani Roka, MS

Golchha Eye Hospital, Biratnagar, Nepal

Tel: +977-9846087834

E-mail: narayaniroka@yahoo.com

Dry eye is a common disorder affecting a significant percentage of the population, particularly in those older than 40 years, throughout the world. In 1995, the National Eye Institute/Industry Workshop published the definition of dry eye states and a new classification. This definition of dry eye states that “Dry eye is a disorder of the tear film due to tear deficiency or excessive tear evaporation which causes damage to the interpalpebral ocular surface and is associated with symptoms of ocular discomfort”. The classification system distinguishes two main categories of dry eye states, an aqueous tear deficiency state and an evaporative state. The aqueous tear deficiency state is subdivided into Sjogren’s syndrome–associated keratoconjunctivitis sicca and non-Sjogren’s KCS (non SS-KCS)

There is no single, readily available diagnostic test that has a high degree of sensitivity and specificity for the diagnosis of dry eye or its classification. The diagnosis, therefore, depends on the history, examination, and a combination of diagnostic studies. The clinical tests used are careful slit-lamp examination, the Schirmer’s test, the tear film breakup time (TBUT) and the Rose Bengal Test. The other dry eye tests include tear film osmolarity (Gilbard et al, 1978), lysozyme and lactoferrin (McEwen et al, 1995; McCollum et al, 1994; Tseng, 1985), impression cytology (Pflugfelder et al, 1990) and conjunctival biopsy.

Although there are so many tests available for detection and diagnosis of dry eye, clinically, only three tests are used routinely. These are the Schirmer’s test, the tear film break up time (TBUT) and the Rose Bengal test. The latter is reserved for use in severe dry eye patients with corneal signs of dry eye. The Schirmer’s test measures the quantity of tear production and the TBUT measures the quality of the tear. The TBUT is also considered to be a measurement of the mucin and lipid layer integrity.

The main aim of this study was to compare tear secretion and tear film instability in patients with pterygium and normal healthy subjects representing

the same age and gender in Nepal. The objectives were to find clinical relationship between pterygium and dry eye; to find out the clinical features, natural history and demographic characteristics; to estimate tear secretion and tear film stability and to determine whether these are risk factors for the development of pterygium in this geographical location.

Materials and methods

A case-controlled study was conducted in Dr N D Joshi Department of Ophthalmology, Manipal College of Medical Sciences (MCOMS), Nepal, between January 2009 and May 2010. The tear secretion and the tear film stability were estimated in patients presenting with pterygium attending the outpatient department and these findings were compared with those from control subjects matched for the age and gender. The inclusion criteria for the cases were: patients presenting with pterygium during the study period, and for the controls, the patients presenting with refractive errors. The exclusion criteria for the cases were: patients having other adnexal, anterior segment or posterior segment diseases that could alter tear secretion and stability or patients who refused to participate in the study, and for the controls all other diseases of the eye except refractive errors.

Statistics: The sample size was calculated using the EPI INFO package. The prevalence of dry eye was assumed to be 50% in cases and 30% in the controls. For a 95% confidence interval and an 80% power, the required number of cases was obtained from 76 pterygium cases (either unilateral or bilateral) and matched with 152 controls. The Z test was used to calculate statistically significant differences between the findings in the two groups. The p values less than 0.05 was considered statistically significant.

The ethical approval was obtained from the Ethics Review Board of Manipal College of Medical Sciences, Pokhara, Nepal and written informed consent was taken from all the patients. They were informed of the purpose of the study and were also



assured confidentiality of the findings. In cases of bilateral pterygium, the eye with the larger pterygium was included in the study. All patients with pterygia and the controls underwent visual acuity assessment, a detailed slit-lamp examination and ophthalmoscopy to rule out adnexal, anterior segment and posterior segment diseases. The following examinations of the pterygium patients were conducted and recorded.

1. Grading of pterygia
 - a. Grade 1 (transparent),
 - b. Grade 2 (intermediate), and
 - c. Grade 3 (opaque);
2. Breadth of the pterygium at the corneal periphery in mm; and
3. Encroachment into cornea in mm.

In both the pterygium and control groups, the tear secretion and its stability were tested by performing the following tests.

1. Tear film break up time (TBUT): Because manipulation of the eyelid or instillation of the anaesthetics may affect the tear film break up time, the TBUT test was performed before other dry eye tests and recorded after fluorescein staining. Care was taken to avoid contact with the cornea to prevent an excessive reflex secretion of tear. The time interval between the opening of the eye lids and appearance of the dry spots on the tear film was recorded using a stop watch. Three recordings were taken and the average was recorded as the TBUT and considered positive if the average tear film break up time was less than 10 seconds.
2. Schirmer's test
 - a. Without anesthesia (Schirmer's test I), and
 - b. After anesthesia (Basal Secretion)

The Schirmer test was performed after a thorough slit-lamp examination so that ocular irritation by the test strip would not interfere with other examination results. After 5 minutes, the strips were removed and the amount of wetting in millimeters was

recorded. The Schirmer I test (without anaesthesia) was considered positive if the length of the wetting was less than 10mm at the end of 5 minutes. The Schirmer test after anesthesia (Basal secretion) was performed after the instillation of topical 4% xylocaine and (wiping the lower fornix with cotton), in the same manner as the Schirmer I test. After testing tear secretion and its stability, both the groups of patients were categorized under following headings.

- a) Normal Schirmer's, normal TBUT,
- b) Abnormal Schirmer's, normal TBUT
- c) Abnormal TBUT, normal Schirmer's, and
- d) Abnormal Schirmer's, abnormal TBUT.

Data was entered in the Microsoft Excel 8. The means of both the Schirmer's test and TBUT, in both eyes, were calculated in the pterygium and control group of patients.

Results

A total of 228 patients were included in this study, with 76 patients as cases and 152 as controls, who were age and sex matched. Out of the 76 pterygium cases studied, 15 (19.7%) had a bilateral disease and 61 (81.26%) had a unilateral involvement. The right eye was involved in 45 (59.21%) and the left in 16 (10.78%) of the pterygium patients. The age of the patients ranged from 21 to 75 years and the mean age was 44.38 years (SD 11.92). There were 43 (56.57%) female patients and 33 (43.42%) male patients.

The largest number of pterygia was found in the fourth to sixth decades of life in both sexes. Indoor workers were more common in both the groups (pterygium-54% and controls-55%). In this study, 55.26% of the patients were using topical tear substitutes, 2.6% steroid eye drops, 5.26% topical NSAID, 1.13% antibiotics and 1.13% decongestants. There was no history of any topical medications in 34.21% of cases.

Regarding the pterygium morphology of the 76 cases studied, 24 (31%) patients had Grade I

(transparent) pterygia, 37(49%) patients had Grade II (intermediate) pterygia and 15 (20%) patients had Grade III (opaque) pterygia. The average encroachment of the pterygium into the cornea was 3.26 mm and the average width of pterygium at the corneal junction was 5.3 mm.

Tests for tear secretion and tear stability

TBUT: The mean TBUT was 10.56 seconds (range 2.50 - 27.50 secs) in pterygium patients and 16.52 seconds (range 6.50 - 29.5 secs) in the control group. The difference in the TBUT in these two groups was statistically significant ($P < 0.05$) (Table 1).

The Schirmer's I test: The mean Schirmer's test I was 16.19 mm (range 2.5 mm - 35mm) in the pterygium group and 20.22 mm (range 4.5 mm - 35 mm) in the control group. There was a statistically significant difference between the two groups ($P < 0.05$) (Table 1).

Basal secretion: The mean basal secretion was 10.01 mm (range 1 mm - 27.5mm) in pterygium patients and 13.25 mm (range 0 mm - 28 mm) in the control group. There was a statistically significant difference between the two groups ($P < 0.05$) (Table 1).

The TBUT test conducted and analyzed showed 33 (43.42%) unstable tear film, 31 (40.78%) borderline and 12 (15.78%) normal tear film in pterygium patients. Similarly 29 (19.07%) showed unstable tear film, 20 (13.15%) borderline and 103 (67.76 %) normal tear film in the control group (Table 2).

Regarding the degree of dry eye, a Schirmer's test of less than 2 mm was not seen in both the case and control groups, whereas in the case group, the Schirmer's test 2-5 mm was in 9 (11.84%), 6 - 9 mm in 15 (19.73%), 10 - 15 mm in 16 (21.05%), 15 mm or above in 36 (47.60%).

In the control group, the Schirmer's test of 2 - 5 mm was in 9 (5.92%), 6 - 9 mm in 19 (19.73%), 10 - 15 mm in 20 (13.15 %) and 15 mm and above in 104 (68.42%) patients. (Table 3)

The basal secretion of less than 2 mm was in 3 (3.94%), 2-5 mm in 21(27.63%), 6-9mm in 21(27.63%), 10-15 mm in 14(18.42%) and 15mm or above in 17 (22.36%) pterygium patients. The basal secretion was less than 2mm in 2 (1.31%), 2 - 5 mm in 24 (15.78%), 6 - 9 mm in 26 (17.10%), 10 - 15 mm in 52 (34.21%) and 15 mm and above in 52 (34.21%) control patients (Table 3).

The TBUT in the control group ranged from 15 - 20 seconds, Schirmer's I value ranged from 19 - 25 mm and the basal secretion value ranged from 12 - 15mm (Table 4).

Dry eye test results were normal in 46.0 % of the pterygium patients and 73.68% of the control group. Abnormal dry eye test was in 54.0% of the pterygium patients and in 26.27% of the control group. (Table 5)

When the results of TBUT and Schirmer's test were analyzed in both the groups, there was no statistically significant difference between sex and dry eye test results.

There was no significant relationship between the occupation (outdoor or indoor) and dry eye test in both the case and the control group ($P > 0.05$). Occupation appeared to have no effect on the risk of developing pterygium.

There was no significant difference in the results of the dry eye tests between pterygium subjects who were currently using eye drops and those who were not ($P > 0.05$).

There is a relationship between pterygium and dry eye ($P < 0.05$). The risk of having pterygium in dry eye patients is 3.28 times higher than in those patients not having dry eye (Odds ratio 3.28) (Table 6).

Table 1: Schirmer's test and TBUT result in pterygium group and control group

Case (n = 76)			Control (n=152)		Z	P value
Dry eye test	Mean	SD	Mean	SD		
Mean TBUT	10.56	4.58	16.52	5.65	7.57	< 0.05
Mean SCH I	16.19	9.21	20.22	8.89	3.1	< 0.05
Mean Basal secretion	10.01	6.91	13.25	6.64	3.39	< 0.05

Table 2 : Degree of tear instability (TBUT)

TBUT	<10 secs (Unstable)		10 -15 secs (Borderline)		>15 secs (Normal)	
	(no)	(%)	(no)	(%)	(no)	(%)
Case	33	43.42	31	40.78	12	15.78
Control	29	19.07	20	13.15	103	67.78

Table 3: Degree of dry eye, SCH I and basal secretion

Schirmer's (I) test (mm)	Case		Control	
	No.	Percentage (%)	No.	Percentage (%)
< 2	0	0	0	0
2 – 5	9	11.84	9	5.92
6 – 9	15	19.73	19	12.50
10 -15	16	21.05	20	13.15
>15	36	47.36	104	68.42
Total	76	100	152	100
Basal Secretion (mm)	Case		Control	
	No.	Percentage (%)	No.	Percentage (%)
< 2	3	3.94	2	1.31
2 – 5	21	27.63	24	15.78
6 – 9	21	27.63	26	17.10
10 – 15	14	18.42	52	34.21
>15	17	22.36	52	34.21
Total	76	100	152	100

Table 4: Tear secretion and Tear Stability in control group

Age group	Male	Female	Total	Mean TBUT (Secs)	Mean SCH I (mm)	Mean Basal sec. (mm)
20 – 30	5.26 %	1.31 %	6.57 %	16.65	24.60	12.15
30 – 40	6.57 %	18.42 %	24.99 %	15.57	20.68	13.47
40 – 50	13.15 %	17.10 %	30.25 %	15.40	19.22	12.86
50 – 60	7.89 %	15.78 %	23.67 %	17.40	20.01	13.38
60 – 70	10.52 %	1.31 %	11.83 %	19.80	19.69	14.30
70 – 80	6.57 %	2.60 %	9.17 %	15.50	20.62	12.50

Table 5: Results of dry eye test

Test	Cases (no)	Percentage (%)	Total	Control (no)	Percentage (%)	Total
Normal TBUT, Normal Schirmer's	35	46.00	46.00	112	73.68	73.68
Abnormal Schirmer's, Normal TBUT	8	10.52		11	7.20	
Abnormal TBUT, Normal Schirmer's	19	25.0		12	7.89	
Abnormal TBUT, Abnormal Schirmer's	14	18.42	54.00	17	11.18	26.27
Total	76	100		152	100	

Table 6: Showing relationship of pterygium and dry eye

	Pterygium		Total
Dry eye	Yes	No	
Yes	41	40	81
No	35	112	147
Total	76	152	

Discussion

There is a wide variation in the incidence and severity of dry eye and pterygia in different parts of the world. A review of the literature has shown that so far no studies conducted earlier have clearly shown a relationship between dry eye and pterygium unequivocally. Studies have either analyzed only the

relationship between symptoms of dry eye and pterygium or correlated TBUT and pterygium or studied tear secretion and pterygium. While some of these studies showed a correlation between dry eye and pterygium (Mithal et al, 1991; Ishioka et al, 2001; Lee et al, 2002; Chaidarron et al, 2003; Balogun et al, 2005; Lekhanont et al, 2006; Gupta et al, 2010), others did not find any correlation between these two conditions (Jie et al, 2009; Goldberg, 1976) As there is no data available about the demographic profile or status of tear secretion and its stability in a Nepalese population, this study also aimed to provide this information.

Some studies have shown (Lee et al, 2002; Fotouhi et al, 2008) the prevalence of dry eye and pterygium to be more common in males and others have found no sex differences (Goldberg et al, 1976). In the present study, females were more affected (56.6%) than males (43.4%) which is similar to three recent studies conducted in Thailand, China and India (Lekhanont et al, 2006; Lu et al, 2007; Gupta et al, 2010).

The prevalence of pterygium was the most common in the fourth to sixth decades of life in this study, which is similar to other studies. Although outdoor activities are the common cause for pterygium (Viso et al, 2011; Cajucom et al, 2010), in this study, we found that indoor workers (54%) were more affected by pterygium than outdoor workers (46%). This is probably because a majority of the population in our country works in the kitchen for at least 3 - 4 hours a day. However, some studies show that there is no association of pterygium with the nature of work (Asokan et al, 2012).

When grading of the pterygium was analyzed, the findings in this study were similar to the study conducted in China by Lu et al in 2007 (Lu et al, 2007).

Although there are so many tests available for detection and diagnosis of dry eye, the Rose Bengal test is reserved for use in severe dry eye patients with corneal signs of dry eye. In this study, the mean Schirmer I value was 16.19 mm (range 2.5 – 35 mm) in the pterygium group and 20.22 mm (range 4.5 mm-35mm) in the control group ($p < 0.05$). The mean basal secretion value was 10.01 mm (range 1 mm – 27.5mm) in pterygium patients and 13.25 mm (range 0 mm -28 mm) in the control group ($p < 0.05$).

In a study from India (Mithal et al, 1991) when Schirmer's test was done in two groups of patients, they found that the mean wetting of the filter paper was 12.6 mm (range 11 - 16 mm) and 5.2 mm (range 3 - 9.4 mm) respectively in normal healthy eyes and the eyes of patients with pterygium. They concluded that both the values were found to be

significantly reduced in cases of pterygium indicating the inadequacy of tear film in these pterygium patients. One study from Turkey (Kadayifçilar et al, 1998) found that there was no significant difference in Schirmer's test I in the pterygium patients.

Chaidaroon and Pogmoragot in Thailand (Chaidarron et al, 2003) assessed Schirmer's test with anesthesia (basal secretion) in both the eyes of patients with unilateral pterygium. The mean Schirmer's test value in the eye with pterygium was 11.6 ± 0.4 mm and 12.4 ± 0.4 mm without pterygium. They concluded that the Schirmer's test value with anesthesia was decreased significantly in the eye with unilateral pterygium when compared with a healthy eye. Ishioka et al (2001) showed that Schirmer's test with anesthesia was shortened and was decreased in the eye with pterygium with marginal significance. They concluded that there is a correlation between pterygium formation and unstable tear film. In another study from Nigeria (Balogun et al, 1995) it was found that the mean TBUT was lower in eyes with pterygia (17.90 secs) than in control eyes (19.86 secs), although the mean difference was not statistically significant. Another study from turkey (Kadayifçilar et al; 1998) found that TBUT was reduced in the pterygium group.

In this study, dry eye was diagnosed when Schirmer's reading was less than 10 mm and TBUT reading was less than 10.0 seconds. When this criterion was used, dry eye test results were normal in 46.0 % of the pterygium patients and 73.68% of the control group. Dry eye test was abnormal in 54.0% of the pterygium patients and 26.27% of the control group. In this study, 26.27 % of the control patients showed abnormal dry eye test results although they did not have any symptoms of dry eye. These findings are in contrast to the findings of Goldberg and David (1976) who analyzed the relationship of dry eye with pterygium in Bantu in South Africa. They divided the patients in both their groups into 4 categories similar to the categories in our study and found that there was no statistically significant difference between the results between



the two eyes of patients with unilateral pterygium and that in both groups, two thirds of the patients showed abnormal results in these tests although these patients did not have a dry eye. Therefore, they concluded that dry eye is not correlated with the pathogenesis of pterygium.

Tear secretion and stability in the normal population: One of the objectives of this study was to study the status of tear secretion in a normal population in this geographical location in Nepal, for future reference. A detailed calculation of tear secretions and tear stability was calculated in the different age groups in both sexes. The TBUT in the control group ranged from 15 to 20 seconds, the Schirmer I value ranged from 19 to 25 mm and basal secretion value ranged from 12 to 15 mm.

Use of tear substitutes: There was no statistically significant difference in dry eye status in pterygium patients using or not using tear substitutes (p value > 0.05). This finding is similar to the study from Thailand (Lekhanont et al, 2006). This finding raises questions on the use of tear substitutes in pterygium patients as there is no statistically significant difference in the dry eye status in pterygium patients.

Relationship between dry eye and pterygium: According to this study, the risk of having pterygium in dry eye patients is 3.28 times higher than in patients who do not have dry eye (odds ratio 3.38 and p value < 0.05) (Table 6).

Conclusion

In Nepal, pterygium is more common in female and in indoor workers. The largest number of pterygia is found in the fourth to sixth decades of life in both sexes. There is no relation between dry eye with sex and occupation. Redness was the most common symptom of pterygium patients followed by grittiness and burning sensation. Most of the patients in this study presented in late stages and the average encroachment of pterygium into the cornea was 3.26 mm and average width of pterygium at the corneal junction was 5.3 mm.

Recommendations

This study has clearly demonstrated that there is a strong relationship between dry eye and pterygium. Therefore, treatment of dry eye should also be part of pterygium management. As both evaporative and hyposecretory types of dry eye was associated with pterygium, all three tests of dry eye (TBUT, Schirmer I and Basal Secretion) should be performed in pterygium patients and appropriate tear substitute should be prescribed based on these results. Appropriate precautions should be taken by all dry eye patients such as use of UV protective glasses, hats and umbrellas to protect their eyes from developing pterygia. They should also avoid exposure of their eyes to strong winds and heat from open flames.

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