ORIGINAL ARTICLE

Prevalence of Dry Eye in University Malaya Medical Centre

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Summary

Two hundred outpatients (115 females and 85 males) attending the University Malaya Medical Center (UMMC) eye clinic, aged 20 years and above and without any ocular surface disorder were recruited for this study. Their tear film status was determined subjectively by their symptoms and quantitatively by the cotton thread test, Schirmer's test, marginal tear film meniscus assessment, fluorescein corneal staining and tear break-up time. Dry eye was considered present if at least one symptom was experienced often or always, within the past 3 months. Dry eye was also considered present if one of these tests was positive; Schirmer's test <5mm, Phenol red thread (PRT) test <10mm and tear film break-up time (BUT) <8 seconds.

The prevalence of dry eye in this sample population as defined by presence of symptoms and an abnormal test result is 14.5%. Presence of dry eye as detected by clinical testing is higher in the Chinese race ($p<0.01$), in the group 40-59 years ($p=0.024$). There is no difference between females and males. A lower BUT score was more strongly associated with presence of dry eye symptoms ($p= 0.02$). Elderly patients have a lower BUT and Schirmer's score.

There is lack of agreement between PRT and Schirmer's test, although both are measures of tear quantity.

Key Words: Dry eye, Tear film, Phenol red thread test, Schirmer's test, Tear film break up time, UMMC

Introduction

Dry eye, a nonspecific term referring to a decrease or unstable tear film and its related conditions commonly causes ocular symptoms relating to ocular surface. It may occur due to decreased tear secretion or increased tear film evaporation. Dry eye is often used synonymously with keratoconjunctivits sicca (KFC) and Sjogren's syndrome and had caused some confusion among clinicians. KFC refers to aqueous deficiency with accompanying superficial conjunctival and corneal changes. KFC may be present with or without Sjogren's syndrome, an autoimmune

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disease which may be primary (isolated) or secondary when it occurs with other autoimmune diseases like rheumatoid arthritis and systemic lupus erythematosus. The purpose of this study was to examine the distribution of dry eye symptoms their association with the objective testing of dry eye in a clinic based population.

Materials and Methods

All patients above the age of 20 years attending the eye clinic UMMC between January 1999 and January 2000 were recruited in this study. Those with history of previous eye surgery, eye infection or inflammation within the past 3 months and on regular use of eye drops within the past 3 months were excluded from this study. Also excluded were patients with known ocular surface problems and contact lens users.

A history of dry eye symptoms was first elicited by asking each participant to fill up an interviewer-administered questionnaire (Appendix). The following questions regarding dry eye symptoms were queried and their frequency recorded:

a. feeling of dryness,
b. grittiness or sandy sensation,
c. burning sensation,
d. redness,
e. crusting of the lashes,
f. intolerant or sensitive to light/draft/smoke and
g. vision disturbance after reading or watching television.

Allowable responses are rarely, sometimes, often or always. A patient is considered as having dry eye symptoms if he/she experienced one or more symptoms often or always. Menopausal status and use of hormone replacement therapy were also inquired from female subjects. Each patient was then examined and clinically tested for his or her tear film status. It is difficult to decide on the optimal order of tests for dry eye because one test may interfere with the next. To achieve uniformity, all tests were done in the same order for all patients.

The order of examination was:

1. Phenol red rest (PRT)
2. Schirmer's test,
3. slit-lamp examination
4. fluorescein staining and
5. Tear film break-up time (BUT).

A 5-minute break between tests 1, 2 and 5 was observed.

The PRT test was performed using a commercially available special cotton thread impregnated with phenol red, a pH sensitive indicator. The thread was placed under the lateral one fifth of the inferior palpebral margin. Anaesthesia was unnecessary, as there was little or no sensation of the thread. The test time was only 15 seconds after which the thread was removed and the length (in mm) of the wet portion which had turned colour to red or bright orange, was recorded as the result. A change of colour of >20mm is normal, <10mm is abnormal and between 10-20mm may indicate marginal dry eye.

The Schirmer's test was performed following instillation of proparacaine (preservative free) for patient's comfort. A 5 x 35mm pre-calibrated filter strip (Schirmer's Tear Test Strip) in the lower fornix at the junction of lateral and middle thirds. Care was taken to avoid touching the cornea. The patient, seated in a chair was asked to blink normally. The strip was removed after 5 minutes and the wetting of the filter paper was determined with a measuring scale. Both eyes were tested simultaneously. A wetting of <5mm was taken to indicate presence of dry eye.

Slit-lamp examination was done to assess the tear film meniscus, the eyelids and the presence of any tear debris or filaments. Tear film

meniscus was documented as intact, scanty or diminished/absent.

Fluorescein staining was done by touching the inferior fornix with moistened fluorescein strip while the patient looked up. Presence of any fluorescein staining of the cornea was recorded and graded as:

0 = no staining of the corneal epithelial surface,
1 = mild staining limited to < 1/3 of the corneal epithelial surface,
2 = moderate staining occupying <1/2 of the corneal epithelial surface, or
3 = severe staining of > 1/2 of the corneal epithelial surface.

Rose Bengal dye was not available for this study.

The **tear film break up** time was done after fluorescein staining. The patient was asked to blink several times and then hold the eyes open. The cornea was scanned with a slit-lamp using a cobalt blue filter. A dry spot was indicated by appearance of a black spot or line. Using a stopwatch the time in seconds between the last blink and the appearance of a random dry spot was recorded. The test was repeated three times in each eye, and the average was recorded. A cut-off value of 8 seconds was used in this study to indicate presence of dry eye.

Dry eye was considered present if any of the following three tests was positive; Schirmer's test <5mm, PRT <10mm or BUT <8 seconds. Test results were documented for both eyes but the result from the worse eye was used for analysis.

All analyses were performed with SPSS Version 7.5.1. Chi-square tests were used to evaluate significant differences in proportions among groups. Pearson correlation coefficient and 'limits of agreement' were used to measure the association between Schirmer's test and PRT.
A p value of less than 0.05 was considered statistically significant.

Results

Age, sex and racial distribution
Of 200 patients recruited, 115 (57.5%) were females and 85 (42.5%) were males. Of the 59 (51.3%) postmenopausal females, only 2 of them were taking hormonal replacement therapy.
Seventy-five patients (37.5%) were Malays, 74 (37%) were Chinese and 51 (25.5%) were Indians. Their age ranged from 20-85 years with a mean age of 48.37 (SD 15.77). 56 patients (29%) were between 20 to 39 years, 86 (43%) between 40 to 59 years and 56 (28%) were aged 60 years and above.

Dry eye symptoms
Fifty-one patients (25.5%) reported presence of one or more symptoms of dry eye often or always. Forty-three patients (21.5%) reported presence of the symptoms sometimes, while 106 patients (53.0%) rarely had any symptoms.

Of the patients with dry eye symptoms, 62.7% were females; 49% were from the age group of 40-59 years and 49% were Chinese. However these were not statistically significant (p=0.38 for gender, p=0.524 for age and p=0.07 for race). There was thus no statistically significant differences in age sex and racial distribution of patients with dry eye symptoms

The most frequent symptoms reported were vision disturbances after reading or watching television which necessitated frequent blinking followed by the feeling of grittiness.

Table I: Shows frequency of each of symptom of dry eye.

Clinical Test Results
Data for the clinical tests are presented for the worse eye only, but the agreement between right and left eyes are high. The Pearson correlation coefficient was 0.80 for Schirmer's test, 0.63 for PRT, 0.85 for break-up time and 0.92 for corneal staining.

Shirmer's test results ranged from 0mm to 36mm with the mean of 14.52(SD 9.79). The range for PRT was 3mm to 45mm with the mean of 20.79(SD 7.73) and the result range of BUT was between 3 to 23 seconds with the mean of 9.08(SD 3.73).

As shown in Table II patients aged 60 and above were found to have a shorter mean BUT time and mean Schirmer's test result. (p =0.001 for both). Chinese patients had a lower mean PRT and Schirmer's test results compared to the other races. (p=0.03 and p<0.01 respectively. The tests were not significantly different between the sexes or between pre- and postmenopausal women.

Presence of dry eyes from abnormal test results

78 (39%) of 200 patients had BUT less than 8 seconds, 26 patients (13%) had Schirmer's test of less than 5mm and 9 patients (4.51%) had PRT less than 10mm. Fifty patients (25%) had diminished or scanty marginal tear film. Eight patients (4%) had corneal staining more than 1/3 of the cornea.

Of patients with dry eye as detected by abnormal test results, 54% were from age group 40-59, 34% aged 60 and above, and 11.5% aged 20-40 (p<0.01). There was a higher percentage of Chinese patients with abnormal test results (40.2% compared to 35.6% Malays and 24.6% Indians; p=0.024). There was no significant differences between the sexes (p=0.842).

Correlation between symptoms of dry eye and clinical tests

Table III shows the number of patients with dry eye symptoms and abnormal test results. A lower BUT score has a better association with presence of frequent dry eye symptoms compared to the other tests (p =0.018 for BUT, p=0.406 for PRT, p=0.108 for Schirmer's test and p=0.105 for corneal staining).

14.5% of all patients (29) had symptoms of dry eye and at least one abnormal test result. Of the patients with dry eye symptoms, 56.9% had at least one abnormal test result. 11.8% had an equivocal test result and 31.4% have normal test result. Of those who had at least one abnormal test result, only 33.3% reported presence of at least one of the symptoms often or always (p=0.036).

Comparison between PRT and Schirmer's Test

Only 3.4% of patients with dry eyes had PRT of <10mm, whereas 21.6% had Schirmer's test <5mm. There was a linear relationship between PRT and Schirmer's test. The correlation was however weak (Pearson correlation 0.47, p=0.01). The mean difference between the 2 tests was 9.84 (SD 6.35, p<0.01). The range of agreement between the tests was -2.86 to 22.54 (d $\pm$ 2SD). There was thus a wide variation between the 2 tests. This lack of agreement was present for patients with and without dry eye symptoms.

Table I: Frequency of symptoms reported (percentage)

	Always	Often	Sometimes	Rarely
Grittiness	1 (0.5)	19 (9.5)	35 (17.5)	145 (72.5)
Dryness	3 (1.5)	11 (5.5)	30 (15.0)	156 (78.0)
Burning sensation	1 (0.5)	4 (2.0)	27 (13.5)	168 (84.0)
Redness	1 (0.5)	3 (1.5)	19 (9.5)	177 (88.5)
Crusting	0 (0.0)	13 (6.5)	19 (9.5)	168 (84)
Stickiness	2 (1.0)	9 (4.5)	20 (10)	169 (84.5)
Increased Sensitivity	1 (0.5)	18 (9.0)	27 (13.5)	154 (77.0)
Vision disturbance	5 (2.5)	22 (11.0)	23 (11.5)	150 (75.0)

Table II: The means of BUT, PRT and Schirmer's test by age, gender and race

		BUT	PRT	ST
Age				
20-39	Mean (SD)	10.60 (3.23)	20.38 (7.54)	18.55 (11.10)
40-59	Mean (SD)	8.52 (3.95)	21.49 (8.77)	13.09 (9.35)
>60	Mean (SD)	8.36 (3.45)	20.14 (6.09)	12.52 (7.72)
Gender				
Female	Mean (SD)	8.79 (3.71)	20.72 (8.35)	14.29 (10.45)
Male	Mean (SD)	9.47 (3.75)	20.88 (6.85)	14.82 (8.87)
Races				
Malay	Mean (SD)	9.65 (4.14)	20.55 (6.90)	15.09 (10.66)
Chinese	Mean (SD)	8.61 (3.73)	19.00 (7.96)	11.07 (7.87)
Indian	Mean (SD)	8.92 (2.97)	23.75 (7.83)	18.67 (9.34)

Table III: Results of the tests in relation to the presence of symptoms

			breakup up time		corneal staining		PRT			Schirmer's test		
			<8	≥8	1/3	>1/3	<10	10 - 19	≥20	<5	5-9	≥10
Symptoms	no dry eye	Count	51	98	145	4	5	57	87	15	33	101
		% dry eye symp	34.23	65.77	97.32	2.68	3.36	38.26	58.39	10.07	22.15	67.79
	dry eye	Count	27	24	47	4	4	18	29	11	10	30
		% dry eye symp	52.94	47.06	92.16	7.84	7.84	35.29	56.86	21.57	19.61	58.82
Total		Count	78	122	192	8	9	75	116	26	43	131
		% dry eye symp	39	61	96	4	4.5	37.5	58	13	21.5	65.5

Discussion

Symptoms of dry eye include visual disturbances, crusting, burning sensation grittiness, redness and intolerance to light. The questionnaire on dry eye symptoms was chosen as they have been used in other larger population based studies [1,2]. The usual clinical tests employed include BUT, Shirmer's test, PRT and slit lamp examination for tear meniscus, debris and ocular surface examination for staining . In diagnosing dry eye, symptoms of ocular irritation as well as a positive clinical test is taken into consideration.

An asymtomatic dry eye from a positive test only is of uncertain clinical importance and does not warrant therapeutic intervention. There is no Malaysian data available on dry eye. This study in UMMC on 200 outpatients showed prevalence of dry eye symptoms in 25.5% of patients and 14.5% with symptoms and an abnormal test. A Japanese multicentre study involving 2127 outpatients reported comparable result of 17% prevalence of dry eye[3]. The Japanese diagnosed dry eye from presence of any symptom, a positive staining and a positive diagnostic test. A population- based study in Maryland however showed a lower prevalence rate of 14.6% of people with symptoms and 3.5 % with symptoms and a positive test[4].

It is generally believed that symptoms of dry eyes are more common with increasing age and in enopausal and post menopausal women as noted in an Australian study[5]. However this study as well as the Maryland[4] population based study showed a lack of association between presence of frequent symptoms of dry eye with age sex and race.

The presence of dry eye from a positive diagnostic test alone however is more common in Chinese (40.2% p=0.04) and in the 40-59 years age group and not in those of 60 years and above as expected. From a diagnostic test also, elderly patients showed lower BUT and Shirmer's score indicating a decrease in tear film stability and tear secretion. A decline in tear function associated with normal aging have also been shown in another study[6] in Iowa in United States.

Of the diagnostic tests, a lower BUT has a better association with presence of frequent symptoms compared to other tests. There is otherwise a lack of correlation between symptoms and findings of dry eye. Presence of symptoms may not indicate presence of dry eye as detected by objective testing. Likewise those with abnormal test results may not complain of any symptom. This weak association between symptoms and objective testing is also noted in other studies [1,7,8,9].

In a study on Sjogren's syndrome[10], it was noted that the diagnostic usefulness of Shirmer's test was inferior to BUT, but is superior to phenol red thread test (PRT). However Shirmer's test and PRT assess a different aspect of tear physiology related to secretion while BUT is a measure of tear stability. Both tests should be used to give a more reliable assessment of tear function.

Abnormal BUT is usually taken as <10 seconds. Lower values of <5 seconds[10], and <8 seconds [5] have been used. We use a cut off value of 8 seconds as BUT in this study was done after application of a non preservative free topical anaesthesia for Shirmer's test and fluorescein staining. Non preservative free topical anaesthesia can affect tear film stability [11] and could explain the lower mean value of BUT of 9.08 seconds compared to those reported elsewhere [12].

Shirmer's test which measure tear secretion remains the mainstay tool for clinicians in diagnosing dry eye. Shirmer's test was done with topical anaesthetic in this study to reduce patient's discomfort and a cut off value of < 5 mm was taken to indicate dry eye. Traditionally Shirmer's test with topical anaesthesia is believed to reflect basic secretion. Although tear flow has been shown to reduce following instillation of topical

anaesthesia [13], data has indicated that Shirmer's test with anaesthetic is not capable of measuring basic secretion independent of reflex secretion [14,15,16]. The mean Shirmer's test result in this study is 14.52mm which is comparable to one obtained from a study by Jordan [16], which shows an average result of 9 to 14mm depending on the age group.

PRT has been promoted as an alternative test to Shirmer's test to measure tear quantity.

The thread has been shown to be a better absorbent of moisture and is more sensitive than filter paper in measuring small amounts of fluid [17]. As a thread is used and its testing time is rapid, it causes less discomfort to the patient. This study showed there is no agreement between the two tests. PRT is theorized to measure a different aspect of ocular lacrimation than Shirmer's test. It gives an indication of the residual tears existing in the inferior conjuctival sac with minimal effect on the rate of tear secretion. The mean PRT in this study is 20.79mm. In a cross-cultural study of PRT in USA and Japan the mean PRT was 23.9mm in USA and 18.8mm in Japan [18].

Conclusion

The prevalence of dry eye in patients attending the attending the UMMC clinic is 14.4%. When diagnosing a patient with dry eye, no single test is diagnostic. Shirmer's test remained the most widely used test in diagnosing this condition, BUT however should also be performed in order to assess the tear function better. In this study BUT is shown to have a better correlation with dry eye symptoms.

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Appendix

Name RN. Age Sex Race

Dry Eye Symptoms questionnaire :

	R (rarely)	S (Sometime)	O (often)	A (always)
Do your eyes feel dry ?				
Do you ever have a feeling of grittiness or sandy sensation in your eyes?				
Do your eyes ever have a burning sensation ?				
Are your eyes ever red?				
Do you notice any crusting on your lashes?				
Do your eyes ever feel sticky or get stuck together in the morning?				
Are you more intolerant or sensitive to light/ draft/smoke in your eyes than other people?				
Is your vision disturbed after reading or looking at television for some time?				

Medical history: Diabetes Mellitus Hypertension, Rheumatoid arthritis, Others Systemic medications

Personal history. Menopause? Yes/ No; On hormone replacement therapy? Yes/ No.
Smoking
Alchohol