Jurnal Sains Kesihatan Malaysia 2(1) 2004: 65-73

Fluorescein Tear Break-up Time in Malays

NORHANI MOHIDIN & AMRAN HJ. RAMLI

ABSTRAK

Pengamal kesihatan mata pada kebiasaannya menggunakan fluoresin untuk menentukan masa pecahan airmata (TBUT) sebagai salah satu kaedah mendiagnosis kekurangan airmata di kalangan pesakit. Nilai yang digunakan berdasarkan nilai min yang ditemui di kalangan bangsa Caucasian. Sepanjang yang kami ketahui min masa pecahan airmata mata dengan menggunakan kaedah fluoresin untuk kaum Melayu belum pernah dilaporkan. Kajian ini melaporkan min nilai masa pecahan airmata bagi satu sampel kaum Melayu dan kesannya dengan peningkatan umur. Keputusan kami menunjukkan nilai min yang jauh lebih rendah dari min yang dilaporkan bagi Caucasian. Pengamal kesihatan mata seharusnya mengambil kira nilai yang rendah ini apabila mendiagnosis mata kering.

Kata kunci: masa pecahan-airmata, fluoresin, stabiliti airmata

ABSTRACT

Eye care practitioners routinely use the fluorescein tear break-up time (TBUT) as one of the tests for diagnosing dry eye. The cut off value is normally taken from data presented from western population studies. To our knowledge the mean fluorescein TBUT of a Malay population has not been reported. In this paper we report the mean value of the fluorescein TBUT in a sample of Malay population and its effect with an increase in age. Our results showed that the mean TBUT value in Malays is much less than established values reported for Caucasian populations. Eye care practitioners should take this value into account when faced with the diagnosis of dry eye.

Key words: Tear break-up time, fluorescein, tear stability

INTRODUCTION

The pre-corneal tear film is a stable continuous layer of film that covers the cornea and conjunctiva. Basically it is made up of three layers consisting of its outermost superficial lipid layer, a middle aqueous layer and an inner

mucin layer. Deficiency in any of these layers may disrupt the stability of the tear film and results in a dry eye.

At present there are many methods available clinically to measure tear film stability. The methods include using paper strip introduced by Schirmer in 1903 (de Roetth 1953), using cotton thread (Kurihashi et al. 1977), measuring fluorescein tear break-up time (Norn 1969) and using a non-invasive technique involving a modified bowl perimeter (Mengher et al. 1985). However the most commonly used test for tear stability is the fluorescein tear break-up time (TBUT).

The technique was first described by Norn (1969) and standardized by Lemp and Holly (1970). In this method fluorescein is introduced into the tear film and the break-up of the tear film is seen as dry spots in the fluorescein film. Dry spots are thoughts to be due to migration of superficial lipids towards the ocular surface, rendering the surface hydrophobic (Holly 1973). The fluorescein TBUT has been defined as the interval between a complete blink and the appearance of the first randomly distributed dry spots. This value in seconds has been utilized as an index of tear film stability. In Western populations the mean fluorescein TBUT value is about 15 s with slight differences quoted by different authors; Norn: 26.8 s (1969), Lemp & Hamill: > 15 s (1973), Kame et al.: 15 s (1976), Vanley et al.: 30 s (1977), Shapiro & Merin: 13.2 s (1979). Eyes that have TBUT value less than 10 s were considered abnormal (Shapiro & Merin 1979, Lemp et al. 1971). Many authors quoted this finding without additional supporting evidence (Cho & Brown 1993).

Cho and Brown (1993) gave a detailed review on the variations of fluorescein TBUT test in their paper. There is no standard procedure for performing the TBUT test, different investigators tend to vary the procedure used. There may be differences in TBUT measurements made in the same subjects among examiners but these differences are smaller with experienced examiners. They also found that TBUT could be measured reliably using either the scanning or full beam slit lamp method in most patients. Using this technique, they found about 70% of Hong Kong Chinese have TBUT values less than 10 s. The TBUT value found among Hong Kong Chinese is definitely much lower than the mean TBUT of 15 s usually quoted for Caucasians.

Measurements of tear stability are needed both in the clinic and for research purpose. Although measurement of fluorescein TBUT in assessing stability of the tear film is somewhat controversial, the technique is widely used. Tear stability is lower in dry eye patients compared to normals (Mengher et al. 1985; Khurana et al. 1991; Jamaliah & Fathilah 2002). It is also reduced in some pathologic eye conditions (Khurana et al. 1992, Toda et al. 1995). In contact lens clinics for example, it is important to exclude dry eye cases to ensure that prospective contact lens patients have enough tears for successful lens wear. An index of tear stability is

therefore a useful measurement prior to and during lens wear, for changes in tear layer during lens wear can be associated with changes on the cornea. However, the mean values of tear stability for specific groups need to be established for reference purposes.

Ethnic differences have been quoted as one of the factors affecting TBUT values. Patel et al. (1995) showed significant differences between TBUT values of subjects from different ethnic background living in Scotland, with Caucasians having the highest TBUT. Cho and Yap (1993) compared the mean TBUT values of Chinese living in Hong Kong and Singapore and found similarities in them. Using fluorescein technique the mean TBUT for Hong Kong Chinese is 7.8 ± 2.4 s and for Singapore Chinese is 6.5 ± 4.0 s. About 80% of subjects in each group had TBUT less than 10 s.

The effect of TBUT with increasing age is contradictory. Much of the earlier work on TBUT showed no significant changes in TBUT with age (Kaine et al. 1976; Chopra et al. 1985) whereas present studies indicate a decrease of TBUT with age (Cho & Yap 1993; Patel et al. 1995; Briggs 1998). The decrease of tear stability with age has been attributed to several factors like tear flow, osmolarity, ocular surface damage and the effectivity of the eyelid maintaining the tear film (Patel et al. 1995; Mathers 2000). With regard to gender most of the present studies showed no significant differences in TBUT between males and females (Kaine et al. 1976; Cho & Brown 1993; Patel et al. 1995; Tonge et al. 1991).

Mohidin et al. (2002) reported on the distribution of tear stability of normal Malays using a non invasive technique of measuring tear break-up time. The instrument used was a modified bowl perimeter and similar to the one used by Mengher et al. (1985). The mean TBUT value obtained using NIBUT is 15.8 ± 9.4 s and the distribution is skewed toward lower values. Since fluorescein TBUT is still widely used in most of the eye hospitals and clinics in Malaysia it is felt that the mean value of TBUT using fluorescein is valuable as guideline and as an aid to clinician to decide on the diagnosis of dry eye. It is the objective of this study to determine the mean TBUT in Malays using fluorescein and to examine its effects with age.

MATERIALS AND METHODS

SUBJECTS

Seventy-six subjects (28 males and 48 females, aged 11 to 58 years old) were recruited from among patients and staff who came to the Optometry Clinic in Kuala Lumpur campus. All subjects were healthy and normal with no history of eye diseases or surgery. They had no symptoms, were not on any medications and had no history of contact lens wear. All subjects gave informed consent to participate in the study.

PROCEDURE:

A fluorescein sodium ophthalmic strip was wetted with a drop of saline, excess fluid shaken off and the strip introduced flat onto the lower bulbar conjunctiva. Subject was asked to blink 3–4 times to ensure that fluorescein was evenly distributed over the whole cornea. Subject was then asked to blink once and to keep their eyes opened for as long as possible. Formation of black spots were detected through a full beam slit lamp biomicroscopy with blue filter and 16x magnification. The interval between the last blink and the appearance of the first black spot on any part of the cornea was timed with a stop watch and was recorded as the fluorescein TBUT.

Measurements of TBUT were taken from the right and left eyes. Five readings were taken for each subject and the best of three results were used for analysis. All measurements were taken in an air-conditioned room of relatively constant humidity and temperature. Ambient temperature was 23°C, and relative humidity was about 60%.

RESULTS

The distribution of TBUT values for both the right and left eyes were found to be normal (Kolgomorov Smirnov test, Right eye; KSZ = 1.053, p = 0.217, Left eye; KSZ= 1.209, = 0.108). For illustration both the right and left eyes were combined and presented in Figure 1. The mean TBUT values for the right and left eye were 8.06 ± 1.97 and 7.8 ± 1.89 s respectively and there is no significant difference between them. Because of this only the right eye was used for further analysis. There is no significant difference in mean TBUT values between males and females (p = 0.15). (Table 1). Eighty-

TABLE 1. TBUT values according to gender

Gender	Number of eyes	TBUT (Mean ± SD) (seconds)
Males	28	7.6 ± 2.36
Females	48	8.3 ± 1.68

(Student t test p = 0.15)

TABLE 2. Values of new break up time of subjects (N = 76)

Range of BUT (s)	No of subjects	mean + SD (seconds)
0-5.00	11	4.67 ± 0.39
5.1-10.00	56	8.28 ± 1.26
10.1-15.00	9	10.89 ± 0.46

eight percent (88%) of subjects had TBUT values equal or less than 10 s (Table 2). In general there is a decrease of TBUT with an increase age in the Malay population (Figure 2). Figure 2 shows the regression graph. The relationship between TBUT and age can be described by the following equations: y (TBUT) = 11.39 - 0.13age with r squared value of 0.5422 ($p < 0.0001$).

DISCUSSION AND CONCLUSION

The mean TBUT of our sample is less than 10 s. This TBUT value is lower than an earlier study reported by Mohidin et al. (2002) on TBUT using a non-invasive technique on a sample of population from the same Optometry Clinic. The main reason for the difference is the method used in obtaining measurement of tear stability. Indeed compared to fluoresecein TBUT, the non-invasive technique for measuring tear stability yielded higher values (Meagher et al. 1985; Tonge et al. 1991).

Our result is also in contrast to the normal value of 15 s, regarded by many eye care practitioners as the standard TBUT value using the fluorescein technique. This value was reported by many authors (Norn 1969; Shapiro & Merrin 1979; Lemp et al. 1971; Kame et al. 1976; Vanley et al. 1977) and is only true for Caucasian population. Briggs (1998) using fluorescein

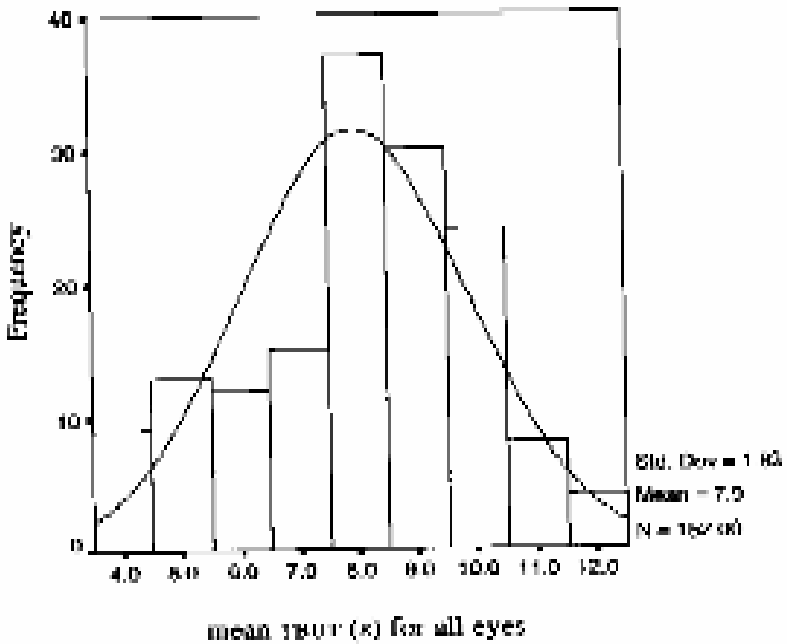

FIGURE 1. Graph of frequency versus tear break-up times for all eyes in the study. Kolmogorov Smirnov test showed normal distribution.

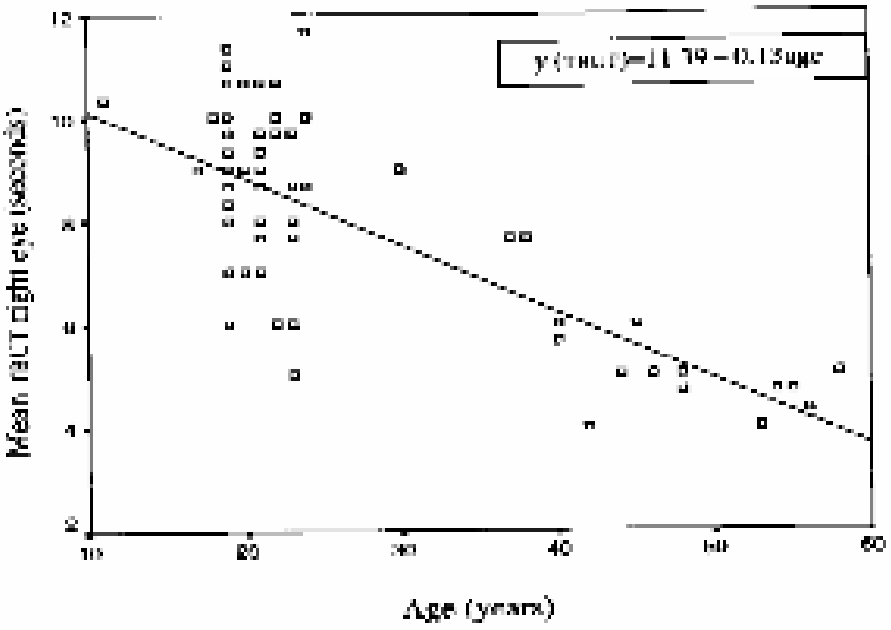

FIGURE 2. Distribution of TBUT by age

as measurement of tear stability found a mean value of 18 ± 7 s in a sample of Saudi Arabian population. However, our study is in agreement with that of Cho & Yap (1993) who found a mean fluoresecein TBUT value of 7.8 ± 2.4 s in a sample of Hong Kong Chinese. Their study involving Singaporean Chinese also showed a relatively lower fluoresecein TBUT value. Patel et al. (1995) found a mean value of 9.8 s among the Chinese population living in Scotland. It appeared as if Asians have lower TBUT values compared to Caucasians and the mean TBUT value for Asians may be an abnormal value for Caucasians. For better clinical interpretation a normal TBUT range for a specific population or ethnic groups should be established for reference. This study found no significant differences in TBUT between males and females. This is in agreement with many other studies on tear stability, although methods of TBUT measurements may be different (Lemp et al. 1970; Tonge et al 1991; Mohidin et al. 2002).

Our results showed TBUT values decreased with age. Earlier investigators found no significant differences of TBUT with age (Norn 1969; Lemp et al. 1973; Kame et al 1976; Vanley et al. 1977). In these studies the narrower age range of subjects used and small number of subjects may account for the insignificant differences of TBUT with age. Later studies by Patel and Farrell (1989), Cho and Yap (1993), Briggs (1998) and Mohidin et al. (2002) showed a decrease of TBUT with an increase in age. The decrease in TBUT with age has been attributed to factors such as reduced rate of tear flow as age increased (deRoeth 1953; Norn 1965) which may be associated with

degenerative changes in the lacrimal glands and it ducts (Damato et al. 1984; Roen et al. 1985). The stability of the tear film also depends on the quality and quantity of tear secretions and on the intrinsic mechanism by which tear is distributed over the whole cornea by the lids. The osmolarity of the tear film increases as a result of decrease tear flow, this will increase the rate of desquamation of corneal epithelium and likely to reduce the concentration of the epithelial microvilli, the presence of which is important in maintaining the stability of the tear film (Gilbart et al. 1984). In the elderly the lids are loose because of reduced tonus of the palpebral muscles, therefore the distribution of tears over the whole surface may not be as efficient as young persons. All these factors may lead to destability of the tear film, manifested as reduced TBUT values in the elderly.

In spite of the controversy of the TBUT technique it is still widely used in clinical situations. Sukul et al. (1983) stated that this technique is very simple and far superior qualitatively to other available tests and it is very useful when incorporated with some other tests for diagnosis of dry eye. Our study implies that practitioners need to take into account of the lower TBUT values in Malays when using fluorescein in measurement of tear stability. In clinical situations contact lens practitioners need to note the lower values in Malays when deciding the cut off value for safe contact lens wear. Similarly eye care practitioners need to re-evaluate the cut off value of TBUT when used as one of the tests for diagnosis of dry eye.

The results of this study showed that fluorescein TBUT in normal Malays was normally distributed and the mean TBUT for the right and left eyes were 8.06 ± 1.97 s and 7.8 ± 1.89 s respectively. TBUT also decreased with age.

REFERENCES

Briggs, S.T. 1998. Tear break-up time in normal Saudi population. *ICLC*. 25: 137-140.

Cho P. & Brown B. 1993. Review of the TBUT technique and a closer look at the TBUT of HK-Chinese. *Optom. Vis. Sci.* 70: 30-38.

Cho, P. & Yap, M. 1993. Age, gender, and tear break-up time. *Optom. Vis. Sci.* 70: 828-831.

Chopra, S.K., Gumpe, S. & Daniel, R. 1985. Tear film break-up time (BUT) in non contact lens wearers and contact lens wearers in normal. *Indian population. Ind. J. Ophthalmol.* 33: 213-16.

Damato, B.E., Allan, B., Murray, S.B. & Lee, W.R. 1984. Senile atrophy of the human lacrimal glands. The contribution of chronic inflammatory diseases. *Br. J. Ophthalmol.* 68: 674-80.

de Roetth, A. 1953. Lacrimation in normal eyes. *A M.A. Arch. Ophthalmol.* 49: 185-89.

Gilbard, J.P., Carter, J.B., Sang, D.N., Refojo, M.F., Hanninen, L.A. & Kenyon, K.R. 1984. Morphologic effect of hyperosmolarity on rabbit corneal epithelium. *Ophthal.* 91: 1205-12.

Holly, F.J. 1973. Formation and rupture of the tear film. *Exp. Eye Res.* 15: 515-25.
Jamaliah, R. & Fathilah, J. 2002. Prevalence of dry eye in University Malaya Medical Centre. *Med. J. Malaysia.* 57: 390-97.
Kame, R.T., Tukenmura, R.K. & Mukai, G.T. 1976. Tear break-up time and the Schirmer tear test. *J. Am. Optom. Assoc.* 47: 1535-38.
Khurana, A.K., Chaudhary, R., Ahluwalia, B.K. & Gupta, S. 1991. Tear profile in dry eye. *Acta Ophthalmol. (Copenh).* 69: 79-86.
Khurana, A.K., Sunder, S., Ahluwalia, B.K. & Malhotra, K.C. 1992. Tear film profile in Graves' ophthalmopathy. *Acta Ophthalmol. (Copenh).* 70: 346-49.
Kurihashi, K., & Yanagihara, N. & Honda, Y. 1977. A modified Schirmer test: the fine-thread method for measuring lacrimation. *J. Pediat. Ophthalmol.* 14: 390-397.
Lemp, M.A. & Holly, F.J. 1970. Recent advances in ocular surface chemistry. *Am. J. Optom. & Physiol. Opt.* 47: 856-880.
Lemp, M.A., Dohlman, C.H., Kuwabara, T., Holly, F.J. & Caroll, J.M. 1971. Dry eye secondary to mucus deficiency. *Trans. Am. Acad. Ophthalmol. Otolaryngol.* 75: 1223-27.
Lemp, M.A. & Hamill, J.R. 1973. Factors affecting tear film breakup time and locations in normal subjects. *Arch. Ophthalmol.* 89: 103-5.
Mathers, W.D. 2000. Why the eye becomes dry: a cornea and lacrimal gland feedback model. Comment, *CLAO.* 26: 118.
Meagher, L.S., Bron, A.J., Tonge, S.R. & Gilbert, D.J. 1985. A non-invasive instrument for clinical assessment of the pre-corneal tear film stability. *Curr. Eye Res.* 4: 1-7.
Mohidin, N., Bay, T.C. & Yap, M. 2002. Non invasive tear break-up time in Malays. *Clin. Expt. Optom.* 85: 37-41.
Norn, M.S. 1965. Tear secretion in normal eyes. *Acta Ophthalmol. (Kbh).* 43: 567-73.
Norn, M.S. 1969. Desiccation of the precorneal film: I. Corneal wetting time. *Acta Ophthalmol.* 47: 856-80.
Patel, S. & Farrell, J.C. 1989. Age related changes in precorneal tear film stability. *Optom. Vis. Sci.* 66: 175-78.
Patel, S., Virbis, S.K. & Farrell, P. 1995. Stability of the precorneal tear film in the Chinese, Africans, Indian and Caucasian eyes. *Optom. Vis. Sci.* 72: 911-15.
Roen, J.L., Stasior, O.G. & Jakobiec. 1985. Age changes in the human lacrimal gland: role of the ducts. *CLAO.* 11: 237-42.
Shapiro, A. and Merin, S. 1979. Schirmer test and break up time of tear film in normal subjects. *Am. J. Ophthalmol.* 88: 752-7.
Sukul, R.R., Shukla, M. & Nagpal, G. 1983. Tear film break-up time in normal Indian subjects. *Ind. J. Ophthalmol.* 31: 325-326.
Toda, I., Shimazaki, J. & Tsubota, K. 1995. Dry eye with only decreased tear break-up time is sometimes associated with allergic conjunctivitis. *Ophthalmol.* 102: 302-09.
Tonge, S.R., Hamsaker, J. & Holly, F.J. 1991. Non-invasive assessment of tear film break-up time in a group of normal subjects: implications for contact lens wear. *J. Brit. Contact Lens Assoc.* 14: 201-5.

Vanley, G.T., Leopold, I.M. & Gregg, T.H. 1977. Interpretation of tear film breakup. *Arch. Ophthalmol.* 95: 445-8.

Norhani Mohidin
Amran Hj. Ramli
Department of Optometry
Faculty of Allied Health Sciences
Universiti Kebangsaan Malaysia
Jalan Raja Muda Abdul Aziz
50300 Kuala Lumpur