Patterns of Ocular Trauma among the Elderly in a South-American Urban Area and the Association between Eye Traumas with Sleep Disorders

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Abstract

Aims: Eye trauma in the older population can lead to blindness. Sleep deterioration is associated with increased risk of occupational injuries. The purpose of the study was to assess the epidemiology of ocular trauma in the elderly population and to evaluate the relationship between eye trauma and sleep quality. Settings and Design: This was a cross-sectional, observational hospital based study done in a Sao Paulo, Brazil. Subjects and Methods: Patients with ocular trauma aged 60 years who attended the Eye Trauma Service of the Santa Casa de Sao Paulo Central Hospital were included. All subjects underwent a complete eye examination and answered to the Pittsburgh Sleep Quality Index (PSQI) questionnaire. The results were compared with an age and gender matched control group. Results: Eighty-nine patients with ocular trauma were included in the epidemiological study, 71 (80%) were male and 18 (20%) were female. The patients’ ages ranged from 60 to 90 years (65.7 ± 7.1 years). Most accidents occurred at home and were of mild severity. The control group had a global PSQI score of 1.21 ± 1.37, whereas in the ocular trauma group the score was 3.11 ± 3.63 (P < 0.038). A post hoc analysis including only patients with severe trauma, the PSQI score was 8.80 ± 2.44 (P < 0.000). Conclusion: The elderly population represents an important group of ocular trauma in their own peculiar characteristics. Elderly victims of ocular trauma, particularly serious eye injury, have worse sleep quality than subjects of the same age.

Keywords: Eye health, eye injuries, penetrating, sleep

INTRODUCTION

The World Health Organization Program for the prevention of blindness estimates that some 55 million eye injuries restricting activities for more than 1 day occur each year and 750,000 of which will require hospitalization each year; there are approximately 1.6 million people blind from injuries and almost 19 million with unilateral blindness or low vision. Although more prevalent in younger, older patients are victims of ocular trauma. Reports of patients aged from 86 to 90 and further up to 103-year-old with eye injuries have been accounted in the medical literature. Sleep deterioration causing daytime sleepiness can interfere with daytime functioning and has been associated with increased risk of both occupational injuries and motor vehicle accidents.

There is a paucity of data on the epidemiology of eye trauma in the older population, especially in developing nations. Hence, the purpose of this study was 2-fold: to evaluate the features of ocular trauma in an urban hospital-based older population in South America and to access the possible association between the quality of sleep and the risk of eye trauma in the elderly. We hypothesize that older subjects with sleep disorders can have excessive daytime sleepiness and as a result, be prone to falls and/or accidents and sustain eye injuries.

MATERIALS AND METHODS

Study design and setting

This was a cross-sectional, observational study that included all subjects older than 60 years of age victims of eye trauma,

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who attended the Eye Trauma and Emergency Service of the Santa Casa of Sao Paulo Central Hospital, Sao Paulo, Brazil from July 2013 to June 2014. The Institution Ethics Committee approved the study and all subjects and/or legal representatives signed the informed consent. The procedures followed adhere to the Declaration of Helsinki and the Resolution 466/2012 (National Health Council, Ministry of Health, Brazil).

**Procedures**

All patients underwent a standardized complete eye examination including, best corrected visual acuity measurement, pupillary reflex evaluation, anterior segment biomicroscopy with a slit lamp and dilated fundus examination. The first examination was done at the emergency room as soon as the patient arrived. Examinations were done by an attending eye physician and reviewed by one of the authors. If both eyes were affected, only that with the worst visual acuity was included for analysis in the study.

For the demographic and epidemiologic data, information related to patients and trauma circumstances were collected and included: age, gender, ethnicity, time from accident to first evaluation, the environment, mechanism, and cause of the injury. The definitions and standardized terminology of the Birmingham Eye Trauma terminology were used in the study, excepted by the addition of a separated item, namely, trauma of eyelids and adnexa. Others examined the types of tissue damage as an indicator of injury severity and included both anterior segment (corneal laceration, hyphema, and cataract) and posterior segment involvement (scleral laceration, intraocular foreign body, prolapse of intraocular tissue, and retinal detachment). Since there is no standardization for ocular trauma, we arbitrarily used eye and adnexa injuries necessitating surgical intervention as an indicator of severe ocular trauma in the study. Often in the scientific jargon, the injury is damage to the body of a human while trauma is any serious injury to the body that has the potential to cause prolonged disability, often resulting from violence or an accident. Nevertheless, in this study, both terms were used interchangeably.

An age- and gender-matched group comprised old patients with minor eye conditions (e.g., early cataract, refractive errors, and early age-related macular degeneration) and good visual acuity (20/40 or better) served as controls.

**Evaluation of sleep disorders**

Sleep problems were assessed using the Pittsburg Sleep Quality Index (PSQI). This is a self-reported questionnaire, and effective instrument used to measure the quality and patterns of sleep in the older adult over a 1-month period. It comprises 19 items rated on a 0–3 Likert scale and clustered in seven domains (subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medications, and daytime dysfunction over the last month). A global score of 0 corresponds to no problems with sleep, and 5 or higher indicate sleep problems with a diagnostic sensitivity of 89.6% and specificity of 86.5% (kappa = 0.75, P < 0.001). The internal consistency of the sleep scale has been previously tested (Cronbach’s alpha = 0.77) as well as test-retest reliability (correlation coefficient = 0.85) with good results. The best evidence synthesis for the PSQI showed strong reliability and validity, and moderate structural validity in a variety of samples, suggesting the tool fulfills its intended utility. Besides, the PSQI has been translated and validated in Brazilian-Portuguese.

**Statistical analysis**

Demographic data were compared between study group and controls using the Chi-squared test and Fisher’s exact test for categorical variables and the Student’s t-test for continuous variables. To ascertain the differences in the PSQI between study group and controls, we have used the Student’s t-test. A subset of patients with severe trauma, i.e., any condition requiring hospitalization and/or surgical intervention, was analyzed as a separated group and compared to controls. A P < 0.05 was set as the threshold value to reject the null hypothesis.

**Results**

**Epidemiologic data**

Eighty-nine elderly patients with eye injuries were evaluated at the Eye Trauma and Emergency Service of the Santa Casa of Sao Paulo Central Hospital in 1 year; 71 (80%) were male and 18 (20%) female. The age ranged from 60 to 90 years (65.7 ± 7.1). All patients had only one eye affected; in 45% the right eye was injured and in 55% the left eye only. In most patients (54 subjects, 61%), the initial visit to the emergency room was within the first 6 h after the accident; 16 patients were seen between 6 and 12 h; 15 patients seek the emergency service between 12 and 24 h; and four patients were seen 24 h after the accident.

As to the place of injury, 32 patients (36%) were injured at home; 28 (31%) at work; 10 patients (11%) were at a leisure facility; and the remaining 19 (22%) were at others/unknown places.

The mechanism of trauma comprised a number of different conditions. Fifty-six patients (63%) presented a corneoscleral lamellar laceration caused by a foreign body; 10 individuals (11%) had blunt trauma; nine subjects (10%) had open-globe trauma (either laceration or rupture); seven patients (8%) had chemical burns; and four individuals (5%) presented with eyelid laceration (only one needed surgical reconstruction), and three had eye injuries caused by other mechanisms.

Patients with corneoscleral lamellar laceration caused by foreign bodies comprise the larger group of eye trauma (56 patients). Mean age of the patients was 65.9 ± 6.5 years; males (91.1%) were more affected than women (8.9%); as to ethnicity, 25 were
white (44.6%), nine were African-Brazilians (16.1%), and 22 (39.3%) of mixed origin. Twenty-nine patients were injured at home (51.8%), 17 at work (30.4%), five were at a leisure facility (8.9%), and five (8.9%) were at others/unknown places. The main cause of injury was wood in 28 patients (50%), followed by iron in 18 subjects (32.1%), and ten patients were injured by plastic, stone, and other materials (17.9%). The median visual acuity at presentation was 20/25 (range, 20/200–20/20).

A subset of ten patients (11%) had an eye and adnexa trauma necessitating surgical intervention. Nine had open-globe trauma - three had corneal laceration, and six had ocular rupture - affecting mainly the sclera and limbus. One patient had eyelid laceration that needed surgical reconstruction. Eight patients were injured at home and two at work. The main cause for open-globe trauma was falls (8 patients) and assault/aggression in two subjects.

Seven patients had previously undergone cataract surgery in at least one eye (four were pseudophakic on both eyes). Only one patient had an ocular rupture in a previously operated eye.

Association between eye trauma and sleep disorders

Table 1 displays the comparison between the study group and controls. Forty-five subjects of the study group were willing to respond to the PSQI questionnaire. Patients with ocular trauma had higher scores in the PSQI as compared to controls (3.1 ± 3.6 and 1.2 ± 1.3, study group and controls, respectively, \( P < 0.038 \)).

A subanalysis of ten patients who sustained severe ocular trauma revealed a greater difference in the PSQI score from controls (8.8 ± 2.4, \( P < 0.001 \)). This subset of patients comprised nine subjects with open-globe injuries (four lacerations and five ocular ruptures), and one eyelid laceration. The mean age was 69.1 ± 10.3 years. Six patients were men and four women.

**Discussion**

Patterns of ocular trauma

In this study, males were more affected than female, on a ratio (4:1) higher than reported previously. In Southwest Nigeria, the male to female ratio was 1.9:1, and in Iran, the rate was 2.76.\(^{[13,14]}\) In industrialized countries, the male to female ratio declines after the age 70 and reverses over 80 years.\(^{[14]}\) In Scotland, a female preponderance was seen after the age of 75 years.\(^{[21]}\) Women seem to be more prone to open globe injuries comprising 58% in a hospital-based geriatric cohort older than 65 years.\(^{[22]}\) This observation might be due to the longer longevity of females as compared to men.\(^{[23]}\)

Most patients in this study were injured at home (36%). Although on a small frequency, this observation concurs with the Nigerian (51.9%) and the Scottish (60%) populations.\(^{[11,23]}\) In general, older people are retired and spend most of their time at home. Even for subjects who engage in hobbies or other activities in community centers and/or churches, the time spent at those places is short lived. In Iran, most accidents occurred at work (40.4%); that seems to be a unique feature of the Iranian population.\(^{[14]}\)

In this cohort of patients, most injuries were superficial corneoscleral lamellar lacerations caused by superficial foreign bodies (63%). Severe injury comprised blunt trauma (11%) and open-globe trauma (10%). Eight patients with open-globe trauma were victims of fall at home (8.7%). The results are similar to those reported in the Nigerian population. Eye injury was mainly of closed globe variety (85.9%) during farm related activities (35.9%).\(^{[13]}\) In the United States Eye Injury Registry (USEIR), however, disproportional high rates of injuries are ruptures mostly caused by fall at home. Falls are over 10 times more common in subjects over 60 years.\(^{[4]}\) In Scotland, 60% of the study population had blunt trauma (specific etiology not mentioned).\(^{[21]}\) In Iran, the main mechanism of ocular injury was sharp trauma (59.6%) followed by blunt trauma (40.4%).\(^{[14]}\)

In this study, ocular open globe injuries were all corneal laceration or ruptures (involving the limbus and the sclera simultaneously). Aghadoost et al. reported corneal laceration in 55% of patients.\(^{[10]}\) Onakpoya et al. found open globe injury in 14.1% in Nigerian elderlies and made no differentiation between scleral and corneal lesion.\(^{[13]}\) In the Scottish population, Desai et al. recounted penetrating injury in 12.0% (no IOFB) and 4.0% (with IOFB) with no reference to corneal or scleral lesions.\(^{[21]}\) The mechanism of ocular trauma in Brazilian patients may account for the differences.

It appears that the eye of an older person has a lower threshold to rupture of the same impact as compared to a younger eye. Using a computational eye model, Stitzel et al. demonstrated an increasing peak stress in the posterior portion of the ciliary body and decreasing peak stress in the posterior portion of the zonules with increasing lens stiffness for severe impacts.\(^{[24]}\) The authors concluded that the risk of eye injury increases with age and as a result, the eyes of older patients may be more susceptible to ciliary body-related eye injuries in traumatic impact situations.\(^{[24]}\) This model is a plausible explanation for the disproportional high rates of ruptures in the USEIR. The
number of eye ruptures in our study, however, was too small to make any postulation.

Previous ocular surgery may be another factor associated to ocular fragility. Age-related changes in healing aptitude affect every phase of the healing process in the skin, including delayed re-epithelialization, delayed angiogenesis and collagen deposition, reduced collagen turnover and remodeling, and decreased wound strength. Would closure after a surgical incision in the sclera may be subject to the same changes. In Iran, Aghadoost et al. reported that 55 patients (58.5%) had a positive history of cataract surgery and in 8 of them (14.5%) previous wound was opened or extended to the posterior scleral area. In this study, only a few patients had previously undergone cataract surgery, and only one had an ocular rupture in the pseudophakic eye with the previous surgical wound opened.

The association with sleep disorders

The result of this study confirms the hypothesis that patients with sleep disorders are more prone to eye trauma. Although we have not established an etiologic significance, this study determined a possible association between eye trauma and sleep disorders. The association between neurobiologically based sleepiness/fatigue and human-error-related accidents has been previously reported. Melamed and Oksenberg, using injury data taken from organizational archives, concluded that workers with excessive daytime sleepiness had over 2-fold higher risk of sustaining an occupational injury. Choi et al. have reported that sleeping for < 7.5 h increased the risk for injuries by 61% (rate ratio, 1.61; 95% confidence interval, 1.21–2.15) in a rural population of Iowa. Others studies have found an association between sleepiness and motor vehicle crashes. To the best of our knowledge, this is the first study that reports an association between sleep difficulties and specifically eye trauma.

The subgroup of patients with severe eye trauma included two victims of assault and eight subjects with falls. A post hoc analysis, eliminating the two victims of assault (n = 8), revealed a statistical significant difference in the PSQI between patients with severe eye trauma and controls (P < 0.000). Falls in these subjects might have been caused by daytime sleepiness due to sleep disorders.

Sleepiness can be caused by a number of different conditions. Nocturia, a common symptom in older individuals, promotes sleep deterioration, with increased daytime sleepiness, and loss of energy and activity. Accidents, for example, fall injuries, are increased both at night and in the daytime in older persons with nocturia.

Snoring and excessive daytime sleepiness, the main symptoms of obstructive sleep apnea influence the risk of occupational accidents and is associated with a higher risk of motor vehicle crashes. Sleep disturbance is common after traumatic events of various types, such as combat, physical trauma, and sexual abuse, and closely intertwined with posttraumatic stress disorder, a common outcome of severe and prolonged trauma. In a French community-dwelling old population, excessive daytime sleepiness was significantly associated in univariate analyses with chronic diseases, early awakening, snoring, severity of depression and lifetime prevalence of manic and hypomanic episodes, and gender (male, multivariate analysis). Sleepiness and fatigue contribute to human error and accidents in technology-rich, industrialized societies in terms of human, environmental, and economic impacts. In our study, we have not explored the specific causes of sleepiness. In addition to sleep disorders, visual risk factors for trauma in older persons have been reported. Lord and Dayhew noticed that impaired vision is an important and independent risk factor for falls in the elderly. Adequate depth perception and distant-edge-contrast sensitivity, in particular, were important for maintaining balance and detecting and avoiding hazards in the environment. Patino et al. evaluated the Latino population in Los Angeles and concluded that both central and peripheral visual impairment were independently associated with increased risk for falls and falls with injury 4 years after the initial examination in a dose-response manner.

In this study, the visual impairment could have played a role in causing the accident that led to an eye injury. The visual acuity in the injured eye was decreased as a result of the trauma, and no objective information on the vision before the accident was available since the initial visit was at the emergency room immediately after the trauma. Nevertheless, considering the visual acuity in the fellow noninjured eye, most patients had between 20/40 and 20/20; one patient with severe trauma had 20/200 in the fellow eye. Except for this patient, we believe that visual impairment was not a determinant cause of accidents in this study.

This study has some drawbacks. We have included patients during a short period (12 months), so the sample size was relatively small. However, we believe that is only a representation of the prevalence of ocular trauma in the population of older people. The prevalence of ocular trauma in the elderly is relatively small. In a previous study done in the same institution, Weber et al. found only nine subjects (5%) with eye trauma older than 60 years. Besides, not all patients were willing to respond to the PSQI. In the emergency room, the victimized patient is anxious, eager to hear from the attending physician how bad his/her eye is and whether they are going blind. Some subjects responded to the questionnaire on a follow-up visit even though, nearly only half of the participants completed the PSQI. Last, this was a case–control study that precludes causal inference. Hence, we can only state that eye trauma was associated with sleep disorders and might or might not be of etiologic significance. Although we suggest sleep disorders as a risk factor, we have neither included all other risk factors nor used a multivariate model to actually estimate risk. The more appropriate design to determine whether eye trauma is more common in people with sleep disorders was to take a sample of people with sleep disorders and matched controls and to determine which group has the higher incidence of eye trauma prospectively.
This design, however, would take a long time and resources beyond our budget to be completed.

**Conclusions**

This study has portrayed the features of ocular trauma in older people from an urban area of a developing country and established a possible association between the quality of sleep and eye injuries. Worldwide, the longevity of the population will increase as new developments in medicine and science allow fighting against degenerative and hereditary diseases. The number of older people will increase, and more aged subjects will be victims of accidents and eye traumas. The prevention of eye trauma in the older population should aim at specific targets at home as a potentially high-risk environment and improve sleep quality.

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**Conflicts of interest**

There are no conflicts of interest.

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