

Eye Injuries in Citizens of South Poland

Wojciech Rokicki^{1*}, Mariola Dorecka¹, Jacek Karpe², Agnieszka Nawrat³, Anna Pitura³ and Wanda Romaniuk¹

¹Department of Ophthalmology, Medical University of Silesia, Poland

²Department of Anesthesiology and Intensive Care, Medical University of Silesia, Poland

³Department of Ophthalmology, Medical University of Silesia, Katowice, Poland

Abstract

Objective: The aim of this study was to evaluate the clinical features and treatment results in adult citizens of Silesia with mechanical eye (globe) injuries.

Design: Retrospective cohort study

Participants: 331 patients, 324 eyes

Methods: Data on 331 patients with eye injuries primarily presented and hospitalized between 1995 and 2005 were retrospectively analyzed.

Results: The incidence of mechanical eye globe injuries requiring hospitalization at our department was 4.3 per 100 000 citizens annually. Out of 331 mechanical injuries 174 were closed globe and 157 open globe injuries. The majority of patients were young men in third to fifth decade. Most injuries occurred at work (43.8%) and at home (33.8%). At highest risk of house-related injuries were women (59.52%), and work-related injuries were men (49.13%). The housekeeping was associated with the highest risk of severe eye injury (64.71%). High-velocity and low-velocity metal pieces were the most common traumatic factor (37, 16%). Four predictors of duration of hospital stay: poor initial and final visual acuity, posterior segment damages and necessity of the performance of complicated surgical procedures were revealed (to date, first reported).

Conclusion: The main risk factor of serious ocular injuries in young-adults is extensive work and house-related activity. We observed, the remaining factors play important, but supporting role in eye trauma.

Keywords: Eye; Injury; Epidemiology

Objective

Ocular injuries still remain a leading cause of avoidable monocular blindness throughout the world, although epidemiology of those traumatic events are not well defined [1,2]. Most ocular traumas occur in working-age people, and in this connection have a significant impact on further personal and occupational life. Medical expenses, worker's compensation and lost of productivity frequently produce big short and long term eye trauma costs. To prevent serious eye injuries in the future it is necessary to gain more information about the risk factors, mechanism and underlying circumstances of various types of ocular trauma in all sorts' societies.

The most densely populated and the highest industrialized territory of Poland is Upper Silesian Industry Area (USIA) which has a population of over 3.5 million of inhabitants in most cases employed in heavy industry (12%) [3]. In the context of eye trauma no one before characterized this area.

Patients and Methods

The University Department and Policlinic of Ophthalmology in Sosnowiec is a part of the major adult trauma centre managing the majority of serious ocular and other organs injuries in Upper Silesian Industry Area.

The source of data was medical records of patients primarily treated for eye (globe) injury between January 1995 and December 2005. Out of these, only records of consecutive patients who were hospitalized due to eye (globe) mechanical injury were retrospectively analyzed. The patients who were primarily treated elsewhere were excluded from analysis. It is possible that some cases were missed due to incorrect coding of cases.

The following variables were analyzed: age, sex, type, mechanism, date, time and circumstances of eye injury, initial visual acuity, surgical procedures, duration of hospitalization, visual outcome measured at the time of final discharge from hospital.

The type of injury was recorded according to the Birmingham Eye Trauma Terminology (BETT) [4].

The severity of the injury was graded by an injury scale specified by the Ocular Trauma Classification Group (OTCG) [5].

The visual outcome was graded according Open and Closed Globe Injury Classification using Snellen chart. (0, 5 or better; 0, 4-0, 2; 0, 10-0,025; 0, 02-light perception and no light perception). A change in Snellen visual acuity of two lines or more was considered to be a clinically significant.

Statistical analysis was performed by using Statistica 7.1 software system (StatSoft Inc.). The demographics, injury circumstances, eye trauma degree and time differences were estimated using Student's t-test for independent variables or Pearson's Chi-Square test respectively.

***Corresponding author:** Wojciech Rokicki, Department of Ophthalmology, Medical University of Silesia, Ceglana 35, 40-952 Katowice, Poland, Tel: 48 32 358 12 27; E-mail: wojtek.rokicki@gmail.com; wjr@xl.wp.pl

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Multiple regression analysis was used to assess an association between duration of hospitalization (as dependent variable) and initial, final visual acuity, zone of injury and surgical procedure and other (as independent variables). The level of statistical significance was set at $p < 0.05$.

Results

Between 1995 and 2005 during emergency service the 13,367 eye trauma patients received treatment. 331 out of them required hospitalization.

The annual incidence of eye trauma requiring hospitalization in adult population of Silesia was estimated to be 4.3 per 100 000 citizens annually.

The right (139) and left (185) eyes were affected approximately equally. There were 7 bilateral injuries. However, in all these cases the condition of only one eye was a basement for hospitalizing.

The patients were mostly men, with male to female ratio of 6.8:1.0 (289 men and 42 women).

The average age at time of injury was 39, $17 \pm 14,17$ years (range 18 – 82 years) with strong significant difference between the sexes (men – $38,36 \pm 13,07$, women – $44,79 \pm 19,51$; $p = 0,0058$, Student's t-test) (Figure 1).

Most eye injuries (77, 64%) occurred at work (145) and at home (112). There were significant interaction between sex, type, severity of injuries and trauma circumstances. At highest risk of house-related injuries were women (59.52%), and work-related injuries were men (49.13%) (Chi-square = 28.83, $p < 0.001$). Both closed and open globe injury were mostly (Chi-square = 35.07, $p < 0.001$) injuries at work.

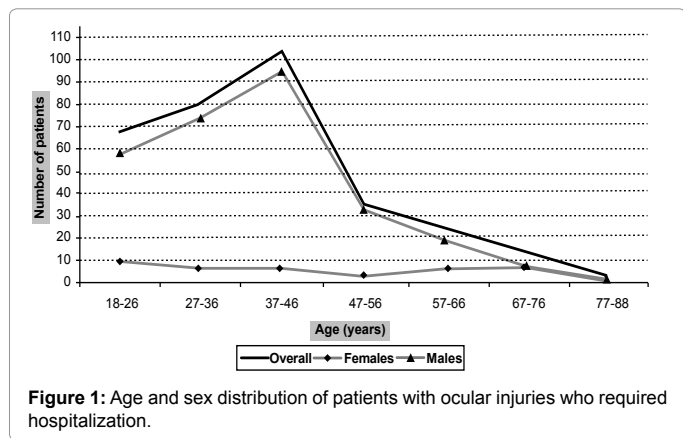


Figure 1: Age and sex distribution of patients with ocular injuries who required hospitalization.

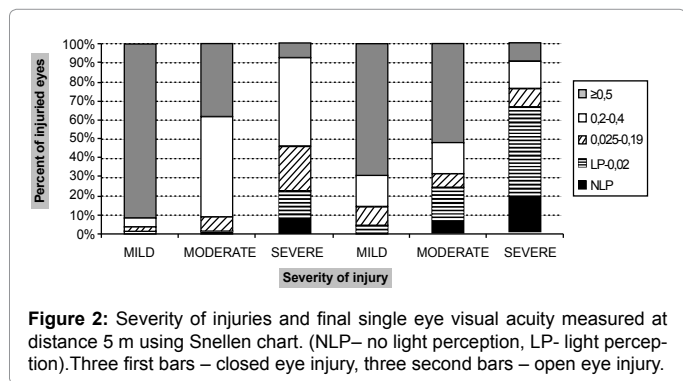


Figure 2: Severity of injuries and final single eye visual acuity measured at distance 5 m using Snellen chart. (NLP – no light perception, LP – light perception). Three first bars – closed eye injury, three second bars – open eye injury.

		CLOSE GLOBE Injury	OPEN GLOBE Injury	TOTAL N = 331
The most frequent objects	Drilling metal	34 (43,59%)	44 (56,41%)	78
	Assault	32 (74,42%)	11 (25,58%)	43
	Wood splinter	28 (70,00%)	12 (30,00%)	40
	Hammering metal	3 (9,68%)	28 (90,32%)	31
	Pressure	25 (96,15%)	1 (3,85%)	26
	Rubber	19 (86,36%)	3 (13,64%)	22
	Nail or wire	4 (28,57%)	10 (71,43%)	14
	Coal	4 (28,57%)	10 (71,43%)	14
	Glass	5 (35,71%)	9 (64,29%)	14
	Stone	4 (33,33%)	8 (66,67%)	12
	Explosion	2 (33,33%)	4 (66,67%)	6
	Traffic injury	3 (100%)	0	3
	Snowball	1 (100%)	0	1
	Miscellaneous	10 (37,04%)	17 (62,96%)	27
Place of injury	At work	65 (44,83%)	80 (55,17%)	145
	At home	59 (52,68%)	53 (47,32%)	112
	Outdoor	39 (92,86%)	3 (7,14%)	42
	Sport	11 (34,38%)	21 (65,63%)	32
Visual acuity	> 0,5	92 (63,01%)	54 (36,99%)	146
	0,4–0,2	50 (69,44%)	22 (30,56%)	72
	0,19–0,025	22 (48,89%)	23 (51,11%)	45
	0,02–LP*	8 (14,04%)	49 (85,96%)	57
	NLP**	2 (18,18%)	9 (81,82%)	11
Severity of injury	Mild	114 (69,5%)	50 (30,5%)	164
	Moderate	47 (35,3%)	86 (64,7%)	133
	Severe	13 (38,2%)	21 (61,8%)	34

*LP – light perception
**NLP – no light perception

Table 1: Causes, circumstances and severity of mechanical eye injuries.

However, the housekeeping was associated with the highest risk of severe eye injury (Chi-square = 21.72, $p = 0.0014$).

Patients with closed globe and open globe injury comparable delayed arrival to the hospital (the median time was 10 hrs and 33 min. ± 1 day, ranged from 15 min. to 7 days).

In the present study no significant daytime, weekday, seasonal and annual variation was observed. No significant correlation between severity and daytime of eye injury was noted although almost 80% occurred during daylight.

High-velocity and low-velocity metal pieces were the most common traumatic factor (123 – 37, 16%) (Table1). Nevertheless, none of objects was significant more frequent cause of the deepest vision acuity lowering. In the examined group 65 IOFB were noted. 49 of them were ferromagnetic, and in the majority were classified as hammering (25 – 51, 02%) and 18 (36, 73%) as drilling metal. This kind of IOFB resulted in blindness in 9 eyes (20, 93%). Remaining intraocular objects were coal (5), wood (4), stone (2) and glass (1). Even though only 4 wooden IOFBs were documented, 50% of them were complicated by blindness.

The initial visual acuity in the closed/open eye injury subgroup measured at the time of admission to the ward was above 0.5 in 92/54, from 0.4 to 0.2 in 50/22, between 0.10 and 0.025 in 22/23, 0.02-light perception in 8/49 and no light perception was observed in 2/9 subjects. Final visual acuity (closed/open eye injury) improved in 78/70 cases, did not change before and after treatment in 83/71 cases, and decreased in 13/16 cases. Three eyes were enucleated (2 - metal IOFB and 1 - wooden IOFB). The average number of Snellen's lines changed was the

Severity of injury	Closed globe injury	Open globe injury
Mild	1,62 ± 2,81 (n=114)	1,56 ± 2,82 (n=50)
Moderate	2,72 ± 3,79 (n=47)	1,97 ± 3,24 (n=86)
Severe	0,92 ± 1,38 (n=13)	1,09 ± 2,49 (n=21)
Total	1,87 ± 3,07 (N=174)	1,72 ± 3,01 (N=157)

Table 2: The average number of Snellen lines improved in subgroups.

Multiple regression analysis for evaluating predictors for the duration of hospitalization. Adjusted R²=0.175, F(4.326)=18.593, std. estimation error=6.7096, p<0.000. VA – visual acuity Std. – standard.

PREDICTORS	STD. BETA COEFFICIENTS	STD. ERROR BETA	t RATIO	p LEVEL
Initial VA	0,143271	0,070618	2,028817	0,043289
Zones of injury	0,108722	0,050104	2,169905	0,030736
Surgery	0,168838	0,053875	3,133915	0,001882
Final VA	0,215421	0,072961	2,952533	0,003381

Table 3: Predictors for the duration of hospitalization.

highest in the group of patients with moderate severity of eye injury (Table 2), but the differences were slightly below the level of clinical significance (p=0.061).

Within the closed globe injury 38 required only conjunctiva closure alone, 7 lens extraction or full cataract surgery and 10 vitreoretinal procedures. Out of the 174 closed globe injured eyes, 119 needed only conservative treatment. Among the patients with open globe injury in all cases surgery was performed (104 wound closure alone, 10 lens extraction or full cataract surgery, 23 iris repair, 20 vitreoretinal procedure). In 6 cases of closed and 14 of open eye injuries more than 1 surgical procedure was required. Secondary procedures were required only for 9 (2, 71%) of the patients with open globe injury.

The mean time of hospitalization was 8.94 ± 6.26 in the closed globe injury and 12.57 ± 8.07 in the open globe injury subgroup were significant different (p<0.001, Student's t-test).

The multiple regression analysis revealed four factors predicting the duration of the hospitalization: initial visual acuity, zone of injury, surgical procedure and final visual acuity (Table 3).

Comparison between occupation and frequency of injuries showed no significant differences.

Even though, data concerning use of alcohol were collected, this factor was not analyzed because of potential tendency to underreport these facts by patients.

The medical costs of eye injury in Poland are difficult to estimate.

The number of patients who used the protective eye wear is too small to perform reliable analysis.

Discussion

The goal of the current study is to provide additional accurate and complete eye injuries data of Silesia in Central Europe which has never been examined in this population before. We hope to provide additional information that would be useful for the development of realistic and effective injury preventions.

Before drawing conclusion from these data, however, the major limitations of the study methodology must be mentioned. Some data (trauma circumstances, use of alcohol and use of goggles, time before injury and admission to emergency room) relied on reporting by patients. There is probably a tendency to underreport some of these facts by subjects. Some patients had not yet finished healing process at the time of the final discharge from hospital, and in many cases

follow-up examination was carried out in different out-patients clinic. Finally, visual acuity outcomes came from post traumatic period only, thus fully impact of injury upon visual acuity was not able to estimate. Our study group included all adult patients with eye globe injury requiring hospitalization, regardless severity of trauma. Nevertheless, retrospective analysis based on OTCG classification justified the necessity of the hospitalization in all cases.

A young men predominance, as showed in this research, is a universal worldwide characteristic and thought to be related to higher, in comparison with women, professional and leisure activity of men [7,8].

The present study revealed that work-related injury was the leading cause of eye injuries, as corroborated by many authors [9,10], what is more the average age of patients who underwent injuries of eye in a place of employment was almost 10 years lowest as compared with the age of house-related trauma patients (36,8 ± 10,33 and 44,13 ± 16,7, respectively). On the other hand, 64, 7% of severe eye injuries occurred at home. This interesting finding of our study, contrasting other reports [10,11], could result from frequently inobservance of principle of safety of work in housekeeping. The constant improvement in conditions and the job security in Polish factories seemed to reflect our results. Almost a twofold fall in the amount of injuries in 2001-2005 years compared with the first five-year investigated period (52 vs. 93) was noted. The similar tendency was characterized in previous reports from industrialized western countries [6,12]. However, these observations differed from the data on Norwegian group [13].

Some authors observed daily [7] and monthly distribution of eye trauma [11,14]. In contrast to these findings we noted only daytime variation without connection to the severity of injury. This is to be expected because people are more physically active in daylight. We suppose, that children eye injuries and rural environments injuries are more seasonal related.

Data concerning specification of the most frequent traumatic factors in the eye injury are diversified in publications [7,11,13]. In our study, a piece of drilling metal was the most frequent cause of both open as well as closed eye injury. Nevertheless, drilling metal (17,65%) was only third most common objects causing the severe eye injuries after wood splinter (32,35%) and hammering metal (23,53%). According to our observation, severity of injury should be correlated with the grandeur of the kinetic energy (mostly with the speed) rather than with the material of object.

Our data confirmed the common knowledge, that injuries complicated by intraocular foreign body (IOFB) should be particularly suspected in high-velocity metal events. According to us (38,46%) and to the United States Eye Injury Registry (USEIR) the most common is hammering metal. In our study, every fifth victim of such injuries resulted in complete and irreversible monocular blindness. The high-velocity metal injuries should be taken especially seriously even when an injury is apparently trivial. The small drilling or hammering splinters hit the globe directly without any loss of energy thus the diameter force per surface area is huge. Two wooden IOFB (50%) were complicated by blindness due to endophthalmitis development. In theory, wooden IOFB aggravates risk of endophthalmitis more than relatively sterile, heated drilling metal.

In the present study lack of follow-up examinations allows only for demonstrating of tendency in the change of visual acuity rather than final outcome. According to our results, the visual outcome was directly related to the severity of eye globe injury, which confirmed the validity

and practical utility of the OTCG classification [5]. In accordance with the severity of the injuries, severe visual impairment and blindness were caused mainly by open globe injuries. In current study as well as reported previously [11] the initial vision acuity was a predictor of the final (at the time of final discharge) visual outcome. As expected, the best improvement was observed in the group of patients with middle eye injury. Nevertheless, in this group average initial visual acuity was relatively low, prognosis as to visual outcome still remained favorable.

To the best of our knowledge, we first observed in multiple regression analysis four independent variables significantly influenced the duration of hospitalization (as dependent variable). Poor initial and final visual acuity, posterior segment damages and necessity of complicated surgical procedures significantly extends hospital stay.

Conclusion

The main risk factor of serious ocular injuries in young-adults is extensive work and house-related activity. We observed, the remaining factors play important, but supporting role in eye trauma.

We believe, the most effective method of preventing visual damage due to eye trauma is to promote awareness amongst public about consequences of eye injuries.

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