

Presentation and Management Outcomes of Corneal and Scleral Perforations in Geriatric Nursing Home Residents

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Abstract: We compared the clinical presentation and treatment outcomes of corneal and scleral perforations in geriatric nursing home residents, geriatric community residents, and non-geriatric population. The medical records of patients who were treated for corneal and scleral perforations at the Prince of Wales Hospital, Hong Kong between January 1, 2004 and May 1, 2013, were reviewed retrospectively. Of 144 cases, 53 (37%) occurred in the geriatric population, of which 16 (11%) lived in nursing homes, and 37 (26%) were community residents. There were 91 (63%) patients in the non-geriatric group. The mean age of the patients in nursing home geriatric group was 86.5 years (87.5% females). The most common etiology of perforation was trauma. Rupture due to fall was more common in geriatric patients ($P < 0.001$) whereas laceration due to penetrating eye injury was more common in non-geriatric patients ($P < 0.001$). There were more cases of infection leading to spontaneous perforation in geriatric nursing home group compared to the other groups ($P = 0.001$). In the geriatric nursing home group, visual acuity at presentation ($P < 0.001$) and postoperative visual acuity ($P = 0.012$) was worse compared to the other groups. Our study showed that corneal and scleral perforations in the geriatric nursing home residents carry a poor visual prognosis. The causes and anatomical outcomes of such events in geriatric age group differ from those in the general population. In our study, geriatric patients residing in nursing homes had worse baseline as well as posttreatment visual acuity, compared to community residents. The authors have no funding and conflict of interests to disclose.

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INTRODUCTION

Corneal and scleral perforations are a common cause of blindness worldwide.¹ The underlying reason can be infectious, degenerative, inflammatory, or posttraumatic.² The posttraumatic cases can be further classified into rupture or laceration. Rupture is an injury caused by a blunt object whereas a sharp object causes laceration. Laceration injuries can be subdivided into penetrating wounds where there is an entrance wound or perforating wound where there is presence of an entrance and an exit wound.³ It is important to identify and understand the underlying factors that lead to scleral and corneal perforations, as it is a preventable cause of blindness. The pattern and etiology of corneal and scleral perforations is different among different age populations. Globe rupture is more common than laceration in elderly patients, and the usual mechanism involves fall.⁴ As a result of an aging population the demand for nursing homes have increased.⁵ There are currently no data regarding scleral and corneal perforations in elderly patients living in nursing homes.

In this retrospective study, we studied and compared the characteristics and outcomes of corneal and scleral perforations in geriatric nursing home residents with geriatric community residents and non-geriatric population.

METHODS

The medical records of all patients who presented with corneal and/or scleral perforations to the Prince of Wales Hospital, Hong Kong between January 1, 2004 and May 1, 2013 were reviewed retrospectively. Institutional Ethics Committee approval was obtained. The study adhered to the tenets of the Declaration of Helsinki. Corneal perforation was defined by a defect in the cornea and a positive Seidel's test. A scleral perforation was defined as a full-thickness wound of the sclera. The geriatric population was defined as those 65-years old or older at time of injury. The posttraumatic perforations were further classified into zone I if they were confined to the cornea including the corneoscleral limbus, zone II, if they were located at the corneoscleral limbus to a point 5 mm posterior into the sclera, and as zone III if they were located posterior to zone II.

All patients were evaluated on arrival to the emergency room. A standard history taking and ocular examination were completed. A noncontrast computed tomography scan of the orbit was requested, and the patient was admitted into the ophthalmological ward. Intravenous (ciprofloxacin) and topical (levofloxacin 0.5%, 8 times a day) antibiotics were started. Repair of the perforation was arranged as an emergency operation under general anesthesia. Evisceration was planned in cases out of clinical necessity such as unsalvageable eyes or with endophthalmitis in eyes with no visual potential.

Data including age, sex, etiology of perforation, lens status, prior cataract or ocular surgery, rupture from previous surgical wound, associated ocular and systemic comorbidities,

time to presentation and treatment, mobility, best spectacle corrected visual acuity at presentation and at 3 months post-operatively, other associated ocular injuries, and surgeries received, were collected and analyzed. Data were presented as arithmetical mean \pm standard deviation. Subjects were classified into Geriatric and non-geriatric groups. Geriatric group was further subclassified into geriatric nursing home group and geriatric community resident group. Demographic factors, ocular and systemic comorbidities, and outcomes were compared between groups by Fisher exact test. Statistical analysis was performed using R 2.15.2 (R Foundation, Vienna, Austria). A P value <0.05 was considered statistically significant.

RESULTS

Overall, 144 eyes were identified and included in the analysis. There were 91 (63%) non-geriatric patients and 53 (37%) geriatric patients, of which 16 (11%) lived in nursing homes and 37 (26%) were in community residents. The baseline characteristics of all patients are summarized in Table 1.

The mean age was 86.5 years (SD 5.95; range, 75–95 years) for geriatric nursing home residents, 77 years (SD 6.66; range, 65–92 years) for geriatric community residents, and

37 years (SD 14.65; range 2–64 years) for non-geriatric age group. Overall, there were significantly more females than males ($P < 0.001$) in the geriatric group ($n = 14$, 87.5%) as compared to community residents ($n = 19$, 51.4%) and non-geriatric group ($n = 13$, 14%).

Overall, trauma was the most common cause corneal and scleral perforations. In the geriatric group, the most common mechanism of injury was due to rupture (52.8%), whereas in the non-geriatric group it was related to laceration (69.2%; $P = 0.002$). Falls were the most common cause of rupture in the geriatric age group, occurring in 38% in geriatric nursing home residents and 46% in the geriatric community residents. The most common mechanism of injury in the non-geriatric group was laceration due to penetrating injuries (66%). Associated intraocular foreign body was more prevalent in non-geriatric age group (13%) compared to geriatric group (0%, $P = 0.004$). Majority of the injuries in geriatric nursing home residents were located in zone 1 (94%), which was more common than geriatric community residents (57%) and non-geriatric subjects (35%, $P < 0.001$) (Table 1).

Geriatric patients had significantly higher number of previous cataract surgeries performed than non-geriatric age group ($P < 0.001$). In the geriatric nursing home group, 5 eyes

TABLE 1. Demographic Characteristics and Mechanism of Corneal and Scleral Perforations in Geriatric and Non-geriatric Patients

	Geriatric Nursing Home	Geriatric Community Resident	Non-geriatric	<i>P</i> Value
Demographics				
Number of patients	16	37	91	
Mean age (range), years	86.5 (75–95)	77.0 (65–97)	37.0 (2–64)	
Male, %	2 (12.5)	18 (48.6)	78 (85.7)	
Female, %	14(87.5)	19 (51.4)	13 (14.2)	
Laterality				
Right eye, %	6 (37.5)	22 (59.4)	57 (62.6)	0.20
Left eye, %	10 (62.5)	15 (40.5)	34 (37.4)	0.20
Etiology, no., %				
1. Trauma				
Rupture				
Fall	6 (38)	17 (46)	0 (0)	<0.001
Assault	0 (0)	1 (3)	8 (9)	
Others	0 (0)	4 (11)	16 (18)	
Laceration				
Penetrating	0 (0)	3 (8)	60 (66)	<0.001
Perforating	0 (0)	0 (0)	3 (3)	
2. Infection				
Endophthalmitis	4 (25)	1 (3)	0 (0)	0.001
Corneal ulcer/abscess	4 (25)	2 (5)	0 (0)	
4. Others				
Ruptured desmetocele	1 (6)	0 (0)	1 (1)	0.66
Uveal melanoma	0 (0)	1 (3)	0 (0)	
Corneal thinning	0 (0)	2 (5)	3 (3)	
Scleral thinning	0 (0)	1 (3)	0 (0)	
Postoperative	0 (0)	1 (3)	0 (0)	
Unknown	1 (6)	3 (8)	0 (0)	
Corneal ectasia	0 (0)	1 (3)	0 (0)	
Zone of injury, %				
1	15 (94)	21 (57)	32 (35)	<0.001
2	1 (6)	13 (35)	37 (40)	<0.001
3	0 (0)	3 (8)	22 (24)	<0.001

Number in bracket represents percentage values.

(31%) had cataract surgery with or without intraocular lens placement, of which all had dehiscence from previous surgical wound after open globe injury and 4 eyes had intraocular lens dislodged from the wound. Twenty four cases (65%) from the geriatric community residents had prior cataract surgery, of which 12 (32%) had dehiscence of a previous surgical wound, and 9 (24%) had intraocular lens dislodged from the wound (Table 2).

In the geriatric nursing home resident group, spontaneous perforation caused by infection including endophthalmitis (25%) and corneal ulcers (25%) were more common compared to geriatric community residents (3% and 5%, respectively; $P=0.001$). There were no cases of perforation due to infection in non-geriatric group.

Geriatric nursing home residents had significantly more ocular comorbidities compared to the other 2 groups. The most common ocular comorbidities were glaucoma (38%; $P < 0.001$) and bullous keratopathy (19%; $P=0.02$), which were not reported in the other groups. Previous repair of corneal or scleral perforation was noted in 1 patient in the geriatric nursing home group. Three (8%) patients in the geriatric community residents had a history of repaired corneal or scleral perforation (1 posttraumatic, 2 postinfectious keratitis). Four patients in non-geriatric groups had history of previously repaired corneal or scleral perforation (3 posttraumatic, 1 postinfectious) (Table 3).

The geriatric group had significantly more systemic comorbidities. All (100%) geriatric nursing home residents, 31(84%) in the geriatric community residents and 4 (4%) in the non-geriatric group had >1 systemic comorbidity ($P < 0.0001$). Eleven (69%) geriatric nursing home residents had 4 or more associated systemic comorbidities, compared to 8 (22%) geriatric community residents ($P < 0.001$). Hypertension was the most common systemic comorbidity noted in 56% of geriatric nursing home residents and 49% of geriatric community residents. In the geriatric nursing home residents group, other more common systemic comorbidities included dementia (38%), anemia (25%), diabetes mellitus (18%), history of stroke (18%), and history of femur fracture (18%).

Geriatric nursing home residents were significantly less mobile compared to the other 2 groups ($P < 0.001$). Seven (44%) patients were bedbound, 4 (25%) were chair bound. Seventy three percent of the geriatric community residents and 100% of the non-geriatric patients could walk unaided (Table 4).

Most (84.6%) of the non-geriatric patients presented within 24 hours to the Accidents and Emergency Department compared to the geriatric patients (64.2%; $P=0.002$). However, there was no statistically significant difference between the time to presentation of the geriatric nursing home residents and geriatric community residents. Majority of the cases in all groups were treated within 24 hours. Thirteen percent ($n=2$) of the geriatric nursing home residents and 19% ($n=7$) of the geriatric community residents were treated within 24 to 48 hours. There was 1 case in each geriatric group that was treated between 48 hours and 1 week. Delay in treatment was due to the need of management of systemic conditions before general anesthesia. There was 1 case (6%) in the geriatric nursing home group and 2 cases (5%) in the geriatric community group that was treated conservatively due to poor general condition.

The visual acuity at presentation was worse in the geriatric nursing home residents ($P < 0.001$) (Table 5). The visual acuity was not recordable in 5 cases (31%) in the nursing home geriatric patients due to cognitive impairment. No light perception was noted in 50% of geriatric nursing home residents, 13% of geriatric community residents, and 11% of non-geriatric patients. There were no statistically significant differences between the 3 groups in terms of associated ocular injuries (Table 5).

In the geriatric nursing home residents, 7 patients (44%) had primary corneal or scleral wound repair, 8 patients (50%) had evisceration, and 1 patient (6%) was managed conservatively. In the geriatric community residents, 25 patients (68%) had primary corneal or scleral wound repair, 1 patient (3%) had primary repair with cataract surgery, 6 patients (16%) had evisceration, 2 patients (5%) had patch graft, 1 patient (3%) had repair by glue, and 2 patients (5%) were treated

TABLE 2. List of Previous Ocular Surgeries and Intraocular Lens Status in Geriatric and Non-geriatric Patients With Corneal and Scleral Perforations

	Geriatric Nursing Home	Geriatric Community Resident	Non-geriatric	P Value
Prior cataract surgery, %				
Total	5 (31)	24 (65)	3 (3)	<0.001
ICCE	1 (6)	0 (0)	0 (0)	
ECCE	2 (13)	14 (38)	2 (2)	
Phacoemulsification	1 (6)	6 (16)	1 (1)	
Cataract OT done but details unknown	1 (6)	4 (11)	0 (0)	
IOL/lens status before operation, %				
Pseudophakic	4 (25)	18 (29)	3 (3)	
Aphakic	8 (50)	4 (10)	0 (0)	
Phakic	2 (13)	10 (27)	0 (0)	
Unknown	2 (13)	5 (14)	3 (3)	
IOL dislodged, %	4 (25)	9 (24)	2 (2)	<0.001
Rupture from previous wound	5 (31)	12 (32)	2 (2)	<0.001

Number in bracket represents percentage values. ECCE = extracapsular cataract extraction, ICCE = intracapsular cataract extraction.

TABLE 3. List of Ocular and Systemic Comorbidities in Geriatric and Non-geriatric Patients With Corneal and Scleral Perforations

	Geriatric Nursing Home	Geriatric Community Resident	Non-geriatric	P Value
Associated ocular comorbidities				
Previous repair of corneal or scleral perforation	1 (6)	3 (8)	4 (4)	0.55
Bullous keratopathy	3 (19)	0 (0)	0 (0)	0.001
Glaucoma	6 (38)	0 (0)	0 (0)	<0.001
Myopic maculopathy	1 (6)	0 (0)	0 (0)	0.11
History of corneal graft	1 (6)	2 (5)	3 (3)	0.54
AMD	1 (6)	0 (0)	0 (0)	0.11
History of LASIK	0 (0)	0 (0)	1 (1)	>0.99
History pterygium surgery	0 (0)	2 (5)	1 (1)	0.31
History of retinal detachment surgery	0 (0)	0 (0)	1 (1)	>0.99
Phthisical	0 (0)	0 (0)	1 (1)	>0.99
Amybyopia	1 (6)	1 (3)	0 (0)	0.070
Proliferative diabetic retinopathy	0 (0)	1 (3)	0 (0)	0.37
Others	1 (6)	0 (0)	0 (0)	0.11
Number of associated systemic comorbidities				
0	0 (0)	6 (16)	87 (96)	<0.001
1	1 (6)	8 (22)	0 (0)	
2	2 (13)	8 (22)	4 (4)	
3	2 (13)	7 (19)	0 (0)	
4	8 (50)	4 (11)	0 (0)	
5	3 (19)	2 (5)	0 (0)	
6	0 (0)	1 (3)	0 (0)	
7	0 (0)	1 (3)	0 (0)	

Number in bracket represents percentage values. AMD = age-related macular degeneration, LASIK = laser in situ keratomileusis.

conservatively. In the non-geriatric age group 64 patients (70%) had primary repair of the corneal or scleral wound, 4 patients (4%) had primary retinal detachment repair with wound repair, 15 patients (16%) had cataract operation with primary wound repair, 1 patient (1%) had corneal patch graft, 1 patient (1%) had

corneal glue, and 6 patients (7%) had intraocular foreign body removal.

All eviscerated eyes were assigned a visual acuity score of no-light perception and were included in the analysis. The geriatric nursing home residents had the worst visual outcome

TABLE 4. Time to Presentation and Mobility in Geriatric and Non-geriatric Patients With Corneal and Scleral Perforations

	Geriatric Nursing Home	Geriatric Community Resident	Non-geriatric	P Value
Time to presentation				
<24 hours	9 (56)	25 (68)	77 (85)	0.002
24–48 hours	3 (19)	2 (5)	10 (11)	
>48 hours – <1week	2 (13)	4 (11)	3 (3)	
>1week	1 (6)	6 (16)	1 (1)	
Unknown	1 (6)	0 (0)	0 (0)	
Time to treatment				
<24 hours	12 (75)	27 (73)	88 (97)	<0.001
24–48 hours	2 (13)	7 (19)	1 (1)	
>48 hours – <1week	1 (6)	1 (3)	1 (1)	
>1week	0 (0)	0 (0)	1 (1)	
Conservative treatment	1 (6)	2 (5)	0 (0)	
Mobility				
Walk unaided	0 (0)	27 (73)	91 (100)	<0.001
Walk with aid (stick/frame)	5 (31)	7 (19)	0 (0)	
Chair bound	4 (25)	2 (5)	0 (0)	
Bedbound	7 (44)	1 (3)	0 (0)	

TABLE 5. Associated Ocular Injuries, Visual Acuity at Presentation and at the End of 3 months in Geriatric and Non-geriatric Patients With Globe Perforation

	Geriatric Nursing Home	Geriatric Community Resident	Non-geriatric	P Value
Visual acuity at presentation				<0.001
No light perception	8 (50)	13 (35)	10 (11)	
Light perception	3 (19)	6 (16)	15 (17)	
Hand motions	0 (0)	6 (16)	25 (28)	
Counting fingers	0 (0)	0 (0)	12 (13)	
1/200–19/200	0 (0)	2 (5)	5 (6)	
20/200–20/50	0 (0)	3 (8)	14 (15)	
20/40 or better	0 (0)	0 (0)	7 (8)	
Not available	5 (31)	7 (19)	3 (3)	
Associated injuries				
Retinal detachment	0 (0)	0 (0)	7 (8)*	0.32
Vitreous hemorrhage	4 (25)	15 (41)	34 (37)	0.58
Choroidal hemorrhage	1 (6.3)	5 (14)	5 (6)	0.27
Iris prolapsed	9 (56)	19 (51)	46 (51)	0.94
Vitreous prolapse	1 (6.3)	11 (30)	17 (19)	0.13
Aniridia	2 (13)	3 (8)	4 (4)	0.23
Hyphema	5 (31)	12 (32)	31 (34)	>0.99
Lid laceration	1 (6.3)	3 (8)	15 (17)	0.39
Cataract	0 (0)	2 (5)	15 (17)	0.08
Lens capsule rupture	0 (0)	0 (0)	9 (10)	0.06
Orbital fracture	0 (0)	4 (11)	2 (2)	0.06
lens prolapsed	3 (19)	1 (3)	8 (9)	0.16
Iridodialysis	0 (0)	0 (0)	6 (7)	0.28
Zonular lysis	0 (0)	1 (3)	5 (6)	0.84
Corneal edema	0 (0)	4 (11)	5 (6)	0.38
retinal hemorrhage	0 (0)	0 (0)	4 (4)	0.58
lens subluxation	0 (0)	1 (3)	1 (1)	0.60
IOFB	0 (0)	0 (0)	12 (13)	0.02
secondary endophthalmitis	0 (0)	0 (0)	3 (3)	0.69
retinal tear	0 (0)	0 (0)	3 (3)	0.69
IOL dislocation	3 (19)	2 (5)	0 (0)	0.001
Choroidal detachment	1 (6.3)	0 (0)	2 (2)	0.44
rectus muscle damage	0 (0)	0 (0)	1 (1)	1.00
Retrobulbar hemorrhage	0 (0)	1 (3)	0 (0)	0.37
Primary Surgery received				
Repair of cornea/scleral wound	7 (44)	25 (68)	64 (70)	
Repair of cornea/scleral wound + cataract extraction	0 (0)	1 (3)	15 (16)	
Repair of cornea/scleral wound + RD + cataract extraction	0 (0)	0 (0)	4 (4)*	
Evisceration	8 (50)	6 (16)	1 (1)	
Patch graft/keratoplasty	0 (0)	2 (5)	0 (0)	
Glue	0 (0)	1 (3)	1 (1)	
Repair of cornea/scleral wound++IOFB removal	0 (0)	0 (0)	6 (7)	
Conservative	1 (6)	2 (5)	0 (0)	
VA 3 months				0.012
No light perception	10 (63)	7 (19)	11 (12)	
Light perception	1 (6)	10 (27)	7 (8)	
Hand motions	0 (0)	5 (14)	9 (10)	
Counting fingers	1 (6)	0 (0)	7 (8)	
1/200–19/200	1 (6)	4 (11)	13 (14)	
20/200–20/50	0 (0)	5 (14)	26 (29)	
20/40 or better	0 (0)	0 (0)	11 (12)	
Not available	3 (19)	6 (16)	7 (8)	

Number in bracket represents percentage values. IOFB = intraocular foreign body, RD = retinal detachment.

*Primary retinal detachment surgery was not performed in all cases.

3 months after surgery ($P = 0.012$). Ten patients (63%) had no light perception, and there were no cases with a visual acuity of 20/200 or better. Visual acuity was not recordable due to cognitive impairment in 3 patients (19%).

DISCUSSION

There is currently no published literature on management outcomes of corneal and scleral perforations in the elderly population living in nursing homes. This study was intended to elucidate this topic. Previous studies on geriatric open globe injuries showed that patients tend to be females involved in falls resulting in globe rupture, with infrequent penetrating or perforating injuries.⁴ The results in our study were similar with falls accounting for 38% and 46% of the open globe injuries in geriatric nursing homes and community residents, respectively, and females being more common in the geriatric group.

Approximately 30% of people aged 65 and over fall each year, increasing to 40% for those over 85 years of age.^{6,7} Between half and three-quarters of nursing home residents fall each year, which is twice the rate of falls among older adults living in the community⁵ due to the frailer condition in institutionalized elderly. Risk factors for falls in elderly are multifactorial, and include age-related physiological changes (visual, hearing, locomotor) or pathological (ocular and systemic) conditions.⁸ In our study, nursing home residents had more ocular and systemic comorbidities, which could account for the high incidence of falls. It is noteworthy that 4 out of 53 (7.5%) of geriatric patients had history of repaired corneal or scleral perforation due to trauma or infection. Although the absolute numbers are small, the occurrence of these events more than once essentially highlights the importance of continued vigilance in the geriatric age group.

In this study, 50% of the corneal or scleral perforations were due to infection in the nursing home residents. Residing in nursing home has been shown to be a risk factor for microbial keratitis associated endophthalmitis.⁹ These patients have coexistent ocular disease such as bullous keratopathy, which compromises the corneal epithelium. Prior studies have found history of ocular disease and ocular surgery to be the leading risk factors of microbial keratitis in elderly. Similarly, systemic diseases such as diabetes and dementia have been associated with microbial keratitis in nursing home residents.¹⁰ Furthermore, there may be a deleterious effect on the general and ocular health from the crowded environment in the nursing homes.

Previous studies have shown that geriatric traumatic open globe injuries usually occur in zone 2 and 3.⁴ However, in our study the majority of our geriatric cases had injuries in zone 1, especially in the nursing home residents. This may be related to the occurrence of injury along the line of cataract surgery incision. The incidence of globe rupture from previous surgical wounds was similar in both geriatric groups (31% in nursing home residents, 32% in geriatric community residents, $P = 0.065$). Furthermore, intraocular lens dislodgement occurred in similar frequencies in both geriatric groups (25% in nursing home residents, 24% in geriatric community residents, $P = 1.000$). Our data are consistent with a previous study, which showed that old incision wounds are the most likely sites of rupture during open globe injury.¹¹

The visual acuity at the time of presentation was overall poor in the geriatric age group. Fifty percent of nursing home residents and 35% geriatric patients in the community presented without light perception. The geriatric nursing home residents had the worst visual acuity at presentation, which could be due

to the fact that this group had more preexisting ocular comorbidities and late presentation. This group also had more eviscerations performed and the worst visual outcomes, which could be due to the time lag between injury and surgery. The number of patients with no light perception increased at the end of 3 months in nursing home residents. Surprisingly, there were fewer patients with no light perception in the community geriatric group postoperatively (13 preoperatively vs 7 postoperatively). Although we are unable to explain the occurrence of this finding, it is likely that these patients were not very cooperative during visual acuity measurement at baseline, which may be further related to a multitude of factors such as impaired cognition as well as extensive ocular injury. Our study was consistent with multiple previous studies that show the association with presenting visual acuity and final visual outcome.^{12–15}

One of the main limitations of the current study is its retrospective nature. Overall, our study showed that corneal and scleral perforations in the geriatric nursing home residents carry a poor visual prognosis because of concurrent ocular comorbidities such as glaucoma and history of surgeries. Its patterns, causes, functional, and anatomical outcomes differ from those in the general population. A better understanding of the mechanism of injury especially can improve prevention and treatment strategies in this subpopulation.

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