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Visual Impairment and Hip Fractures: A Case-Control Study in Elderly Patients

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Key Words
Visual impairment · Hip fracture · Cataract · Glaucoma · Macular degeneration · Falls

Abstract
Aims: To investigate the relationship between visual impairment and fall-related hip fracture and to determine the etiology of visual impairment in a population of elderly patients with hip fracture. ***Methods:*** A case-control study compared 96 patients diagnosed with hip fracture to a randomly selected control group of 103 patients without hip fracture. Inclusion criteria for the case group were as follows: patients aged 60 years and over with a hip fracture. Clinical assessment included visual acuity and ophthalmic examination. ***Results:*** Forty-three patients with hip fracture had a visual impairment compared to only 12 patients in the control group. Visual impairment was a significant risk factor for hip fracture (OR = 6.15; 95% CI 2.98–12.69). Twenty-seven hip fracture patients had an uncorrected refractive error compared to only 15 controls (OR = 2.78; 95% CI 0.92–8.35). There was no significant difference of dense cataract between both groups (OR = 2.28; 95% CI 0.75–6.93). Fourteen hip fracture patients had a macular degeneration compared to only 8 controls (OR = 5.63; 95% CI 1.57–20.18), and 10 patients had suspicion of glaucoma compared to only 5 controls (OR = 10.65; 95% CI 2.21–51.3). ***Conclusion:*** Visual impairment was significantly associated with an increased risk of hip fracture in elderly people. There are many etiologies that may contribute to hip fractures, most notably refractive error, cataract, macular degeneration and glaucoma.

Introduction

Falls among elderly persons are common and are potentially responsible for severe injuries and reduced quality of life. Indeed, falling is associated with considerable mortality, morbidity and reduced functioning, causing a major threat to the health of the elderly. Of all fall-related fractures, hip fractures cause the greatest number of deaths and frequently lead to disability within the early postoperative period [1]. Falls frequently result from an interaction of multiple and diverse risk factors and situations, some of which are often unrecognized. Especially, poor vision has long been evocated as a risk factor for falling if undiagnosed and untreated [2–6]. Visual impairment oc-

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curs increasingly frequently as people age and several studies have suggested that visual impairment contributes to falls in the elderly. Consequently, as a substantial proportion of visual deficit may be reversible by improving spectacle correction or performing a cataract surgery, prevention of falling could be considerably improved.

While several investigations have studied fall-related factors and hip fractures, only a few studies have focused specially on the relationship between hip fracture and visual impairment [2, 7–9].

The purpose of this study was to investigate the relationship between visual impairment and fall-related hip fracture and to determine the etiology of visual impairment in a population of elderly patients with hip fracture in comparison to a control group of similar age.

Materials and Methods

The investigation was a monocentric hospital-based case-control study comparing consecutive patients admitted for hip fracture and treated surgically to a randomly selected control group of similar age without hip fracture. Data were recorded prospectively over a 6-month period and then analyzed retrospectively. Case records were reviewed for the following inclusion criteria: patients had to be aged 60 years and over and had to have been admitted with a history of fall and hip fracture treated surgically at our Department of Orthopedics. The control group was composed of consecutive patients with no history of hip fracture, recruited from the ocular surface consultation of our Department of Ophthalmology.

Both groups were matched for age and sex. The reference date for age was the date of the ophthalmologic examination. Written informed consent was obtained from all patients. In accordance with French law, institutional review board and ethics committee approval were not required for this study because no modifications to French standards of treatment or follow-up were made. Described research adhered to the tenets of the Declaration of Helsinki. The data collected by a single independent observer during a medical interview were the following: demographics characteristics, fall and ocular history, presence of visual complaints, previous lens surgery and time since last visit to the ophthalmologist. Visual acuity was recorded with current glasses and after subjective refraction. Snellen visual acuity values were converted to the logarithm of the minimum angle of resolution (logMAR) for statistical analysis [10]. An extensive clinical ophthalmic examination of the anterior and posterior segments of each eye was performed, including slit-lamp and fundus examination and measurement of intraocular pressure using the Goldmann applanation tonometer. Pupillary responses were assessed before dilation. The lens opacity of each eye was assessed under pupil dilation and graded into clear, early, moderate and dense using the Lens Opacities Classification System III (LOCS III) standards [11]. Macular degeneration, diabetic retinopathy or maculopathy were diagnosed clinically by indirect ophthalmoscopy of the fundus.

Visual acuity was classified into three categories: 20/40 or better, 20/50 to 20/70 and 20/80 or worse. Vision was considered impaired if best-corrected visual acuity was below 20/40 in the best eye. Glaucoma was suspected if optic disc excavation was superior to 0.5 and intraocular pressure was superior to 21 mm Hg.

All patients were examined at the Department of Ophthalmology. For the case group, the examination was performed 5–7 days after the hip surgery. Patients were sitting in wheelchairs and the medical examination modalities were similar in both groups.

For the bivariate analysis, a χ^2 test was used to describe the differences between the case group and the control group regarding categories of visual acuity. Results were considered statistically significant if 95% confidence intervals (CI) did not include 1. Conditional logistic regression was used for the multivariate analysis. We evaluated a set of covariables including ocular pathologies and findings of the ophthalmic examination. We report odds ratios (OR) as relative risk with 95% CI.

Results

Demographic Data

A total of 199 patients (398 eyes) were enrolled in this study (96 cases and 103 controls). Seven patients were excluded from the case group due to severe cognitive impairment which precluded an accurate visual acuity and proper ophthalmic examination. The mean age of cases was 78.8 ± 9.8 years ranging from 60 to 99 years (33 male and 63 female patients). The mean age of controls was 80.6 ± 9.5 years ranging from 62 to 98 years (37 male and 66 female patients). All cases experienced a fall from standing height and presented with a hip fracture requiring surgery.

Visual Impairment

Fifty-five (57%) patients with hip fracture had visual complaints compared to only 48 (46%) in the control group (OR = 1.54; 95% CI 0.88–2.7). There was no significant difference in ophthalmologic care between the case group and the control group. Twenty (21%) patients with hip fracture compared to 14 (14%) controls had not seen an ophthalmologist for more than 3 years preceding the current data collection (OR = 1.67; 95% CI 0.79–3.53). A comparison of visual impairment in both groups is reported in table 1.

Forty-three (45%) hip fracture patients had a visual acuity below 20/40, which we defined as a visual impairment, compared to 12 (11%) patients in the control group. Visual impairment was a significant risk factor for hip fracture (OR = 6.4; 95% CI 3.8–10.8). The findings of the ophthalmic examination in both groups are summarized

in table 2. Twenty-seven (28%) cases had uncorrected refractive error compared to only 15 (15%) controls. In the case group, 10 (10%) patients had a dense cataract, 5 (5%) a posterior subcapsular cataract and 66 (69%) had a clear lens or an intraocular lens. In the control group, 5 (5%) patients had a dense cataract, 3 (3%) a posterior subcapsular cataract and 84 (81%) had a clear lens or an intraocular lens. There was no significant difference of dense cataract between the case group and the control group (OR = 2.28; 95% CI 0.75–6.93). There was no significant association between posterior subcapsular cataract and hip fracture (OR = 1.83; 95% CI 0.43–7.87). Fourteen (15%) hip fracture patients had a known age-related macular degeneration or were diagnosed during examination compared to only 8 (8%) in the control group. Ten (10%) patients in the case group had treated glaucoma or met criteria for suspicious glaucoma compared to only 5 (5%) in the control group. No significant difference was found regarding prevalence of corneal disease and other ocular pathologies in both groups. The presence of age-related macular degeneration was related to a significantly increased risk of hip fracture (OR = 10.65; 95% CI 1.57–20.18) as well as the suspicion of glaucoma (OR = 10.65; 95% CI 2.21–51.3).

We found no significant association between the incidence of hip fracture and the other findings upon examination as the 95% CI included 1. The results of the multivariate analysis are reported in table 3.

Table 1. Comparison of visual acuity between the case group and the control group

Best-corrected visual acuity	Case group, n (%)	Control group, n (%)	OR	95% CI
20/40 or better	53 (55)	91 (88)	0.16	0.08–0.33
20/50 to 20/70	18 (19)	6 (6)	3.73	1.41–9.85
20/80 or worse	25 (26)	6 (6)	5.69	2.22–14.6
Total <20/40	43 (45)	12 (12)	6.15	2.98–12.69
Total	96	103		

Table 2. Main ophthalmic etiologies found in the case group and the control group

Ophthalmic pathology	Case group, n (%)	Control group, n (%)
Normal examination	16 (17)	57 (55)
Uncorrected refractive error	27 (28)	15 (15)
Corticonuclear cataract	27 (28)	17 (16)
Posterior subcapsular cataract	5 (5)	3 (3)
Clear lens or intraocular lens	66 (69)	84 (81)
Early cataract	13 (13)	9 (9)
Moderate cataract	9 (9.4)	6 (6)
Dense cataract	10 (10)	5 (5)
Total cataract	32 (33)	20 (19)
Macular degeneration	14 (15)	8 (8)
Glaucoma	10 (10)	5 (5)
Corneal disease and other	5 (5)	3 (3)
Total	96	103

Table 3. Multivariate OR for the risk factors for hip fracture

Risk factor	OR	95% CI
Normal examination	0.91	0.23–3.58
Uncorrected refractive error	2.78	0.92–8.35
Corticonuclear cataract	2.84	0.92–8.8
Posterior subcapsular cataract	3.58	0.52–24.59
Macular degeneration	5.64	1.57–20.18
Glaucoma	10.65	2.21–51.3
Corneal disease and other	4.83	0.75–31.2

Discussion

The present study explored the relationship between visual impairment and fall-related hip fracture and brought into focus various etiologies of visual impairment and hip fractures in elderly fallers. In this series, we found a significant association between poor vision and hip fracture in patients aged 60 years and over. The prevalence of visual impairment was significantly increased in the case group (45%) in comparison with the control group (11%). Elderly patients with poor vision were 6.4 times as likely to fall and to have a hip fracture as patients with preserved visual acuity (OR 6.4; 95% CI 3.8–10.8).

Similar findings have been reported in other studies [2, 3, 6, 8, 9, 12]. However, in a large prospective cohort study, Felson et al. [2] found that moderately impaired vision was a nonsignificant risk factor for fracture.

Uncorrected refractive error was the major cause of visual deficit in our series, followed by cataract, macular degeneration and suspicion of glaucoma. These results are coherent with most series described in the literature [6, 8, 9].

It has been shown that cataract may cause substantial defects in mobility and orientation, even with a good vi-

sual acuity, under low luminance conditions [13, 14]. Furthermore, Schwartz et al. [15] found that cataract surgery significantly improved postural stability and was cost effective with regard to the high cost of treating fall-related injuries in the elderly. Contrary to Ivers et al. [12], who found that posterior subcapsular cataract was specifically associated with hip fracture, we did not report such an association in our study.

In our series, the second leading cause of impaired vision was age-related macular degeneration. Previous studies also reported an increased fall rate as well as a higher need for assistance with daily activities in patients with neovascular macular degeneration [16–18]. Patino et al. [5] observed that patients with a loss of central vision were at a higher risk of falling than patients with peripheral impairment. However, peripheral visual impairment was independently associated with an increased risk for falls and falls with injury. Considering that progressive optic neuropathies may initially affect the peripheral vision, the existence of glaucoma should be tracked in patients with falls, all the more so given the late apparition of the symptomatology. In our series, 10% of patients in the case group had a confirmed glaucoma or presented clinical indicators that could arouse suspicion of glaucoma. This increased proportion in comparison to the control group is suggestive of an association between hip fractures and glaucoma. For the leading etiologies of visual impairment reported in our series, in most cases, an effective treatment or preventive measures are available. Uncorrected refractive error can easily be solved with an appropriate spectacle correction. Blurred vision, faded colors and photophobia related to a corticonuclear cataract are likely to be fully corrected by performing routine cataract surgery.

With regard to glaucoma, it is now recognized that an early detection and treatment may prevent or delay progressive visual field impairment [19]. Similarly, age-related macular degeneration is now easier to diagnose through the recent development of retinal imaging techniques. Moreover, the generalization of intravitreal anti-VEGF injections brought a substantial improvement to the preservation of central vision in the ageing population. Therefore, most of these conditions could be treated or controlled by treatment, provided that they are detected before falling complications. A systematic screening, especially in older patients, should lead to early management of a beginning loss of vision. For this reason, a good ophthalmology attendance seems essential in the prevention of falls and hip fractures in patients aged 60 years and over.

Some limitations of our study should be mentioned. Past medical history has mainly been collected using patients' self-report data. Consequently, subjects were often unable to report the number of times they had fallen accurately. Moreover, the exclusion of the frailest older patients with dementia may have resulted in the exclusion of some subjects who had a visual impairment-related fracture.

Moreover, the ophthalmologic examination did not include any visual field assessment. We thought a single visual field examination in elderly patients could be of limited reliability for the detection of glaucoma and result in a potential confounding effect.

It is also possible that some bias was introduced into this study because, whereas both groups were matched for sex and age, we did not consider the association with other potential risk factors for falling. The most important limitation of our study is the lack of information on potentially confounding risk factors or risk indicators such as physical ability prior to the fall, general comorbidity and medication. However, data that accurately evaluated cognitive and physical abilities were not available for all patients.

In conclusion, this study found that visual impairment is considerably associated with an increased risk of hip fracture in elderly people. There are many etiologies of loss of vision that may contribute to falls and hip fractures, most notably refractive error, cataract, age-related macular degeneration and glaucoma. Many of these visual deficits could be managed by initiating a medical treatment or performing a surgery, with good potential visual recovery. Therefore, it appears that early detection and treatment of eye diseases could help provide a substantial improvement in the global prevention of falls and hip fractures. A multidisciplinary approach should be fostered, involving geriatrics, orthopedics and ophthalmologists to treat these modifiable risk factors. Further studies that evaluate the efficiency of treatment in preventing hip fractures could confirm these findings.

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Disclosure Statement

The authors have no conflicts of interest to report.

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