The impact of first- and second-eye cataract surgery on injurious falls that require hospitalisation: a whole-population study

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Abstract

Background: cataract is a leading cause of reversible vision impairment and may increase falls in older adults.
Objective: to assess the risk of an injury due to a fall among adults aged 60+, 2 years before first-eye cataract surgery, between first-eye surgery and second-eye surgery and 2 years after second-eye surgery.
Design: a retrospective cohort study.
Setting: Western Australian Hospital Morbidity Data System and the Western Australian Death Registry.
Subjects: there were 28,396 individuals aged 60+ years who underwent bilateral cataract surgery in Western Australia between 2001 and 2008.
Methods: Poisson regression analysis based on generalised estimating equations compared the frequency of falls 2 years before first-eye cataract surgery, between first- and second-eye surgery and 2 years after second-eye cataract surgery after accounting for potential confounders.
Results: the risk of an injurious fall that required hospitalisation doubled (risk ratio: 2.14, 95% confidence interval: 1.82 to 2.51) between first- and second-eye cataract surgery compared with the 2 years before first-eye surgery. There was a 34% increase in the number of injurious falls that required hospitalisation in the 2 years after second-eye cataract surgery compared with the 2 years before first-eye surgery (risk ratio: 1.34, 95% confidence interval: 1.16–1.55).
Conclusions: there was an increased risk of injurious falls after first- and second-eye cataract surgery which has implications for the timely provision of second-eye surgery as well as appropriate refractive management between surgeries.

Keywords: cataract, falls, injury, cataract surgery, older people
Introduction

Cataract is the leading cause of reversible vision impairment in developed countries and by the age of 70 years, almost everyone will have developed some degree of cataract [1]. Cataract affects several aspects of vision, and may increase the risk of falls in older adults due to reduced balance, stability and hazard detection [2, 3]. Falls are also a leading cause of morbidity in Australia and the leading cause of accidental death in persons aged 65+ years [4]. It is conservatively estimated that 30% of older adults fall each year with 20% of these falls resulting in hospitalisation for injuries [5–7], resulting in over a billion dollars in medical treatment, disability and lost output each year in Australia [8].

The rate of cataract surgery has increased threefold in Australia over the past 20 years [9] and is a highly successful treatment for improving vision and quality of life [10, 11]. However, studies on the impact of cataract surgery on falls have produced conflicting results. A study of older women in the UK reported a 34% reduction in the overall rate of falls during the year after expedited first-eye cataract surgery compared with wait listed surgeries [12].

A smaller study also found a statistically significant reduction in the number of self-reported falls 6 months after surgery [13]. In contrast, another UK study found a non-sigificant decrease in self-reported falls after the second-eye surgery among a cohort of 239 older women [14] and a prospective study from the USA also found no difference in falls after cataract surgery [15]. However, a recent study reported a 27% increase in hospitalisation for falls in the year after first-eye cataract surgery only [16]. Lastly, a recent Cochrane systematic review concluded that the correction of visual deficiency and its effect on reducing falls still remained unknown [17].

Although cataracts are usually bilateral, cataract surgery is usually performed on one eye at a time [11]. Previous research has found that first-eye cataract surgery brings about significant improvements in visual acuity and contrast sensitivity [10, 11, 18]. However, those with bilateral cataract frequently report vision-related problems while waiting for second-eye surgery, most likely due to differences in vision between the operated and un-operated eyes [10, 11, 19, 20]. Second-eye surgery largely corrects this problem [10, 17]. Since people with bilateral cataract may need to function for substantial periods of time with un-operated cataract before and between cataract surgeries, it is essential to understand the separate effects of first- and second-eye surgery on falls. However previous research has either examined first eye only, combined first, and second eye in the analyses or it has not been specified [12, 13, 15].

The aim of this study was to assess the risk of an injurious fall requiring hospitalisation among adults aged 60+ years in Western Australia between 2001 and 2008 before first eye, between first and second eye, and after second-eye cataract surgery using data from the Western Australian Data Linkage System (WADLS).

Methods

Study design

A whole-population retrospective cohort study was undertaken comparing the number of hospital admissions from injurious falls among adults aged 60+ years in Western Australia 2 years before first eye, between first and second eye and 2 years after second-eye cataract surgery.

Data sources

De-identified data were obtained from the WADLS following ethics approval from Curtin University. The WADLS includes all hospital admissions, birth and death records, mental health service contacts, motor vehicle crash records, cancer registrations and midwives’ notifications for all Western Australians [21].

International Classification for Diseases (ICD) codes [22] were used to identify all cataract surgeries in persons with a Western Australian residential postcode from 2001 to 2008: 42698-00, 42702-00, 42702-01, 42698-01, 42702-02, 42702-03, 42698-04, 42702-08, 42702-09, 42698-02, 42702-04, 42702-05, 42698-03, 42702-06, 42702-07, 42731-01, 42698-05, 42702-01, 42702-10, 42702-11.

The cohort comprised those who had bilateral cataract surgery. To ensure that no participant had cataract surgery prior to the study period, all hospital records were extracted and anyone found to have had previous cataract surgery was excluded. The cohort was linked to the Death Registry to identify deaths during the study period, in order to account for a shorter follow-up period.

An injurious fall was recorded if the principal diagnosis for at least one hospital admission in the cataract cohort’s record was an ‘injury’, as designated by a diagnosis code between S00.0 and T14.9 (Chapter XIX, ICD-10-AM), with a primary external cause code: W00-W19 (ICD-10-AM [20]; 1 July 1998–2008) from 1999 to 2010.

The extracted demographic information included age, gender, indigenous status, residential location, marital status, socioeconomic status (SES) and the presence of co-morbidities. Residential location was defined as metropolitan, rural or remote based on residential postcode at admission for first-eye cataract surgery. Indigenous was defined as being Aboriginal and/or Torres Strait Islander. Marital status was classified as having a partner (married or de-facto) or not. Comorbidity was the presence of one or more of 17 conditions recorded during any hospital admission in the year prior to first-eye cataract surgery [23]. The presence or absence of these co-morbid conditions was used in the analysis. SES was measured using the Socioeconomic Indexes for Areas’, Index of Relative Disadvantage and summarised as quintiles at 10, 30, 50 (median), 70 and 90%, with 10% being the lowest and 90% the highest SES level. Age was treated as a categorical variable.
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Statistical analysis

Descriptive statistics were used to summarise the cohort. Baseline characteristics of those who had an injurious fall and those who did not were compared using Chi-square tests. The outcome of interest was a hospital admission due to an injurious fall.

Poisson regression analysis based on generalised estimating equations (GEEs) was undertaken to compare the frequency of injurious falls after accounting for potential confounders. To investigate the association of timing of cataract surgery and falls risk, follow-up time was divided into three ‘cataract exposure’ periods of time unique to each individual: the 2 years prior to first-eye cataract surgery, the time between first and second cataract surgery and 2 years after the second cataract surgery. The follow-up was censored accordingly for those who died during the study period.

The GEE approach extends the standard Poisson regression by accommodating the inherent correlation of the data collected at three time points and provides robust standard error estimates. The Poisson GEE analysis was performed using the STATA (version 9) statistical package. Results were considered significant at the 0.05 level.

Results

There were 28,396 individuals aged 60+ years who had bilateral cataract surgery in Western Australia from 2001 to 2008. Of this group, 1,094 (3.85%) people experienced 1,220 injurious falls that required a hospitalization. During the follow-up period, 983 (3.46%) persons experienced one injurious fall, 96 (0.34%) had two injurious falls and 15 (0.06%) persons had three or more injurious falls. A total of 4,944 (17.40%) deaths occurred during the study period.

Demographic characteristics comparing those who had an injurious fall that required hospitalisation with those who did not are shown in Table 1. The majority who fell were female (75.41%). The average number of co-morbidity was 2.92 (99.4%), reported at least one co-morbidity (75.87%) and were not married (56.19%), were non-indigenous (71.52%), lived in the metropolitan area (58.96%), lived in the metropolitan area (71.52%), were not married (56.19%), were non-indigenous (71.52%), were not married (56.19%), were non-indigenous (71.52%), were not married (56.19%), were non-indigenous (71.52%) and had at least one comorbidity (75.87%) and were female (75.41%). The average number of comorbidities was 2.74 (SD = 2.77) for those who fell and 1.58 (SD = 2.47) for those who did not have a fall.

The results of the univariate Chi-square tests found that gender (P < 0.0001), marital status (P < 0.0001), age at first cataract surgery (P < 0.0001) and comorbidity status (P < 0.0001) were significantly associated with an injurious fall (Table 1). Indigenous status (P = 0.80) and residential location (P = 0.70) were not associated with an injurious fall, while SES was marginally associated with falls. The mean time between first- and second-eye cataract surgery was 10.4 months (SD = 16.54) with 46.71% of falls occurring in the first 5 months after first-eye cataract surgery.

Table 2 presents the results of the adjusted multivariate Poisson GEE analysis. The risk of an injurious fall that required hospitalisation doubled between first- and second-eye cataract surgery compared with the 2 years before first-eye cataract surgery [risk ratio (RR): 2.14, 95% confidence interval (CI): 1.82–2.51]. There was a significant 34% increase in an injurious fall that required hospitalisation in the 2 years after bilateral cataract surgery compared with the 2 years before first-eye cataract surgery (RR: 1.34, 95% CI: 1.16–1.55). Being female (RR: 2.24, 95% CI: 1.91–2.63) and having at least one comorbidity (RR: 2.84, 95% CI: 2.46–3.29) significantly increased the risk of an injurious fall that required hospitalisation. There was a progressive increase of an injurious fall with increasing age, with the risk in those aged 85+ years almost seven times (95% CI: 3.93–11.93) than that of the 60–64 years age group. Those who were married (RR: 0.30, 95% CI: 0.60–0.80) had a reduced risk of an injurious fall that required hospitalisation.

Discussion

This was the first population-based study to examine the association between first- and second-eye cataract surgery and the number of injurious falls that required hospitalisation in bilateral cataract patients. The prevalence of injurious falls during the study period was 3.85%. This is much lower than a
suitable comparison group was a further limitation of the study. Associated with an increased number of falls. The lack of a comparison group which aspects of visual function may have been assessed with measures of visual function, so we were not able to determine the effect of visual function on falls risk.

The data linkage methodology has the advantage of reduced selection bias, minimal loss to follow-up, and examination of the problem at the whole-population level [19]. It also has the advantage of detecting small differences by inclusion of large number of cases as well as high-quality, objective data, which can be more accurate than self-reported information [19]. The data from the WADLS represented the most severe cases of injurious falls that required hospitalisation and may underestimate the overall risk of falling. The available data also did not capture lifestyle factors, refractive management, other co-existing ocular pathologies or specific measures of visual function, so we were not able to determine which aspects of visual function may have been associated with an increased number of falls. The lack of a suitable comparison group was a further limitation of the study, although our ‘before and after’ design using the same person as their own control took account of inter-individual differences that can confound studies using separate control groups. We were also not able to determine whether the patients lived independently or were in residential care.

Previous studies have produced conflicting results on whether cataract surgery reduces the incidence of injurious falls [12–14]. First-eye surgery has been shown to bring about significant improvements in visual acuity, contrast sensitivity and stereopsis [10, 11, 18]. Our previous study [16] examined the risk of injury due to a fall in an older population who required one eye cataract surgery only from 2004 to 2008. We found the risk for a fall increased by 27% after first-eye surgery [16]; less than this study of bilateral cataract surgeries. The differences in results may be due to bilateral cataract patients frequently reporting vision-related problems while waiting for second-eye surgery, most likely due to differences in vision between the operated and un-operated eyes [10, 11, 19, 20]. When this difference is large, it can negatively impact on stereopsis (depth perception) [11], which was shown to be important for safe negotiation around objects [24] and for reducing the risk of falls among older people [25]. Ophthalmologists work hard to avoid anisometropia (unequal refractive power between eyes) using biometry to tailor the strength of the intraocular lens implant. However, the eyes may be out of balance until after second-eye surgery has been completed. It is also possible that some of our cohort may have delayed obtaining new glasses until after their second surgery due to the cost of prescription glasses. This meant they had to cope with uncorrected refractive error during the waiting period between surgeries, which increased their risk of falling. Future research should differentiate between these two groups as the risks may be different.

Second-eye cataract surgery can bring about large improvements in stereopsis [10, 19], yet we found a 34% increase in falls compared with the 2 years before first-eye cataract surgery. The risk, however, was considerably lower than after first-eye cataract surgery. Almost half of injurious falls that occurred during the period between first- and second-eye surgery, occurred in the first 5 months after first-eye surgery, and provides preliminary evidence for expedited second-eye cataract surgery in people with bilateral cataract.

Past research has also identified a strong link between physical activity and risk of falls in the older population. Certain types of physical activity increase the risk of a fall by displacing a person’s centre of gravity, exposing them to risky environmental factors or inducing fatigue [26, 27]. There is minimal research examining physical activity levels throughout the different stages of cataract surgery; however, cataract surgery was shown to increase confidence and possibly risk taking behaviour [12, 14]. It is possible that patients may be more physically active following cataract surgery compared with the period before first-eye surgery when poor vision may lead them to be more cautious. Therefore, a thorough understanding of the impact of physical activity throughout the cataract process may be essential to understanding falls risk for older adults before, between and after cataract surgery.

Reasons for the differences in results between the current study and the RCTs conducted by Harwood et al. [12] and Foss et al. [14] examining first- and second-eye cataract surgery and falls risk are not clear. However, we examined...
only hospitalisation falls while Harwood et al. [12] and Foss et al. [14] included all self-reported falls. It should also be noted that our study included a younger age group and both males and females in the sample.

Most of the cohort who had an injurious fall were women and is consistent with previous research [6]. The current study also has confirmed that those who are older are at an increased risk of falling due to their advanced age and fragility [28, 29]. The decreasing frequency in the risk of a fall after second-eye surgery may imply adaptation to the new vision however the increasing frequency of falls over the cataract surgery process may be related to the ageing process. In this study, the cohort who experienced a fall had more co-morbid conditions than those who did not fall. It is also possible that those who are older may also be taking medications, use mobility appliances or have problems with balance and gait [13, 27], which we were not able to determine using the WADLS. We were also not able to determine the cognitive status of those who were hospitalised for a fall. The mechanism for falls risk for older people with cataract is multifactorial and a large prospective cohort study is warranted to better clarify the determinants of risk not possible using the linked databases such as activity levels and refractive problems.

The results of this study have relevance for ophthalmologists when discussing cataract surgery with patients. Those with bilateral cataract should be warned of a potential increased risk of falling following first-eye surgery. Patients should also be advised of the importance of second-eye surgery to correct remaining visual impairment and appropriate refractive management between surgeries.

These findings have implications for the timely provision of second-eye cataract surgery for older adults and provide the impetus for policy changes, given the growing number of older people with bilateral cataract.

Key points

• Increased risk of fall between first- and second-eye surgery may be related to differences in vision between both eyes.
• The decreasing frequency in the risk of a fall after second-eye surgery may imply adaptation to the new vision.
• Increasing frequency of falls over the cataract process may be related to the ageing process.

Authors’ contribution

All authors contributed extensively to the work presented in this paper. LM: study design, conduct of the project, analysis and drafting of the manuscript. MF: study design and writing of the manuscript. JN and NM: study design and manuscript revision.

Conflicts of interest

None declared.

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References

Development and validation of a delirium predictive score in older people

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Abstract

\textbf{Background:} Delirium is frequently under diagnosed in older hospitalised patients. Predictive models have not been widely incorporated in clinical practice.

\textbf{Objective:} To develop and validate a predictive score for incident delirium.

\textbf{Design and setting:} Two consecutive observational prospective cohorts (development and validation) in a university affiliated hospital.

\textbf{Subjects:} Inpatients 65 years and older.

\textbf{Methods:} In the development cohort patients were assessed within the first 48 h of admission, and every 48 h thereafter, using the confusion assessment method to diagnose delirium and data were collected on comorbidity, illness severity,