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Cataract surgery is more prevalent and occurs at an earlier age in a high cardiovascular risk cohort: Comparison with the Blue Mountains Eye Study

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1. Introduction

Cataract is a multi-factorial disease that has been linked with both cardiovascular risk factors and increased mortality [1,2]. Cardiovascular risk factors associated with cataract and cataract surgery include hypertension [3], diabetes, high body mass index [4], and hypercholesterolemia [5]. These associations strongly suggest that cataract may share similar underlying pathophysiological mechanisms an age-related disease such as cardiovascular disease.

However, both cross-sectional and longitudinal studies that have investigated the associations between cardiovascular disease risk factors and cataract/cataract surgery have not yielded consistent results [6–8]. For instance, longitudinal data have shown that history of angina is associated with higher cataract surgery incidence [9], while another longitudinal study found few associations between cardiovascular risk factors and cataract [10], and concluded that a constellation of metabolic markers related to insulin resistance may be more likely to predict cataract prevalence or incidence than any individual cardiovascular risk factor alone [10]. Extant studies have also not directly quantified cardiovascular disease by coronary angiography.

The prevalence and incidence of cataract surgery has been well documented in population studies like the Blue Mountains Eye Study (BMES) [11]. In the absence of data on cataract prevalence, this present study attempts to examine the prevalence and age of cataract surgery as a surrogate for prevalent cataract, in a clinical cohort with cardiovascular risk factors. Comparisons with the baseline Blue Mountains Eye Study (BMES-1) may help to identify differences in cataract prevalence and age of onset compared to the general population.

Consequently, the specific objectives of this study were to: (i) describe the prevalence of cataract surgery in a unique clinical cohort of participants presenting for coronary angiography (the Australian Heart Eye Study, AHES); (ii) compare age-standardized prevalence of cataract surgery in the AHES with the baseline Blue Mountains Eye Study (BMES-1); and (iii) determine whether associations exist between the extent and severity of coronary artery disease (CAD), as quantified by coronary angiography scores, and the prevalence of cataract surgery.

2. Methods

2.1. Study population and data collection

The AHES is a clinical cohort study of 1680 participants who presented to a major tertiary referral hospital servicing the greater western Sydney area (Westmead Hospital, Sydney, Australia) between June 2009 and January 2012 to evaluate potential CAD by coronary angiography. These methods are also described elsewhere [6,12].

All eligible participants presenting for assessment of suspected CAD were included in this study. Exclusion criteria were participants with a history of coronary artery bypass graft or coronary artery stenting. These participants were excluded because the Gensini and extent scoring systems used have not been validated in this group. Participants were also excluded if they had absent Gensini or extent scores.

Ethics approval for the AHES was obtained from the Western Sydney Local Health Network Human Research Ethics Committee (Westmead). All participants provided written informed consent to participate in the study.

2.2. Prevalence of self-reported cataract and cataract surgery

A comprehensive questionnaire was used by study personnel to obtain a medical history, including year of cataract diagnosis or surgery, chronic steroid use, and visual impairment. Cataract surgery prevalence

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was defined as a "yes" response to the question "Have you had an operation for cataract?". Chronic steroid use was defined as reported use greater than one month in duration. Visual impairment was based on self-report of spectacle use. Other information collected included past cardiovascular events, cardiovascular risk factors, other medical conditions, drug and alcohol history, and history of past angiography and/or interventions (coronary artery stent or coronary artery bypass graft).

2.3. Assessment of coronary artery disease

Routine diagnostic coronary angiography was performed after six hours fasting via either the femoral or radial artery using a catheter of known dimension (5Fr to 7Fr). Selective coronary injections of Ultravist (Schering) were filmed in standard projections on a Siemens Bi-Plane radiographic unit (Siemens Healthcare, Germany).

All angiograms were analyzed offline by a trained cardiologist masked to the results of the adjunctive investigations and retinal grading. The coronary artery segments were defined using the Syntax system, which divides the arterial tree into 16 segments, based on the modified American Heart Association (AHA) classification [13]. For each segment, the severity of obstruction was documented using several grades: normal, 1–25%, 25–50%, 50–74%, 75–99% and 100% (occluded). Each lesion that was visually scored as greater than 50% luminal obstruction in a vessel that was ≥1.5 mm diameter was further analyzed using quantitative coronary analysis (QCA). QCA was performed using validated computerized edge-detection software (QCAPLUS, Sanders data Systems, Palo Alto, California, USA).

Coronary angiograms were scored according to two methods to document both the severity and extent of CAD:

1) Gensini score (severity score): This has been described previously [14]. Briefly, the coronary arterial tree was divided into segments with multiplying factors according to the functional importance of any given segment (5 for the left main trunk to 0.5 for the most distal segments) and the percentage reduction in luminal diameter of each narrowing was assigned a score (0, 1, 2, 4, 8, 16 or 32), according to the degree of stenosis. The sum of the scores of all segments gives the Gensini score, which places emphasis on the severity of the disease [15].
2) Extent score: The extent score was proposed by Sullivan et.al to define the proportion of the coronary arterial tree with angiographically detectable coronary atheroma [16]. The proportion of each vessel involved by atheroma, identified by lumen irregularity, was multiplied by a factor for each vessel, which is related to the length of that vessel. The scores for each vessel were added to give a total score out of 100. This percentage represents the proportion of the coronary intimal surface area containing coronary atheroma [15].

2.4. Statistical methods

All analyses were performed using SAS statistical software (version 9.2, SAS Institute Inc., Cary, North Carolina, USA). Statistical significance was defined as p-value < 0.05.

Multivariable analyses using logistic regression models adjusted for age, sex, diabetes mellitus, chronic steroid use, smoking history, and visual impairment, were used to estimate odds ratios (OR) and 95% confidence intervals (CI), in order to determine whether associations exist between coronary angiographic scores (Gensini and extent score) and prevalence of cataract surgery.

The initial analyses were of total cataract surgery prevalence, and Gensini and extent scores were analyzed as continuous variables. However, in subsequent age-stratified analyses of prevalence of cataract surgery, Gensini and extent scores were treated as binary variables (either 0 or greater than 0) in order to better fit the small sample sizes following stratification.

The student t-test and Kolmogorov–Smirnov test were used to compare the mean age of cataract surgery in the AHES and BMES-1.

3. Results

A total of 1665 participants had complete information on cataract surgery history, and were included in the analyses. The mean age of participants was 72.2 ± 9.0 years. Table 1 summarizes the baseline characteristics of the study population.

The mean age of cataract surgery was 67.1 years. This was significantly younger than the mean age of cataract surgery in the BMES-1, which was 71.0 years (p ≤ 0.0005).

3.1. Prevalence of cataract surgery

The prevalence of those who reported cataract surgery was 13.1% (males 8.9%). The prevalence of cataract surgery increased with age (p < 0.0001) up to 80 years. Table 2 shows the prevalence of cataract surgery, stratified by age and sex. Table 3 shows that the prevalence of cataract surgery in the AHES was significantly higher than that of the BMES-1 (p < 0.0001). The age-sex-adjusted prevalence was 10.7% and 2.7% in the AHES and BMES-1, respectively.

3.2. Association between Gensini/extent of CAD and prevalence of cataract surgery

After adjusting for age, sex, ethnicity, diabetes mellitus, visual impairment, and chronic steroid use, there were no significant associations between either Gensini or extent scores and the prevalence of cataract surgery. For instance, non-significant associations were observed between extent scores and cataract surgery: multivariable-adjusted OR 0.97 (95% CI 0.53–1.77).

Since it was postulated that age may have masked the effect of cataract surgery on the extent and severity of CAD, participants were next stratified by age. Among both participants aged over and under 65 years, no significant associations were found between the extent or severity of CAD and the prevalence of self-reported cataract surgery. For instance, the odds ratios for the Gensini score among participants aged over and under 65 years were OR 1.10 (95% CI 0.47–2.56) and OR 1.36 (95% CI 0.53–3.47), respectively (Table 4).

Table 1
Demographic and clinical characteristics of participants with information on history of cataract surgery[a].

Characteristics	Cataract surgery (n = 218)
Age, years	72.2 (9.0)
Sex (M)	148 (67.9)
Ethnicity	
Caucasian	150 (68.8)
East Asian	10 (4.6)
Southeast Asian	19 (8.7)
Middle Eastern	22 (10.1)
Others	17 (7.8)
Body height, m	1.7 (0.1)
Body weight, kg	78.1 (15.7)
BMI, kg/m^2	28.6 (5.2)
Waist-hip ratio	60.3 (8.0)
Blood pressure, mm Hg	
Systolic	130.8 (20.8)
Diastolic	70.0 (12.7)
Mean arterial	90.3 (13.3)
Smoking status, n(%)	36 (16.6)
Total cholesterol, mmol/L	4.6 (1.2)
History of hypertension	173 (79.4)
History of diabetes	99 (45.6)
History of AMI	63 (29.4)
History of steroid use for greater than 1 month	30 (14.6)

[a] Data are presented as mean (±standard deviation) or n(%).