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# Cataract Surgery and Mortality in the United States Medicare Population

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***Purpose:*** To determine the association between cataract surgery and all-cause mortality in United States Medicare patients with cataract.

***Design:*** Retrospective cohort study.

***Participants:*** A 5% random sample of United States Medicare beneficiaries with a diagnosis of cataract from the 2002 through 2012 Denominator and Physician/Supplier Part B files.

***Methods:*** The exposure of interest was cataract surgery and the outcome of interest was all-cause mortality. Baseline characteristics that were examined included demographics, systemic comorbidities, and ocular comorbidities. Cox proportional hazards regression modeling was used to assess the association between cataract surgery and mortality. Additional subgroup analyses were performed in propensity score deciles and within strata of age, gender, region, systemic disease burden, and in patients with versus without severe cataract subtypes.

***Main Outcome Measures:*** All-cause mortality.

***Results:*** The 5% Medicare sample included 1 501 420 patients with cataract, of whom 544 984 (36.3%) underwent cataract surgery. Patients with cataract surgery were followed up for a mean of 11.4 quarters (standard deviation [SD], 10.8 quarters; range, 0.0–44.0 quarters), whereas patients without cataract surgery were followed up for a mean of 12.9 quarters (SD, 12.2 quarters; range, 0.0–44.0 quarters). Mortality incidence was 2.78 deaths per 100 person-years in patients with cataract surgery and 2.98 deaths per 100 person-years in patients without surgery ($P < 0.0001$). Overall, patients with cataract surgery had a lower adjusted hazard of mortality compared with patients without surgery (hazard ratio [HR], 0.73; 95% confidence interval [CI], 0.72–0.74). The strongest associations were observed in patients with a high propensity score decile (HR, 0.52; 95% CI, 0.50–0.54), patients 80 to 84 years of age (HR, 0.63; 95% CI, 0.62–0.65), women (HR, 0.69; 95% CI, 0.68–0.70), patients in the western United States (HR, 0.52; 95% CI, 0.32–0.86), patients with a moderate systemic disease burden (HR, 0.71; 95% CI, 0.69–0.72), and patients with severe cataract (HR, 0.68; 95% CI, 0.66–0.70).

***Conclusions:*** In a national cohort of United States Medicare beneficiaries with cataract, cataract surgery was associated with decreased all-cause mortality. Further studies are needed to examine mechanisms surrounding the association between cataract surgery and mortality. *Ophthalmology 2016;■:1–8 © 2016 by the American Academy of Ophthalmology.*

*Supplemental material is available at www.aaojournal.org.*

Cataracts are a leading cause of visual impairment among adults in the United States.[1,2] Visual impairment secondary to cataracts has been shown to be associated with increased mortality, likely secondary to a combination of poor systemic health, lower functional status, and decreased quality of life.[3–5] Cataract surgery is the mainstay of treatment for visually significant cataract and reverses the vision impairment associated with cataract. Although the vision-improving benefits of cataract surgery are well understood, it is unknown whether vision improvement resulting from cataract surgery subsequently can improve long-term survival.

Previous studies have examined the association between cataract surgery and mortality with conflicting findings. Only 2 existing studies[6,7] have examined the association between cataract surgery and mortality in a cohort of patients entirely with cataract, and both of these studies found that cataract surgery was associated with decreased mortality. However, both of these studies were conducted in isolated voluntary cohorts within Western Sydney, Australia, and it is unknown whether their findings are generalizable to the United States population. The remainder of studies examining the association between cataract surgery and mortality[8–19] included patients without cataract in the comparison group, which could lead to confounded findings because any associations detected between cataract surgery and mortality could be explained by the presence of cataract rather than by the intervention of cataract surgery.

Given the conflicting findings in previous studies of cataract surgery and mortality, further studies are warranted,



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especially in the United States population. To this end, the purpose of the present study was to examine the association between cataract surgery and all-cause mortality in patients with cataract in the national United States Medicare population between 2002 and 2012.

## Methods

### Study Population

Data were extracted from a 5% random sample of Medicare beneficiaries from the 2002 through 2012 Denominator and Physician/Supplier Part B files from the Centers for Medicare and Medicaid Services (CMS). Patients with an International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM),[20] code for cataract during this period were included in the study population (Appendix 1, available at www.aaojournal.org). Patients with the following characteristics were excluded: age younger than 65 years, residence outside the 50 contiguous United States or the District of Columbia, lack of Medicare Part B coverage, and coverage from a health maintenance organization outside of CMS. The study was approved by the Institutional Review Board at the University of California, Los Angeles, and complied with the Health Insurance Portability and Accountability Act.

### Exposure

The cataract surgery group was the exposed group and consisted of all patients with an ICD-9-CM diagnosis code for cataract that appeared anytime between 2002 and 2012 and a Current Procedural Terminology (CPT)[21] code for cataract surgery that appeared anytime between 2002 and 2012 (Appendix 1, available at www.aaojournal.org). The cataract diagnosis group was the unexposed group and consisted of all patients with an ICD-9-CM diagnosis code for cataract that appeared anytime between 2002 and 2012 who were without a CPT code for cataract surgery. All follow-up durations were calculated by fiscal quarters because data in the 5% Medicare database are available only in fiscal quarters. Patients in the cataract surgery group were followed up starting from the first quarter when the CPT code for cataract surgery appeared between 2002 and 2012. If a patient underwent cataract surgery after 2002, the time from 2002 until the date of surgery was excluded and follow-up time commenced at the date of surgery. Information on laterality is not available in the 5% Medicare claims database, and we did not attempt to distinguish between unilateral versus bilateral cataract surgery based on the number of times the CPT code for cataract surgery appeared for each patient because it was unclear if this was a reliable measure of laterality. Patients in the cataract diagnosis group were followed up starting from the fiscal quarter when the ICD-9-CM code for cataract first appeared. If a patient was diagnosed with cataract after 2002, the time from 2002 until the date of cataract diagnosis was excluded and follow-up time commenced at the date of cataract diagnosis.

Patients with an ICD-9-CM code for aphakia or pseudophakia without a CPT code for cataract surgery were included in the aphakic or pseudophakic group (Appendix 1, available at www.aaojournal.org). The aphakic or pseudophakic group was analyzed 2 ways: (1) by excluding them from the study population entirely and (2) by including them in the exposed group. When included, patients in the aphakic or pseudophakic group were followed up from the fiscal quarter when the ICD-9-CM code for aphakia or pseudophakia first appeared. If a patient was diagnosed with aphakia or pseudophakia after 2002, the time from 2002 until the date of aphakia or pseudophakia diagnosis was excluded and follow-up time commenced at the date of aphakia or pseudophakia diagnosis. Because the date of cataract surgery was unknown for patients in the aphakic or pseudophakic group, we chose to focus our primary analyses on results excluding the aphakic or pseudophakic group.

### Outcome

The outcome of interest was all-cause mortality at any time from patient inclusion in the study until the end of the study on December 31, 2012. Mortality status was ascertained from an indicator variable in the CMS Denominator File. Deaths of Medicare beneficiaries were reported automatically to CMS by the United States Social Security Administration (SSA).[22] Data regarding the cause of death were not available in the Physician/Supplier Part B files.

### Covariates

Demographics that were collected included age, gender, self-reported race or ethnicity, and United States region of residence. Age was analyzed as a continuous variable and also was categorized into 5-year age groups that truncated at age 98 years because all patients 98 years of age or older are coded as age 98 years in the Medicare database. Gender, race or ethnicity, and region of residence were analyzed as categorical variables.

Both systemic and ocular comorbidities were included as covariates in the study. The Charlson comorbidity index (CCI) score[23,24] was used as a covariate to represent overall systemic health. The CCI is a weighted index of systemic disease burden based on the presence or absence of 17 systemic comorbidities. Based on their systemic disease profiles, patients are assigned a CCI score of between 0 and 6 that can be used to predict the risk of 1-year mortality. Diseases in the CCI include myocardial infarction, congestive heart failure, peripheral vascular disease, cerebrovascular disease, dementia, chronic pulmonary disease, rheumatologic disease, peptic ulcer disease, cirrhosis, hepatic failure, immunosuppression, diabetes mellitus (DM) with or without complications, hemiplegia or paraplegia, chronic renal disease, malignant neoplasms, multiple myeloma or leukemia, lymphomas, metastatic solid tumor, and AIDS. The CCI score variable was categorized into scores of 0, 1 to 2, 3 to 4, and more than 5. Ocular comorbidities that were examined included age-related macular degeneration, glaucoma, and DM with ophthalmic manifestations. Determination of the presence of systemic and ocular comorbidities was based on the presence of ICD-9-CM codes for these conditions (Appendix 2, available at www.aaojournal.org).

Because visual acuity data are not available within Medicare, 1 additional baseline characteristic that was examined was the presence of severe cataract subtypes as a proxy for these factors. Patients with ICD-9-CM codes for anterior and posterior subcapsular cataracts, total or mature cataract, hypermature cataract, and combined forms of cataract were considered as having severe forms of cataract (Appendix 1, available at www.aaojournal.org). These subtypes were grouped into 1 indicator variable representing the presence or absence of severe cataract.

### Statistical Analysis

Continuous variables were analyzed using descriptive statistics and histograms. Categorical variables were analyzed using frequency distributions and contingency tables. Cox proportional hazards regression was used to analyze the association between cataract surgery and time to death resulting from any cause. Time to death was coded as a continuous variable starting from the beginning of patient follow-up and ending at the time of patient death. Patients who were still alive at the end of the study period were censored administratively