Rate of Endophthalmitis After Cataract Surgery in Quebec, Canada, 1996-2005

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Objective: To estimate the annual incidence of endophthalmitis after cataract surgery from January 1, 1996, through December 31, 2005, in Quebec, Canada.

Methods: Deidentified data were obtained from an outpatient physician billing database (Quebec State Control for Health Insurance [RAMQ]) with regard to all cataract surgical procedures performed from January 1, 1996, through December 31, 2005, in Quebec. For this cohort, records of an International Classification of Diseases, Ninth Revision (ICD-9) code for endophthalmitis during the same years were requested from 2 sources: the RAMQ outpatient database and an inpatient hospital discharge database (Maintenance and Exploitation of Data for the Study of Hospitalized Patients [MED-ECHO]). Endophthalmitis after cataract surgery was assumed if it occurred within 90 days of the surgery. Risk factors were examined using χ² tests and logistic regression.

Results: After exclusions, 490,690 cataract surgical procedures were performed from January 1, 1996, through December 31, 2005. A total of 754 cases of endophthalmitis occurred within 90 days after surgery for an overall incidence rate of 1.5 per 1000 surgical procedures (95% confidence interval [CI], 1.4-1.7). Factors associated with endophthalmitis included age of 85 years or older (odds ratio [OR], 1.34; 95% CI, 1.06-1.70), male sex (1.44; 1.24-1.66), later year of surgery (0.94; 0.92-0.97), and region of cataract surgery, because regions 6 (2.21; 1.91-2.55) and 9 (4.00; 2.48-6.43) had higher rates compared with all other regions.

Conclusion: Reasons that explain the apparent decrease in endophthalmitis, especially in 2005, should be explored and further research performed to understand why certain patients and regions have higher risks of endophthalmitis after cataract surgery.


Cataract surgery is one of the most common surgical procedures performed in Canada.1 Complications of this surgery are relatively rare. However, sometimes a serious postoperative infection called endophthalmitis occurs, which frequently causes severe vision loss in the affected eye.2,3 According to previous studies,4-9 endophthalmitis occurs 0.5 to 2 times per 1000 cataract surgical procedures. Because cataract surgery is such a common procedure in Canada, with more than 300,000 surgical procedures performed per year, approximately 150 to 600 cases of endophthalmitis after cataract surgery can be expected per year if the rate of endophthalmitis is similar to that of other countries.10 A recent US study by West et al8 that used Medicare data found that the rate of endophthalmitis increased in 1998 possibly owing to a change in cataract surgery technique.

Canadian population-based data with regard to the rate of endophthalmitis after cataract surgery are limited. Recently, in a study that used physician billing data from the province of Ontario from January 1, 2002, through December 31, 2006, Hatch et al11 report an overall rate of 1.4 cases per 1000 cataract surgical procedures.

A study in 2005 by Hammoudi et al12 collected data with regard to endophthalmitis after cataract surgery, in an anonymous survey of cataract surgeons across Canada. Of the 30% of the ophthalmologists who responded to the survey, a rate of postoperative endophthalmitis of 0.9 per 1000 surgical procedures in the previous year was reported. Another Canadian study13 has described the rate of endophthalmitis at a single hospital, although rates are thought to vary widely by hospital.

The primary goal of this study was to examine the rate of reported endophthalmitis after cataract surgery in the province of Quebec from January 1, 1996,
through December 31, 2005, to determine if endophthalmitis rates also increased here in the late 1990s because the cataract surgery technique changed to clear corneal incision. A secondary goal was to examine risk factors.

STUDY POPULATION

Canada has a universal health care system, and nearly all ophthalmologists in Quebec are reimbursed for cataract surgery by the Quebec State Control for Health Insurance (RAMQ). We requested deidentified data on all people who had a RAMQ procedural code that indicated cataract extraction with an intraocular lens implantation from January 1, 1996, through December 31, 2005 (codes are reported in Table 1). The procedural codes in the RAMQ database are thought to be reliable because they are linked to remuneration and are susceptible to audit. We excluded those who underwent trabeculectomy or corneal transplantation on or within 90 days of their cataract surgery because endophthalmitis rates after these procedures may be higher than after cataract surgery alone.

DATA COLLECTION

For each cataract surgery record, we obtained data from the RAMQ on age at surgery (in 5-year age categories except for youngest and oldest categories, which were <1 and ≥85 years), sex, Quebec health region where cataract surgery occurred, and date of cataract surgery. Quebec health regions are defined by the provincial ministry of health and often include multiple counties and municipalities. Regions are referred to by numbers in this article to protect the identity of individual surgeons. Some reasonable assumptions were made for this analysis. First, we assumed that a person could only have endophthalmitis once. Given the rare nature of this condition, we believe this is a reasonable assumption. Third, we assumed that a person could only have endophthalmitis on several different days. If a person had a record of endophthalmitis in both the RAMQ and MED-ECHO databases, we chose the date of the endophthalmitis code that was closest after the date of cataract surgery and determined whether this date was within 90 days.

ASSUMPTIONS

Some reasonable assumptions were made for this analysis. First, as is typical of most physician billing databases, we did not have information as to which eye received treatment. Therefore, we assumed that if a person had endophthalmitis within 90 days after cataract surgery, the endophthalmitis occurred in the same eye that had undergone the recent cataract surgery. Second, sometimes a person underwent 2 cataract surgical procedures within a few months and then developed endophthalmitis. For these cases, we used the minimum time between each date of cataract surgery and the first date of endophthalmitis and determined whether either of these durations was within 90 days. Third, we assumed that a person could only have endophthalmitis one. Given the rare nature of this condition, we believe this is a reasonable assumption.

ANALYSIS

For each year, the rate of endophthalmitis per 1000 cataract surgical procedures and the 93% exact confidence interval (CI) were calculated assuming a binomial proportion. The rate by year was graphed with Lowess smoothing procedures by means of R software. Lowess is a robust nonparametric regression approach to fit a line to a scatterplot. Linear trends were examined by means of the Cochrane-Armitage test of trend. Logistic regression analysis was used to determine whether age, sex, region, and year of cataract surgery were independent risk factors for endophthalmitis. P < .05 was considered statistically significant. All analyses (except where noted) were performed with SAS statistical software, version 9.1 (SAS Institute Inc, Cary, North Carolina).

RESULTS

We received data on 517,463 cataract surgical procedures with intraocular lens implantation performed in Quebec from January 1, 1996, through December 31, 2005. The number of cataract surgical procedures more than doubled during this period from 33,165 surgical procedures in 1996 to 69,357 in 2005, whereas the...

<table>
<thead>
<tr>
<th>Table 1. Administrative Codes Used for the Analysis</th>
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<tbody>
<tr>
<td>Procedure</td>
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<tr>
<td>Cataract surgery extraction with intraocular lens implantation</td>
</tr>
<tr>
<td>Trabeculectomy</td>
</tr>
<tr>
<td>Corneal transplantation</td>
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<tr>
<td>Endophthalmitis</td>
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Abbreviations: ICD-9, International Classification of Diseases, Ninth Revision; MED-ECHO, Maintenance and Exploitation of Data for the Study of Hospitalized Patients; RAMQ, Quebec State Control for Health Insurance. *Quebec procedural codes are different from the Current Procedural Terminology codes used in the United States.
population of Quebec only increased by 6%. The age range of the population at the time of the cataract surgery in Quebec, Canada. The curve shows the Lowess smoothed line.

Table 2. Annual Rate of Reported Endophthalmitis After Cataract Surgery in Quebec, Canada

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of Patients</th>
<th>No. of Cataract Surgical Procedures</th>
<th>Rate per 1000 Surgical Proceduresa (95% Confidence Interval)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996</td>
<td>70</td>
<td>33 165</td>
<td>2.1 (1.6-2.7)</td>
</tr>
<tr>
<td>1997</td>
<td>50</td>
<td>34 547</td>
<td>1.4 (1.1-1.9)</td>
</tr>
<tr>
<td>1998</td>
<td>64</td>
<td>38 689</td>
<td>1.7 (1.3-2.1)</td>
</tr>
<tr>
<td>1999</td>
<td>70</td>
<td>44 784</td>
<td>1.6 (1.2-2.0)</td>
</tr>
<tr>
<td>2000</td>
<td>97</td>
<td>50 723</td>
<td>1.9 (1.6-2.3)</td>
</tr>
<tr>
<td>2001</td>
<td>99</td>
<td>53 998</td>
<td>1.8 (1.5-2.2)</td>
</tr>
<tr>
<td>2002</td>
<td>94</td>
<td>56 061</td>
<td>1.7 (1.4-2.1)</td>
</tr>
<tr>
<td>2003</td>
<td>84</td>
<td>62 152</td>
<td>1.4 (1.1-1.7)</td>
</tr>
<tr>
<td>2004</td>
<td>83</td>
<td>65 032</td>
<td>1.3 (1.0-1.6)</td>
</tr>
<tr>
<td>2005</td>
<td>43</td>
<td>51 539</td>
<td>0.8 (0.6-1.1)</td>
</tr>
<tr>
<td>Total</td>
<td>754</td>
<td>490 690</td>
<td>1.5 (1.4-1.7)</td>
</tr>
</tbody>
</table>

a Cochrane-Armitage test for linear trend P < .001.

b Cataract surgical procedures occurring after September 30, 2005, were excluded to allow for 90-day follow-up for endophthalmitis.

data until endophthalmitis was first treated was 7 days (interquartile range, 4-15 days).

The rate of reported endophthalmitis by year is presented in Table 2 and the Figure. The rate was high in 1996, at 2.1 per 1000 cataract surgical procedures, then it decreased sharply in 1997, to 1.4 cases per 1000 surgical procedures. For the next 5 years, the rate stayed between 1.6 and 1.9 cases per 1000 surgical procedures. Finally, the rate decreased steadily from 1.4 cases per 1000 surgical procedures in 2003 to 0.8 cases per 1000 surgical procedures in 2005 (Cochrane-Armitage trend test, P < .001).

Data presented in Table 3 show the number of cases of reported endophthalmitis within each of 15 Quebec health regions where the cataract surgery was performed. Endophthalmitis rates were higher than 2 per 1000 surgical procedures in 2 regions of Quebec: region 6 (2.3 per 1000 surgical procedures; 95% CI, 2.1-2.5) and region 9 (4.3 per 1000 surgical procedures; 95% CI, 2.6-6.8). Region 6 had a rate at or above 2.0 per 1000 surgical procedures every year except 2005, whereas region 9 had a rate higher than 2 per 1000 surgical procedures from January 1, 1998, through December 31, 2003, then again from January 1 to September 30, 2005. Region 9 twice had a rate of 10 or more per 1000 surgical procedures from January 1 to December 31, 1998, and again from January 1 to December 31, 2002 (5 cases per 406 surgical procedures and 4 cases per 407 surgical procedures, respectively).

We first examined the relationship between age and endophthalmitis by examining age in 5 categories (<60, 60-69, 70-79, 80-84, and ≥85 years). The rate of endophthalmitis was essentially the same in all the categories except that of the oldest patients (1.5-1.6 per 1000 surgical procedures in those <85 years vs 1.9 cases per 1000 surgical procedures in those ≥85 years) (P = .25). When we collapsed the age categories that had similar endophthalmitis rates and instead examined age as a di-
We found that the overall rate of reported endophthalmitis after cataract surgery in Quebec in 1996-2005 was 1.5 per 1000 cataract surgical procedures. Contrary to the findings of West et al, who found a sharp, sustained increase in the rate of endophthalmitis by 0.8 case per 1000 surgical procedures from 1997 to 1998 in the United States, we did not see a clear increase in the rate of endophthalmitis in the late 1990s. The increase found by West et al persisted through 2001, which was the last year of their study. Instead, we saw a decreasing trend in the rate of endophthalmitis, with the most significant decrease occurring in 2005. With administrative data, we cannot determine what caused this decrease. However, this period corresponds to the Clostridium difficile outbreak in Quebec, which began in 2002 and led to stricter hospital infection control procedures and more money designated for hospital infection control. Also, beginning in mid 2004, fourth-generation topical fluoroquinolones were approved for use after cataract surgery in Canada. A 10-year, hospital-based study in the United States from 1997-2007 reported a decrease in endophthalmitis rates after cataract surgery in 2003 after the switch to fourth-generation fluoroquinolones prescribed postoperatively. However, no clinical trials have been performed to test the efficacy of these new postoperative topical drugs on endophthalmitis prevention.

We also found that rates were higher in adults 85 years and older, in men, and in certain regions of Quebec. The high rate in region 6 could have been owing to a slightly older population (and incomplete age adjustment owing to only having age data in broad categories such as ≥85 years), worse hospital infection control practices compared with the rest of the province, or other differences. The high rate in region 9 is based on a small number of cataract surgical procedures (n=4163), so it is less precise and could be heavily influenced by one surgeon or hospital. We do not have data with regard to surgeon or hospital to protect the confidentiality of the patients. On the basis of simulation models constructed by Sparrow, the high annual rates in region 9 in 1998 and 2002 had less than a 5% probability of occurring because of chance alone and may have indicated outbreaks. The results of this study have been communicated to the ophthalmologists and hospitals in regions 6 and 9 in an effort to enhance prevention efforts.

A rate of 1.5 per 1000 surgical procedures is consistent with other Canadian and US data. As previously mentioned, Hatch et al found a rate of 1.4 per 1000 surgical procedures in the province of Ontario in 2002-2006 using physician billing data. In this study, the authors examined endophthalmitis within 14 days of cataract surgery. They did not see a decrease in endophthalmitis after cataract surgery in 2005 as we did. West et al reported a rate of 2.15 per 1000 surgical procedures within 90 days after cataract surgery in adults 65 years and older in 1994-2001 using Medicare data in the United States. These aforementioned rates in North America are higher than the 0.5 per 1000 rate reported in Sweden using administrative data. The Swedish study did not use a maximum time between cataract surgery and endophthalmitis. Whether apparently higher rates in North America compared with Sweden are spurious because of reporting differences or are real because of differences in preventive measures such as the use of intracameral cefuroxime axetil is not known. Other studies in addition to ours have also identified older age as a risk factor for endophthalmitis. Most studies have not found male sex to be a risk factor for endophthalmitis after cataract surgery, although the European Society of Cataract & Refractive Surgeons clinical trial reported that men had a higher risk of culture-proven endophthalmitis (OR, 2.70; 95% CI, 1.07-6.80). The recent study by Hatch et al also reported that men were more likely to develop endophthalmitis (OR, 1.40; 95% CI, 1.19-1.64).

A strength of this study is the large sample size that covered the entire province of Quebec. Also, we used 2 administrative databases to capture endophthalmitis cases treated on both an inpatient and an outpatient basis. Studies that use only an outpatient or an inpatient database would miss a large percentage of cases (almost 40%).

This study has several limitations. First, a limitation that is common when using administrative databases is that the endophthalmitis diagnostic codes in the RAMQ and MED-ECHO databases are not validated. The diagnosis codes in the MED-ECHO hospital discharge data-
base are thought to be reliable because they are recorded by medical archivists from a thorough review of the medical record. The diagnostic codes in the RAMQ database may be less reliable because they are not directly tied to remuneration. It is likely that our rate is an underestimate of the true rate of endophthalmitis because some physicians may have miscoded a true case of endophthalmitis or may not have included a diagnostic code. However, we do not expect that any misclassification would have systemically varied by time or risk factor. Second, the RAMQ and MED-ECHO databases do not specify which eye had cataract surgery or endophthalmitis. Therefore, we relied on an assumption that a case of endophthalmitis that occurred within 90 days after cataract surgery was in the same eye and was owing to the cataract surgery. When we examined other periods besides the 90-day period, the rate varied between 1.1 cases per 1000 surgical procedures with a 14-day window and 1.7 cases per 1000 surgical procedures with a 365-day window. Third, because this is an administrative database, we do not have individual-level data with regard to incision type, antibiotics used, or other factors that could help to explain differences in endophthalmitis rates. Fourth, we only received data on whether endophthalmitis was a primary reason for hospital admission in the MED-ECHO database. In the probably rare event that patients were hospitalized for a different reason and then developed endophthalmitis within 90 days of cataract surgery while in the hospital, these people would not have been coded as having endophthalmitis. We may have lost a small percentage of cases by taking this approach, but it was unlikely to have much impact on the results. Despite these limitations, the use of administrative databases provides a valuable resource to explore trends for rare outcomes such as endophthalmitis.26 Certainly, the validation of diagnostic codes by RAMQ would improve the quality of these data for clinical research and disease surveillance.

Our data indicate that the rate of reported endophthalmitis decreased in recent years. However, according to our study, older adults, men, and certain regions are at higher risk. Because these are administrative data, our findings should be confirmed and reasons for these differences should be further explored in future research. Efforts to track the rates of endophthalmitis and other adverse events after cataract surgery should be pursued.

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REFERENCES