

# Epidemiology and management of thoracic aortic dissections and thoracic aortic aneurysms in Ontario, Canada: A population-based study

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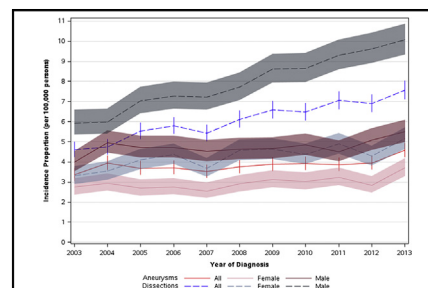
## ABSTRACT

**Objectives:** To determine hospital incidence, mortality, and management for thoracic aortic dissections and aneurysms.

**Methods:** A population-based retrospective cohort study of anonymously linked data for residents of Ontario, Canada, was carried out. Incident cases of thoracic aortic dissections and aneurysms were identified between 2002 and 2014. Treatment and mortality trends were assessed.

**Results:** There were 5966 aortic dissections (Type A n = 2289 [38%] and Type B n = 3632 [61%]). Overall incidence proportion for aortic dissections was 4.6 per 100,000. There were 9392 thoracic aortic aneurysms with an overall incidence proportion of 7.6 per 100,000. The incidence for both dissections and aneurysms significantly increased over the 12-year study. Only 53% (1204 out of 2289) of Type A dissections underwent surgery. Type B dissection treatment was 83% (3000 out of 3632) medical, 10% (370 out of 3632) surgery, and 7% (262 out of 3632) endovascular. Thoracic aortic aneurysm treatment was 53% (4940 out of 9392) surgery, 44% (4129 out of 9392) medical, and 3% (323 out of 9392) endovascular. Thirty-five percent of known descending thoracic aortic aneurysms (323 out of 924) received a stent graft. Cardiac surgeons performed 87% of the open surgical repairs. Vascular surgeons performed 91% of the endovascular procedures. All-cause 3-year mortality significantly decreased for both aortic dissections (44% to 40%) and aneurysms (30% to 22%). All-cause hospital mortality also decreased. Women had worse outcomes than men.

**Conclusions:** The incidence of thoracic aortic dissections and aneurysms increased over time but all-cause hospital and late outcomes improved. Gender differences exist. Men incur more disease but women have higher hospital mortality. Surgery was primarily referred to cardiac surgeons. Endovascular therapy was primarily referred to vascular surgeons. (J Thorac Cardiovasc Surg 2018; ■:1-11)



Incidence proportions for thoracic aortic dissections and aneurysms in Ontario, Canada.

## Central Message

The incidence of thoracic aortic aneurysms and dissections has increased, but hospital mortality and late outcomes have improved. Men incur more thoracic aortic disease but women have higher hospital mortality.

## Perspective

The incidence of disease is integral to resource allocation for cost-efficient care. This study demonstrates the incidence of thoracic aortic aneurysms and dissections have increased yet hospital and late outcomes have improved. Men incur more aortic disease yet women have higher hospital mortality. Surgical care is primarily performed by cardiac surgeons. Vascular surgeons perform most endovascular procedures.

See Editorial Commentary page XXX.

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**Abbreviations and Acronyms**

CCI	= Canadian Classification of Health Interventions
ICD-10-CA	= International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Canada
IRAD	= International Registry for Acute Aortic Dissection
NACRS	= National Ambulatory Care Reporting System
TEVAR	= thoracic endovascular aortic repair



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Thoracic aortic dissections and thoracic aortic aneurysms are highly resource intensive intermixed disease processes associated with significant morbidity and mortality. Such conditions put profound strain on health care systems. With a clinical presentation that spans the indolent and likely benign (small aortic aneurysm) to that of emergent and life threatening (aortic dissection), proper allocation of health service resources to ensure quality patient care becomes a challenge. Moreover, data to characterize the true burden of thoracic aortic disease are sparse.<sup>1-8</sup> Characterizing this burden is critical to ensuring quality care remains cost-efficient. In a single-payer health care system, such as present in Canada, this is prudent to financial sustainability.<sup>9,10</sup> We performed a population-based study to characterize the contemporary burden of disease and describe recent treatment paradigms.

**MATERIALS AND METHODS****Study Design**

We designed a retrospective cohort study using anonymously linked health information for persons residing in the province of Ontario, Canada. The primary outcomes of interest were the overall and annual calendar year incidence of thoracic aortic dissections and thoracic aortic aneurysms. The cohort encompassed more than 13.5 million (12.2 million in 2002, increased to 13.7 million in 2014) persons of ethnic diversity with the majority being white. The data were housed at the Institute for Clinical Evaluative Sciences. The Institute for Clinical Evaluative Sciences links de-identified, patient-level population-based health information across several administrative databases in Ontario using a unique encrypted health number identifier. A systematic algorithm was constructed to facilitate a distinction between patients who incurred a Stanford type A or type B aortic dissection. Research ethics approval

was obtained from the research ethics committees at Queen's University Kingston, Ontario, Canada, and Sunnybrook Hospital, Toronto, Ontario, Canada. Secondary outcomes included a descriptive characterization of thoracic aortic dissection and aneurysm treatments (medical, endovascular, or surgery), an assessment of surgical and hospital mortality rates, reintervention rates, and specialty involvement (cardiac or vascular surgeons).

**Patient Selection**

All persons residing in the province of Ontario, Canada, between April 1, 2002, and March 31, 2014, were included in the study. Cases were acquired by presentation with the condition of interest to the 231 hospital sites or multitude of ambulatory clinics within the Ontario health care system. A thoracic aortic dissection or thoracic aortic aneurysm was an incident case if no prior diagnosis for that entity had been identified during the previous 5 years. The size criterion to determine whether an aorta was aneurysmal was at the treating physician's discretion. Marfan, Ehlers-Danlos, and Turner syndrome, as well as connective tissue disorders of unspecified nature, were identified and tabulated. For each incident case, if treatment via endovascular therapy or surgery could not be identified, optimal medical therapy was the presumed treatment. Any reintervention after an initial endovascular or surgical procedure were recorded. Reintervention was defined as any endovascular stenting or surgical therapy > 72 hours after the initial procedure. The specialist on record as the primary operator for each case was captured to delineate cardiac and vascular surgery involvement. All-cause nonoperative hospital mortality (used for patients treated solely with medical therapy during hospital admission. All-cause nonoperative hospital mortality was defined as death occurring in a patient who did not have a surgical or endovascular procedure where the patient's in-hospital record indicated a discharge status of dead, regardless of cause and length of stay) and operative mortality were assessed (used for patients treated with open surgery or endovascular therapy. Operative mortality was defined as all deaths occurring during the hospitalization in which the operation was performed, even if after 30 days). Follow-up ended on March 31, 2015, or the date of a patient's death, whichever came first.

**Data Collection**

The compiled dataset for the cohort of interest was the product of several multilinked administrative databases and networks. The Registered Persons Database, the Canadian Institute for Health Information Discharge Abstract Database and Same Day Surgery Database, the National Ambulatory Care Reporting System (NACRS), the Ontario Health Insurance Plan Database, the Ontario Drug Benefit Database, the Office of the Registrar General-Deaths database, and Statistics Canada.

The Registered Persons Database collects vital statistics on all permanent residents of Ontario. The Canadian Institute for Health Information Discharge Abstract Database and Same Day Surgery Database record all hospital admissions and discharges along with information on diagnoses and any procedures performed. The NACRS collects data on all ambulatory visits, including outpatient clinics and visits to an emergency department. Diagnoses at presentation are coded using the International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Canada (ICD-10-CA). Hospital procedures are coded using the Canadian Classification of Health Interventions (CCI) coding system. For the cardiovascular system and pertinent to the study, CCI codes are discernably specific, partitioning surgical procedures based on the segment of aorta involved (ascending aorta, aortic arch, or descending thoracic aorta). Coding also partitions thoracic endovascular stenting procedures based on anatomic positioning within the abdominal or descending thoracic aorta. To cross-reference Canadian Institute for Health Information and NACRS data, the Ontario Health Insurance Plan Database captures fee-for-service billing claims for inpatient and outpatient services. The Ontario Drug Benefit Database records patient

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