From the Canadian Society for Vascular Surgery

Geographic disparities in the burden of ruptured and unruptured abdominal aortic aneurysms

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Background: **The province of Saskatchewan presents unique challenges for the care of ruptured abdominal aortic aneurysms (AAAs), including variable access to health care resources and long transportation distances to tertiary vascular care. This study assessed the rates of ruptured and total AAA to determine regional variations within Saskatchewan and ascertain whether there are areas of high AAA prevalence that would possibly benefit from the implementation of a targeted screening program.**

Methods: **All diagnoses of AAA from 2001 to 2012 in the province of Saskatchewan were reviewed, with patients grouped by health region of residence. Diagnoses of ruptured and unruptured AAAs were obtained from the Saskatchewan Discharge Abstracts Database, Medical Services Billings Claims data, and Vital Statistics data.**

Results: **During the study period, 6163 AAAs were diagnosed. The provincial age-adjusted rate of AAA was 53.0/100,000 person-years (95% confidence interval, 48.8-57.6). The highest age-adjusted rate of AAA was found in the Five Hills Health Region (FHHR), at 63.1/100,000 person-years (95% confidence interval, 57.6-69.0), which was significantly higher than the provincial average ($P < .05$). The rate of ruptured AAA in FHHR was nearly twofold higher than the provincial average (6.0 vs 2.9/100,000 person-years, respectively).**

Conclusions: **There are significant geographic variations in the prevalence of AAA in the province of Saskatchewan, with the highest rate of AAA found in the FHHR. (J Vasc Surg 2015;62:1421-8.)**

Abdominal aortic aneurysm (AAA) is a relatively common disease, with an estimated prevalence of 4.0% to 7.7% in men aged >65 years and 1% to 2% in women of this age group.[1-3] Most AAAs are asymptomatic and are discovered incidentally through investigations for unrelated pathology. Large (>5.5 cm) aneurysms are at significant risk for rupture, with population studies having demonstrated mortality rates approaching 90% in ruptured AAA.[4-6] Nearly 50% of patients do not survive transport to vascular care after AAA rupture, and even with the advent of minimally invasive endovascular procedures, mortality in patients surviving transport remains ~30% to 50%.[7]

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Given the morbidity and mortality associated with ruptured AAA, significant attention has been paid to early identification and elective repair. Focused abdominal ultrasound screening of the aorta has been shown to be very accurate in the detection of AAA, with sensitivity and specificity reported to be 100% and 98%, respectively.[8,9] To date, four large randomized controlled trials have investigated AAA-related mortality with screening of at-risk populations for AAA.[10-13] Meta-analysis of these studies has demonstrated a 40% absolute risk reduction in aneurysm-related mortality.[14] Dedicated analysis of the cohort aged 65 to 75 years demonstrates a number needed to screen (NNS) of 625, with a number needed to treat (NNT) with elective repair of three to prevent one aneurysm-related mortality. These NNS and NNT values compare favorably with other common screening programs such as fecal occult blood testing for colorectal cancer (NNS, 808) and mammography for breast cancer (NNS, 1887).[15]

The implementation of an ultrasound-based screening program for AAA is recommended by numerous vascular and medical societies worldwide, including in Canada, for the prevention of AAA-related rupture and death.[11,16-18] Current Canadian guidelines from the Canadian Society for Vascular Surgery recommend a one-time abdominal ultrasound screening for all men aged 65 to 75, women aged >75 who are at increased risk (cerebrovascular disease, smoking, family history of AAA), and men <65 with a family history of AAA. Most provinces in Canada, including Saskatchewan, do not currently have an organized province-wide screening program.

Much current literature has been devoted to the changing epidemiologic characteristics of screened populations,

including a decline in AAA prevalence.[17,19,20] The decline has coincided with reductions in modifiable AAA risk factors, most notably smoking, and has prompted some to question the applicability of screening low-prevalence areas. Interestingly, a large population study in Sweden showed a significant geographic variation in the prevalence of AAA, with a higher prevalence of AAA noted in northern Sweden.[21]

Saskatchewan provides a unique challenge to the elective and emergency management of AAAs. With a total area of 651,900 square kilometers (251,700 square miles) and a population of only 1,033,381, of whom ~50% live in rural areas,[22] nearly half of the people in the province live a significant distance from specialist vascular care. Furthermore, with a population diverse in risk factors, such as age and ethnicity, spread across large geographic areas, a universally implemented screening program for AAA would be logistically difficult and would likely only have significant yield in areas where populations with traditional AAA risk factors predominate.

The goal of this study was to determine whether significant discrepancies exist in the geographic distribution of unruptured and ruptured AAAs in Saskatchewan through the province's health regions. A second goal was to observe trends in aneurysm rates with time in the province of Saskatchewan.

METHODS

The province of Saskatchewan provides universal health insurance for all citizens and permanent residents. As with all Canadian provinces, this is a single-payer system, with the provincial Ministry of Health funding all physician and hospital services, including primary care and specialist consultations, diagnostic testing, therapeutic interventions, and follow-up visits. Because all services are provided exclusively through the public health care system, a unique provincial Health Services Number can be used to identify and link individual patient data through a large number of administrative data sets.

Study design. All records with a diagnosis of ruptured or unruptured AAA for the period April 1, 2001, to March 31, 2012, were collected using International Classification of Diseases (ICD)-Ninth Revision (ICD-9) codes 441.3, 441.4 and ICD-10th Revision-Canadian enhancement (ICD-10-CA) codes I71.3, I71.4 from four provincial databases maintained by the Saskatchewan Ministry of Health and accessed through the Health Quality Council of Saskatchewan. These databases included the Discharge Abstracts Database (DAD), Medical Services Billings Claims Data, Personal Health Registration System (PHRS), and the Vital Statistics Database.

The DAD includes all hospital separations in Saskatchewan. Diagnoses in DAD are coded using ICD-9 up to and including fiscal year 2001 and 2002 and ICD-10-CA 2002 and 2003 and onwards. In addition to most responsible diagnosis, other hospital diagnoses are captured in the data, including but not limited to comorbid conditions and the development of complications during hospital stays.

The Medical Services Billings Claims Data includes billing claims submitted to the provincial health ministry by physicians who are paid by fee for service. Single diagnosis, coded by ICD-9 (3-digits only) is recorded in each claim. Additional information, such as date of service, service fee code, and location of service, is captured in the data. Salaried physicians are also submitting claims for administrative purposes, a practice known as shadow billing; however, completeness of data is unknown.

PHRS captures patient data, including demographics (ie, date of birth, sex, Registered Indian status), health region of residence, and date of coverage by the provincial health insurance. The Vital Statistics Database was used to identify all deaths from the study period with AAA listed as an underlying cause of death on the death certificate.

All unique patients were identified by Health Services Number and given a study identification number, which was subsequently linked across the databases to prevent double counting of cases. Hospital separations taken from the discharge abstracts database with a most responsible diagnosis of AAA were used to estimate aneurysm-related intervention (open or endovascular), and the data were subsequently stratified by ruptured and unruptured AAA.

Vascular surgical services in Saskatchewan are centralized within Regina and Saskatoon, the two major urban centers in the province. Patients in the surrounding 10 Regional Health Authorities (RHA) require transport to one of these two centers for all emergency, urgent, and elective vascular care. The geographic region covered by each RHA is shown in Fig 1. For the purposes of this study, the three most northern health regions, Mamawetan Churchill River Health Region, Keewatin Yatthé Health Region, and Athabasca Health Authority, were amalgamated into one Northern Region because of sparse population. Most importantly, analyses were stratified by the RHA in which the patient resided rather than by the health region within which health services were obtained. The respective populations of each RHA from the years 2001 through 2012 were obtained from PHRS (Fig 1).

The University of Saskatchewan Biomedical Research Ethics Board (Bio-REB#13-55) approved this study. The need for individual participant consent was waived because the study involved data from administrative data sets.

Statistical analysis. Data for the province of Saskatchewan and each RHA were expressed as unique patients (identified by linked data from hospital separations, physician billing codes, and death certificates with an underlying cause of death reported as AAA) per 100,000 person-years and expressed as a crude rate. To determine if variations in rates of AAA could be related to known regional variations in population demographics, we determined rates adjusted by age, sex, and Registered Indian status using Poisson regression and calculated 95% confidence intervals (CIs) for the age, sex, and Registered Indian status standardized rates.

RESULTS

We identified 6163 unique individuals with a diagnosis of AAA from any or all of the databases during the study