Complications of Type 2 Diabetes Among Aboriginal Canadians

Prevalence and associated risk factors

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Despite a dramatically increasing burden of type 2 diabetes in Aboriginal Canadian communities (1–5), relatively little information is available regarding the prevalence of, and risk factors for, the complications of type 2 diabetes in this population (6). Although previous studies have documented micro- and macrovascular disease in Aboriginal Canadians with diabetes, the majority of these reports have relied heavily on hospital records, chart reviews, and disease registries (6). These approaches may underestimate the magnitude of the complications burden because only those with the severest disease are included, and standardized methods are infrequently used to document complications. The objective of the present research project was to systematically determine, using validated methods, the prevalence of micro- and macrovascular complications among Aboriginal Canadians who have type 2 diabetes and to identify risk factors that are associated with these conditions.

RESEARCH DESIGN AND METHODS — The Sandy Lake Diabetes Complications Study has been presented in detail previously (6). Briefly, all community members known to have type 2 diabetes were invited to participate; 189 of 250 (76%) eligible subjects were enrolled, although the sample size varies given time-limited access to certain equipment. Participants were older than nonparticipants and more likely to be male but did not differ in diabetes treatment. Signed informed consent was obtained from all participants, and the study was approved by the Sandy Lake First Nation Band Council and the Mount Sinai Hospital Ethics Review Committee.

We used validated methods to assess retinopathy, neuropathy, nephropathy, and cardiovascular disease risk factors, as described previously (6). Digital fundus photography was performed using a nonmydriatic retinal camera, with no pharmacological pupillary dilation. Three 45° images were taken in each eye, as described (7). After initial clinical assessment and referral by an ophthalmologist (B.S.), photographs were transferred to the Ocular Epidemiology Grading Center at the University of Wisconsin (Madison, WI), where they were graded for retinopathy (mild nonproliferative diabetic retinopathy [NPDR], moderate/severe NPDR, or proliferative diabetic retinopathy [PDR]) and macular edema (8,9). Diabetic sensory neuropathy was determined using a modification of the Michigan Neuropathy Screening Instrument (10). (In the current study monofilament testing was added and the questionnaire portion was not used.) Scores range from 0 to 9, and individuals with scores >2 were considered to have neuropathy. Diabetic nephropathy was determined by measuring the albumin-to-creatinine ratio in a single, random, daytime urine sample (11) using the Bayer DCA 2000 Point-of-Care Analyzer, which has been validated (r = 0.95) against laboratory techniques (12). Intimal-media thickness (IMT) was determined using a high-resolution duplex ultrasound scanner (ATL 5000 HDI; Advanced Technology Laboratories, Seattle, WA), as described (13–15). The ankle-brachial blood pressure index was determined using a blood pressure cuff and Doppler stethoscope. Angina and intermittent claudication were assessed using the Rose questionnaire (16,17).

Risk factors were assessed using laboratory and physical measurements and standardized, interviewer-administered questionnaires (6). Measures included HbA1c (A1C) using the DCA 2000 Analyzer (validity 0.90–0.98 vs. laboratory measures) (18), high-sensitivity C-reactive protein and lipid concentrations (19), height, weight, waist circumference, du-
CONCLUSIONS — The high prevalence rates of both micro- and macroalbuminuria in this study are notable and consistent with previous data suggesting that Aboriginal Canadians may be especially susceptible to the renal complications of diabetes (6,20–26). The mechanism underlying this elevated renal risk is unknown, although suboptimal glucose and blood pressure control likely play a role. In addition, a variant of the gene encoding angiotensinogen, AGT 235, has been associated with a qualitative measure of microalbuminuria in this population (26).

Previous chart review studies in Aboriginal Canadians have documented neuropathy prevalence ranging from 0 to 12% (20–22,27); these rates are notably lower than the estimate from the
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present study (46.3%). This divergence is likely due to differences in procedures used to measure neuropathy. Cases of diabetic neuropathy recorded in medical charts likely represent only the severest portion of the disease spectrum, whereas the Michigan Neuropathy Screening Instrument will have also detected subjects in the earlier stages of sensory neuropathy (10).

Limited data are available on the prevalence of diabetic retinopathy among Aboriginal Canadians. Maberley et al. (28) reported prevalence rates of macular edema, NPDR, and PDR that were remarkably similar to those from the present study (24% NPDR, 5% macular edema, and 2% PDR). The relatively low prevalence rates of PDR and macular edema in this population, especially in light of the high rate of nephropathy, possibly reflect the low median duration of diabetes or the presence of protective genetic factors.

The strengths of this study include the high participation rate, the community-based setting, and the use of a wide range of validated, systematically applied exposure and outcome measures. Limitations include the small sample size and the cross-sectional design. Notwithstanding, this study represents the first comprehensive, systematic, and standardized documentation of diabetes complications and associated risk factors among Aboriginal Canadians.

In conclusion, in a community-based study of Aboriginal Canadians, we found high prevalence rates of both diabetes complications and associated risk factors and, furthermore, that well-established associations between risk factors and complications were apparent. These results highlight the urgent need to implement culturally appropriate strategies for the prevention of diabetes complications in this population.

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