



Evidence

Études

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Incidence of tuberculosis among reported AIDS cases in Quebec from 1979 to 1996

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Abstract

Background: The impact of HIV infection on tuberculosis (TB) rates in Quebec has not been fully established. Because concurrent HIV infection is the single most important factor in TB reactivation, the authors used Quebec AIDS surveillance data to quantify the extent of TB among reported AIDS cases and to identify the characteristics of AIDS patients with TB.

Methods: The study population comprised people aged 15 years and over with AIDS diagnosed between Jan. 1, 1979, and Dec. 31, 1996, and reported by Mar. 31, 1997. Patients with TB (all forms) and those without TB were compared. Multivariate logistic regression analysis was used to examine the independent effect of each variable on the AIDS-TB cases. The authors also compared the number of AIDS-TB cases with the number of TB cases to estimate the effect of HIV infection on TB incidence.

Results: Of the 4684 people with AIDS reported in Quebec, 242 (5.2%) had active TB at some point during the course of their illness. During 1992-1995, 9.6% of the people with TB in Montreal, and 5.8% in the province of Quebec, also had HIV infection. Those with AIDS and TB were predominantly male (75.2%), manual workers (40.1%) and residents of Montreal (86.4%) and were born in an HIV-endemic country (63.8%). The multivariate analysis indicated that AIDS patients who were born in HIV-endemic countries in the Caribbean, sub-Saharan Africa or other developing regions were 21.8 times (95% confidence interval [CI] 19.5-28.5), 17.9 times (95% CI 12.7-27.1) and 4.9 times (95% CI 3.5-7.0) more likely to have TB than those born in Canada; manual workers and unemployed people with AIDS were 1.6 times (95% CI 1.3-2.0) and 2.0 times (95% CI 1.5-2.6) more likely to have TB than professional workers; and people who acquired HIV infection through heterosexual contact were 2.1 times (95% CI 1.6-3.1) more likely to have TB than men who acquired it through sexual contact with other men.

Interpretation: AIDS seems to contribute significantly to the number of TB cases. The results of this study reinforce the importance of offering HIV testing to people in high-risk groups, such as those born in a country where HIV and TB is endemic.

HIV infection is a major risk factor both for reactivation of latent tuberculosis (TB) and for rapid progression of recent TB infection to active disease. TB increases HIV replication¹ and is now a major cause of death among HIV-infected patients in developed and developing countries.²

Although TB rates have been steadily declining in the province of Quebec as a whole, the incidence of TB in Montreal has not declined since 1985 and remains at 11.0 per 100 000 population, double the rate in the rest of the province.³ Furthermore, until 1996 approximately 500 new AIDS cases were reported every year in Quebec and the overall prevalence of HIV infection among adults is estimated to be 1.7 per 1000 people (5.0 per 1000 in Montreal).⁴

In this study we analysed Quebec AIDS surveillance data to quantify the extent of TB among reported AIDS cases and to identify the characteristics of AIDS patients with TB.

Methods

The study population consisted of people aged 15 years and over with AIDS diagnosed



from Jan. 1, 1979, to Dec. 31, 1996, and reported by Mar. 31, 1997. In Quebec AIDS is reported non-nominally to regional health departments by the diagnosing physician using a standard notification form. After the validity and completeness of the information have been verified, data are forwarded to the Quebec AIDS Surveillance Program.

The program's database records data on a case-by-case basis and includes the AIDS-defining conditions reported by the diagnosing physician at any time during the course of illness. In 1994 in Quebec TB diagnosis occurred within 6 months before or after AIDS diagnosis in 85% of AIDS-TB cases and within the same month in 61%.⁴ Data on TB occurring after another indicator condition may be captured at the time of the original report (which may be submitted months and sometimes years after the AIDS diagnosis) or during a systematic follow-up of cases carried out to obtain data on vital status subsequent to the original report.

In September 1987 extrapulmonary TB was added to the list of AIDS-defining conditions for the case definition of AIDS.⁵ In 1993 pulmonary TB was added.⁶ In our study, to avoid these limitations and to capture more complete information, we included all AIDS cases diagnosed from 1979 to 1996 in which there was a history of any form of active TB.

We calculated the incidence rate of coinfection with AIDS and TB (AIDS-TB cases) per 100 000 population by dividing the number of reported AIDS-TB cases by the population of Quebec aged 15 years and over (1991 Canada census). The corresponding TB incidence rate reported for the province was also calculated for this age group,⁷ and the same calculations were carried out for Montreal. Data used in calculating the AIDS-TB incidence rates were adjusted by the methods of Rosenberg⁸ and of Zeger and colleagues⁹ to account for delays in reporting AIDS diagnosis; we assumed that reporting delays were the same for AIDS-TB cases as for other AIDS cases. The proportion of AIDS patients among people with TB was calculated for the period 1992-1995.

The cases of AIDS-TB were compared with those of AIDS alone according to year of diagnosis, sex, age, mode of HIV transmission, occupation, region of residence and country of birth. Categories considered for mode of HIV transmission were men who have sex with men (MSM), injection drug users (IDUs), people who received blood or blood products, people born in an

HIV-endemic country, people infected through heterosexual contact,¹⁰ and other or unknown. There was only one case of an AIDS patient with TB who fell into both the MSM and the IDU categories; we included this case in the MSM category. The occupational categories obtained from the AIDS case-reporting form (66% completion rate) were grouped into 4 general classes: professional (including managers), manual workers (tradespeople, farmers, employees, factory workers), unemployed (including homeless people) and unknown. These 4 categories were used for national AIDS statistics in France.¹¹

We considered 2 regions of residence for patients living in Quebec — the island of Montreal and elsewhere in Quebec — because 77% of people with AIDS in Quebec are from Montreal.⁴ Patients born outside of Canada were grouped into categories according to the estimated risk of TB infection in their country of birth: low- to medium-risk industrialized countries (Europe, Australia, New Zealand, Japan, the United States and the independent states of the former Soviet Union), and high-risk countries or regions (the Caribbean [Haiti, the Dominican Republic and Jamaica], sub-Saharan Africa and other developing countries).

The χ^2 test was used to evaluate differences in proportions for several variables between the AIDS-TB and AIDS only cases. To examine the independent effect of each variable on TB among reported AIDS cases, we performed multivariate logistic regression analysis taking into account the period of diagnosis (before 1987, 1987-1992 and 1993-1996). Findings were considered statistically significant at a *p* value of 0.05 or less. All tests were 2-tailed. Odds ratios were adjusted for sex, age, country of birth, occupation, region of residence, mode of HIV transmission and year of diagnosis. Because the category Caribbean as region of birth and the category born in an HIV-endemic country as a mode of HIV transmission were highly correlated ($r = 0.92$), only the former variable was retained in the multivariate analysis. Those whose country of birth was unknown were excluded.

Results

Of the 4684 people 15 years of age and older with AIDS diagnosed between Jan. 1, 1979, and Dec. 31, 1996, 242

Table 1: Incidence of AIDS, with and without associated tuberculosis (TB) (adjusted for reporting delays), and TB notifications among people 15 years of age and older in Montreal and in the province of Quebec during 1992-1995

Location; year	AIDS only		AIDS-TB		TB only		% of TB patients who have AIDS
	No.	Incidence*	No.	Incidence*	No.	Incidence*	
Montreal area							
1992	433	24.5	12	0.8	193	12.9	6.2
1993	441	24.9	26	1.7	176	11.8	14.7
1994	456	25.6	21	1.3	206	13.8	10.2
1995	348	19.5	15	0.9	197	13.2	7.6
Total	1678	23.6	74	1.1	772	12.9	9.6
Province of Quebec†							
1992	540	7.8	13	0.2	373	6.7	3.5
1993	574	8.3	29	0.5	347	6.3	8.3
1994	586	8.5	26	0.4	357	6.5	7.3
1995	493	7.1	16	0.2	359	6.5	4.4
Total	2193	7.9	84	0.3	1436	6.5	5.8

*Annual number of cases per 100 000 population.

†Including Montreal.



(5.2%) had active TB at some point during the course of their illness (95% confidence interval [CI] 4.6%–5.9%). Between 1992 and 1995 the incidence of AIDS–TB peaked in 1993: 1.7 cases per 100 000 population on the island of Montreal and 0.5 per 100 000 in the province of Quebec (including Montreal) (Table 1). Over this 4-year period the proportion of AIDS–TB cases among all TB cases varied from 6.2% to 14.7% in Montreal and from 3.5% to 8.3% in the province of Quebec (mean 9.6% and 5.8% respectively).

People with AIDS–TB (Table 2) were predominantly male (75.2%), aged 30–39 years (42.6%), manual workers (40.1%) and residents of the island of Montreal (86.4%). Over one-quarter (26.9%) were in the MSM category of mode of HIV transmission, and 63.6% were born in HIV-endemic countries. Of the latter, 141 of 154 people (91.6%) were born in Haiti where HIV transmission is predominantly heterosexual. Of 235 people with AIDS–TB and complete clinical information, 111 (47.2%) had pul-

monary TB only, 83 (35.3%) had extrapulmonary disease only, and 41 (17.5%) had both.

The characteristics of patients with AIDS and TB who were reported to have pulmonary disease only were compared with those who had extrapulmonary TB alone or both forms of TB in terms of sex, age, mode of HIV transmission, occupation, region of residence and country of birth. No significant difference in any characteristic studied was found; thus, the 2 forms of TB were grouped for further analysis.

The proportion of AIDS–TB cases among the reported AIDS cases differed significantly by year of diagnosis ($p < 0.05$), decreasing from 13.1% until 1987, to 4.6% for the 1993–1996 period. The proportion also varied by age group ($p < 0.05$): it was significantly higher among people 15–29 years (6.8%) than among those 30–39 (4.8%) or 40–49 years (4.7%). The rates of AIDS–TB were higher among women (12.9%) than among men (4.3%); among patients who acquired HIV infection through heterosexual contact (4.4%) than among those who were in the MSM category (1.9%); and among patients from the Caribbean (29.5%), sub-Saharan Africa (22.0%) and other developing countries (8.9%) than among Canadian-born people (1.8%). AIDS–TB was also significantly more common among unemployed patients (8.3%) and manual workers (7.2%) than among professionals (2.7%) and among patients living in Montreal (5.8%) than among those in other parts of Quebec (3.0%) ($p < 0.05$).

In the multivariate analysis (Table 3), 132 (2.8%) of the 4684 AIDS cases were excluded because of missing information on country of birth. There was one case of TB among these patients. Results of the analysis indicated that, after adjustment for other potential confounding factors, people with AIDS who acquired HIV infection through heterosexual contact were 2.1 times (95% CI 1.6–3.1) more likely to have TB than those in the MSM category. Manual workers and unemployed people with AIDS were 1.6 times (95% CI 1.3–2.0) and 2.0 times (95% CI 1.5–2.6) more likely to have TB than professionals. Finally, those with AIDS who were born in the Caribbean, sub-Saharan Africa or another developing country were 21.8 times (95% CI 19.5–28.5), 17.9 times (95% CI 12.7–27.1) and 4.9 times (95% CI 3.5–7.0) more likely to have TB than those born in Canada.

Interpretation

In Quebec, from 1979 to 1996, 5.2% of AIDS patients aged 15 years and older had active TB diagnosed at some point during the course of their illness. This proportion is somewhat higher than that reported elsewhere in Canada, where it varied from 1.6% in Ontario¹² to 4.3% in British Columbia¹³ and 4.1% for Canada as a whole.¹⁴ The Quebec rate is much lower than the rate of 19.2% observed in Europe¹⁵ but similar to the rate of 5.0% in the United States.¹⁶ The proportion of AIDS–TB cases in our study is an indicator of the prevalence of TB infection in the HIV-infected population.

Table 2: Characteristics of people with AIDS, with and without associated TB

Characteristic	Disease group; no. (and %) of patients	
	AIDS–TB <i>n</i> = 242	AIDS only <i>n</i> = 4442
Sex*		
Men	182 (75.2)	4036 (90.9)
Women	60 (24.8)	406 (9.1)
Age group, yr		
15–29	57 (23.6)	778 (17.5)
30–39	103 (42.6)	2028 (45.7)
40–49	59 (24.4)	1185 (26.7)
≥ 50	23 (9.5)	451 (10.2)
Mode of HIV transmission*		
MSM	65 (26.9)	3297 (74.2)
IDU	5 (2.1)	235 (5.3)
Blood or blood product	1 (0.4)	139 (3.1)
Born in HIV-endemic country	154 (63.6)	351 (7.9)
Heterosexual contact	13 (5.4)	283 (6.4)
Other/unknown	4 (1.7)	137 (3.1)
Occupation class*		
Professional worker	32 (13.2)	1143 (25.7)
Manual worker	97 (40.1)	1247 (28.1)
Unemployed	46 (19.0)	510 (11.5)
Unknown	67 (27.7)	1542 (34.7)
Region of residence*		
Montreal area	209 (86.4)	3379 (76.1)
Quebec, other than Montreal area	33 (13.6)	1063 (23.9)
Country of birth*		
Canada	65 (26.9)	3618 (81.4)
Other industrialized country	6 (2.5)	189 (4.3)
Caribbean	148 (61.2)	353 (7.9)
Sub-Saharan Africa	11 (4.5)	39 (0.9)
Other developing country	11 (4.5)	112 (2.5)
Unknown	1 (0.4)	131 (2.9)

Note: MSM = men who have sex with men, IDU = intravenous drug user.
*Differences in these categories are significant at $p < 0.001$ level.



Comparing the number of reported AIDS–TB cases with the number of TB cases gives a minimum estimate of the effect of HIV infection on TB incidence. During 1992–1995, 9.6% (about 18 cases per year) of TB cases in Montreal and 5.8% (about 21 cases per year) in the province of Quebec were associated with HIV infection. Although this study period is short, it is somewhat reassuring to note that the incidence of TB among reported AIDS cases, both in Montreal and in the province of Quebec, did not increase; an increasing trend could represent widespread transmission of TB within the HIV-infected population. Our AIDS–TB case rate was similar to the 8.9% reported for Europe in 1994¹⁵ but higher than the 2.8% rate reported for Ontario during 1990–1995.¹⁷ Furthermore, a recent study in Montreal based on TB surveillance data also estimated that no more than 10% of TB cases were associated with HIV.³

Our findings are likely to be an underestimate of the true number of AIDS–TB cases because of underreporting

of AIDS cases (estimated to be 15%),⁴ delayed reporting of AIDS cases (the median time from diagnosis to reporting is about 7 months)⁴ and incomplete information about TB on AIDS reporting forms (although underreporting of AIDS should not affect the proportion of TB among AIDS cases). Indeed, a recent study that linked records in the TB and AIDS surveillance databases using a capture–recapture method revealed that the Quebec AIDS registry had captured 73% of the AIDS–TB cases in Montreal during 1992–1995.¹⁸ TB diagnosed before the completion of an AIDS case report is more likely to be reported than TB diagnosed later in the clinical course. Nevertheless, because TB usually occurs relatively early in the course of HIV-induced cellular immunodeficiency, it is likely that not many instances of TB developing after another AIDS-defining condition were missed.

Some of the characteristics we found associated with a higher risk of TB among reported AIDS cases have been previously associated with a higher TB incidence. Indeed, TB incidence has been consistently found to be higher among people from developing countries than among those from industrialized countries.¹⁹ Occupation is an indirect indicator of socioeconomic status, and several studies have found an association between low socioeconomic status and TB.^{20,21} TB incidence has also been found to be higher in urban than in rural areas.²² The observed increased risk of TB among people with AIDS may reflect increased exposure to *Mycobacterium tuberculosis* infection, either remote or recent. In our study the high risk of TB among AIDS patients from developing countries probably reflects past TB exposure (i.e., a high rate of infection in the country of origin).

The higher risk of TB observed among AIDS patients living on the island of Montreal than among those living elsewhere in Quebec appears to be largely related to country of birth and profession, since residence was no longer a significant factor in the multivariate analysis (Table 3). Indeed, over 80% of the foreign-born population of Quebec resides on the island of Montreal, representing 23.5% of the province's population but 77.3% of TB cases in the province.³

The lack of association between age and AIDS–TB in the adjusted model is somewhat surprising, since the prevalence of *M. tuberculosis* infection is generally higher among older people in industrialized countries owing to the decrease in the risk of TB infection over recent decades. Our observation is most likely a reflection of the fact that the average age of people with TB in the foreign-born population of Quebec is considerably lower than the average age of those born in Canada (40.9 v. 57.5 years).³

In our study the crude analysis revealed that women were overrepresented among the AIDS–TB cases. This was also found in Canadian data, where 4% of men but 13% of women reported with AIDS also had TB.¹⁴ This may be explained in part by the fact that men who have sex with men (the MSM category) constitute the majority of male AIDS patients, a group at relatively low risk for TB.

Table 3: Multivariate logistic regression analysis comparing characteristics of people with AIDS–TB and those of patients with AIDS only

Characteristic	Crude OR (and 95% CI)	Adjusted OR (and 95% CI)*
Sex		
Men	1.0	1.0
Women	3.3 (2.8–3.8)‡	1.1 (0.9–1.4)
Age group, yr		
15–29	1.0	1.0
30–39	0.7 (0.6–0.8)‡	0.8 (0.7–1.0)
40–49	0.7 (0.6–0.8)‡	1.1 (0.9–1.4)
≥ 50	0.7 (0.5–1.0)	1.0 (0.8–1.4)
HIV transmission category†		
MSM	1.0	1.0
IDU	1.1 (0.7–1.7)	1.0 (0.6–1.6)
Heterosexual contact	2.3 (1.7–3.2)‡	2.1 (1.6–3.1)‡
Other/unknown	1.5 (0.9–2.5)	0.9 (0.6–1.5)
Occupation class		
Professional worker	1.0	1.0
Manual worker	2.8 (2.2–3.4)‡	1.6 (1.3–2.0)‡
Unemployed	3.2 (2.5–4.1)‡	2.0 (1.5–2.6)‡
Unknown	1.6 (1.2–1.9)‡	1.2 (0.9–1.5)
Region of residence		
Quebec, other than Montreal area	1.0	1.0
Montreal area	1.9 (1.6–2.4)‡	1.2 (1.0–1.5)
Country of birth		
Canada	1.0	1.0
Other industrialized country	1.8 (1.0–2.7)	1.5 (1.0–2.4)
Caribbean	23.3 (19.9–27.4)‡	21.8 (19.5–28.5)‡
Sub-Saharan Africa	15.7 (10.9–22.4)‡	17.9 (12.7–27.1)‡
Other developing country	5.5 (3.9–7.7)‡	4.9 (3.5–7.0)‡

Note: OR = odds ratio, CI = confidence interval.

*Adjusted for sex, age, country of birth, occupation, region of residence, mode of HIV transmission and time of diagnosis.

†“Blood or blood product” is included in “Other/unknown”; “Born in HIV-endemic country” was excluded from the analysis.

‡ $p < 0.05$.

As of 1996 each case of TB in Montreal in which HIV infection is recorded is transferred without identifying information to the AIDS Surveillance Program. If the case is not already in the program's database, the treating physician is contacted and provided with an AIDS case reporting form. This registry linkage should improve the quality of information on AIDS-TB cases.

Characterizing AIDS patients with TB may help to identify HIV-infected people who could benefit from TB chemoprophylaxis. Our study indicates that, in Quebec, HIV-infected patients of low socioeconomic status and those born in the Caribbean or sub-Saharan Africa, where heterosexual HIV transmission predominates are at particularly high risk for TB. In other parts of Canada a recent report indicated an important increase in the role of HIV infection in the pattern of TB occurrence.²³ Significantly more intravenous drug users, aboriginal Canadians and women in British Columbia now have HIV-related TB.²³ This reinforces the importance of offering HIV testing to people at high risk for TB-HIV coinfection such as those born in an HIV-endemic country who, according to our study, are also at high risk for TB. According to the recommendations of both Canadian and US public health authorities, HIV-infected people should undergo tuberculin skin testing, and preventive therapy should be initiated in those with a positive result.^{24,25}

Monitoring future trends in TB among AIDS patients in Quebec will assist in targeting resources for its control in this population and evaluating control measures. This is particularly important in the view of the regional differences in the epidemiology of TB in Canada.¹⁴

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