Analysis of risk factors associated with hepatitis B and C infection in correctional institutions in British Columbia

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RG PRÉFONTAINE, RK CHAUDHARY, RG MATHIAS. Analysis of risk factors associated with hepatitis B and C infection in correctional institutions in British Columbia. Can J Infect Dis 1994;5(4):153-156. The factors associated with infection with hepatitis B (HBV) and C viruses (HCV) were studied in residents of correctional institutions in British Columbia. Four hundred and fifteen residents volunteered to participate in this study. Among 415 residents tested, 28% were positive for HBV or HCV markers. Sixty-five per cent of the residents positive for HBV markers were also infected with HCV. However, in HBV-negative residents, only 14% were positive for antibody to HCV (anti-HCV). The highest rates for HBV and HCV were in 25- to 44-year-old residents. The analysis of risk factors and infection predictors in 354 residents showed that intravenous drug use and history of hepatitis were associated with infection with both HBV and HCV. The relative risk for HBV in intravenous drug users was 4.4 times that in nonusers; for HCV relative risk was 3.4 times. In the group with history of hepatitis, the relative risk was 6.2 and 4.5 times for HBV and HCV, respectively. The multivariate analysis of the data showed that both intravenous drug use and a history of hepatitis were significant ($P < 0.0001$). Tattooing or history of transfusion was not associated with increased risk for HCV, but tattooing and age were significant factors for HBV.

Key Words: Hepatitis B virus, Hepatitis C virus, Risk factors

Analyse des facteurs de risque associés à l'hépatite B et à l'hépatite C dans les établissements correctionnels de la Colombie-Britannique

RÉSUMÉ : Les facteurs associés à l'infection au virus de l'hépatite B et de l'hépatite C (HBV et HCV) ont été étudiés chez des prisonniers incarcérés dans des établissements correctionnels de la Colombie-Britannique. Quatre cent quinze résidents se sont portés volontaires pour participer à cette étude. Parmi les 415 résidents soumis aux analyses, 28 % se sont révélés séropositifs à l'égard des marqueurs du virus de l'hépatite B ou C. Soixante-cinq pour cent des résidents séropositifs à l'égard des marqueurs du HBV étaient également infectés au HCV. Toutefois, chez les résidents HBV-négatifs, seuls 14 % étaient positifs à l'égard de l'anticorps anti-HCV. Les taux les plus élevés à l'égard du HBV et du HCV se trouvaient dans la tranche des 25 à 44 ans. L'analyse des facteurs de risque et des prédictors de l'infection chez 354 résidents a révélé que la prise de drogues intraveineuses et les antécédents d'hépatite étaient autant associés à l'infection par HBV que par HCV. Le risque relatif de HBV chez les usagers de drogues intraveineuses était de 4,4 fois plus élevé que chez les non-utilisateurs. Pour le HCV, le risque relatif à l'égard du HBV était de 3,4

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fois plus élevé. Dans le groupe présentant des antécédents d'hépatite, le risque relatif était de 6,2 et de 4,5 fois, pour le HBV et le HCV respectivement. L'analyse à variables multiples des données a révélé que, et les drogues intraveineuses et les antécédents d'hépatite étaient significatifs ($P < 0.0001$). Le tatouage ou les antécédents de transfusion n'ont pas été associés à un risque accru de HCV, mais le tatouage et l'âge ont été des facteurs significatifs à l'égard du HBV.

THE INTRODUCTION OF A NEW TEST FOR THE DETECTION OF antibody to hepatitis C virus (anti-HCV) has allowed the study of infection with this virus in different risk groups (1). A high prevalence of hepatitis C virus (HCV) infection has been reported in hemodialysis patients (2), intravenous drug users (3) and hemophiliacs (4). Several studies (5-8) have shown that there is a high prevalence of infection with hepatitis B virus (HBV) in residents of correctional institutions. Recent studies have also shown a high prevalence of infection with HCV in residents of correctional institutions (9-11). However, in these studies, the associated factors were not investigated.

We report here the analysis of the factors associated with the seroprevalence of HBV and HCV in residents of federal correctional institutions in British Columbia.

PATIENTS AND METHODS

In 1989 Correctional Services of Canada implemented a hepatitis B immunization program for all inmates incarcerated in federal institutions. In the Pacific region (British Columbia and Yukon), where 14.4% of federal inmates are incarcerated, a seroprevalence study for viral hepatitis markers was undertaken as part of the immunization program. The initial phase of the program was to provide the inmate population with information on the potential short term and long term effects of hepatitis B infection and the benefits of immunization. Information brochures were distributed, audiovisual presentations and group and individual counselling were given. In the first six months of the program, 23% of the population accepted the invitation to participate in the immunization program. Informed consent was obtained from all participants before immunization with hepatitis B vaccine and screening for viral hepatitis markers. Providing a blood sample or completion of a questionnaire designed to identify predictor (ie, history of hepatitis) and risk factors was not mandatory for immunization. The questionnaire requested information on history of hepatitis, blood transfusions, tattooing, intravenous drug use and sexual orientation.

Blood samples were obtained from 415 male residents of the federal correctional institutions in British Columbia. The number of residents tested from each age group and sampling rates are given in Table 1. Samples were tested for hepatitis B surface antigen (HBsAg), antibody to core antigen (anti-HBc) and antibody to surface antigen (anti-HBs) by enzyme immunoassays (Abbott Laboratories, Illinois). These samples were stored at -70°C and later tested for anti-HCV by enzyme

TABLE 1
Sampling rate of residents in British Columbia correctional institutions

Categories	Age groups (years)				
	15-24	25-34	35-44	45-54	>55
Total population (1806)	290	769	498	164	85
Number tested (415)	50	174	117	43	30
Response rate (%)	17	23	23	26	35

immunoassay. The anti-HCV repeat positive samples were further tested by first-generation recombinant immunoblot assay (RIBA) HCV (Ortho Diagnostics Inc, New Jersey). The RIBA HCV indeterminate samples were later tested by second-generation RIBA HCV test.

An individual was infected with HBV if he or she was HBsAg-positive and/or anti-HBc-positive. Individuals who were anti-HBs-positive only were not included in the infected group. A positive result for anti-HCV was defined as a positive enzyme immunoassay plus a positive confirmatory test. Data were entered in a computer file without individual identifiers. Analysis was carried out using χ^2 or multivariate analysis using logistic regression.

RESULTS

Four hundred and fifteen inmates consented to have blood drawn. There were 1806 eligible for the study (Table 1). The questionnaires were completed by 354 (85.3%) of 415 participating residents. The sampling rates were similar for the older groups at 23 to 35% but lower in the 15 to 24 age group at 17%. Twelve residents (3.0%) were positive for HBsAg (Table 2). The prevalence of HBV markers was 28%. None of the inmates had been immunized with HBV vaccine to the authors' knowledge but three were positive for anti-HBs alone, which may represent immunization.

The prevalence of anti-HCV was also high, with 106 samples (25.5%) positive by both enzyme immunoassay and first generation RIBA HCV tests. Of 10 samples that were indeterminate by first generation RIBA HCV, nine were positive by second-generation RIBA; thus, the overall prevalence of anti-HCV was 28% in this population.

The distribution of markers (Table 2) showed that 259 residents were negative, 41 were HBV-positive and HCV-negative, 37 were anti-HCV-positive and HBV-negative and 76 (65%) were positive for both. Results showed that residents positive for HBV or HCV alone had somewhat different distributions of risk factors. Intravenous drug use was a risk factor in 76% of anti-HCV

TABLE 2

Prevalence and relationship of HBV markers and anti-HCV in the residents of British Columbia correctional services

	Number (%)
Total samples tested	415
Positive for HBsAg	12 (3)
Positive for HBV markers	117 (28)
Positive for anti-HCV	115 (28)
Positive for both	76 (65)
Negative for both	259 (62)
HBV-positive HCV-negative	41 (10)
HCV-positive HBV-negative	37 (9)

HBsAg Hepatitis B surface antigen; HBV Hepatitis B virus; HCV Hepatitis C virus

TABLE 3

Predictive factors for the prevalence of hepatitis B and hepatitis C viruses

Risk factors		Hepatitis B			Hepatitis C		
		Rate/100	RR	95% CL	Rate/100	RR	95% CL
Intravenous drug use	With	50	4.4	2.9-6.7	83	3.4	2.7-4.3
	Without	11			24		
Tattooing	With	75	1.5	1.3-1.8	75	1.5	1.3-1.8
	Without	49			49		
Transfusion	With	21	1	0.64-1.6	22	1.1	0.68-1.7
	Without	21			20		
History of hepatitis	With	34	6.8	3.5-11.2	30	4.5	2.6-8.0
	Without	5			7		

CL Confidence limits; RR Relative risk

and 45% of HBV-positive residents. Tattooing was a risk factor for HBV (18%) but not for anti-HCV-positive (5%) residents. Transfusion was a small risk factor for anti-HCV-positive residents only (data not shown).

The positivity rate for HBV markers and anti-HCV for different age groups is given in Figure 1. Results showed that the rate for HBV (18%) and HCV (16%) was similar in the 15 to 24 year age group, with a small percentage (4%) of individuals infected with both. In the 25 to 34 year age group, the infection rates for HBV, HCV and dual infection were 30, 32 and 22%, respectively. The rate for HBV was further increased to 38% in the 35 to 44 year age group, whereas the prevalence of anti-HCV (30%) decreased somewhat and the prevalence rate for dual infection remained the same (21%). However, the rates for both HBV (16%) and HCV (16%) were significantly reduced in the 45 to 54 year age group. Dual infection was detected in 9% of the residents tested. There was a further decline in the prevalence of HBV markers (13%) in residents 55 years of age or older. The prevalence of HCV (3%) was also significantly reduced. The dual infection rate in this group was 1%.

Of the 415 residents, 354 completed questionnaires regarding risk factors. Having a history of hepatitis was a strong predictor of having HBV markers, (relative risk [RR]=6.2, 95% confidence limits [CL] 3.5-11.2) or HCV markers (RR=4.5 95% CL 2.6-8.0) (Table 3). Of the risk

Figure 1) Prevalence rates of hepatitis B (HB) virus, hepatitis C (HC) virus and both in different age groups of residents of British Columbia correctional institutions

factors measured, intravenous drug use had an RR of 4.4 (range 2.9 to 6.7) for HBV and 3.4 (range 2.7 to 4.3) for HCV. Tattooing had an RR of 1.5 (range 1.3 to 1.8) for HBV and HCV. A history of transfusion was not a risk factor for either HBV or HCV (RR 1.1 and 1.0, respectively). Sexual preferences could not be analyzed as a risk factor because the answers were ruled unreliable.

Multivariate analysis using multiple regression showed that intravenous drug use, tattoos and age were all significantly associated with HBV, in that order, while for HCV only intravenous drug use was significant in the model.

DISCUSSION

Results have shown a high prevalence of hepatitis B and C infection among residents of correctional institutions in British Columbia. The low response rate in our survey indicates a major possibility of response bias. The prevalence of HBV and HCV must be interpreted cautiously. The finding that our rates were similar to other studies helps to reduce concerns about the response bias.

The comparison of risk factors should be less biased as prior knowledge of HCV status would not have been available to these individuals. Although a few may have known that they had had non-A, non-B hepatitis, this is less likely to have influenced their decision to be

tested. As this was part of an immunization program, the prevalences may be low because immunization was not available for those who had been infected previously. In spite of this, similar data have been reported previously by other investigators (5-8) for HBV. Intravenous drug use has been found to be important for HBV infection (8,11-13); however, the risk factors associated with HCV infection in residents of correctional institutions has not been fully explored. The comparison of risk factors for HBV-positive with those for HCV-positive individuals may give some information on the relative infectivity of routes of infection.

Twenty-eight per cent of residents were positive for anti-HCV. A similar prevalence rate (29.8%) was reported (9) from another institution in Canada. The risk factor associated with HCV infection is intravenous drug use. Intravenous drug use has been recognized previously as an important risk factor (14) for infection with HCV. History of hepatitis was also a predictive factor for infection with HCV. However, the significance of this factor is that, in the event of an exposure to the blood of a person with history of hepatitis, that exposure is much more likely to be to HBV or HCV than in an individual without such a history, at least in this population.

Transfusion, age and tattooing were not associated with increased risk for infection with HCV. A recent report (14) from the United States also indicated that the majority of HCV infections was not associated with transfusion. That transfusion is not a risk factor is possibly due to screening of blood donation for HCV. Our results indicate that there is a relationship between HBV and HCV transmission as 65% of HBV-positive residents were also positive for HCV. Hence the screening for HBV has

also reduced the risk for HCV. The multivariate analysis showed that both intravenous drug use and history of hepatitis were significant for HCV infection ($P < 0.0001$).

Another observation was of the coexistence of infection with HBV and HCV in a large proportion of residents (65%) tested. A similar finding was also reported from Alberta, where 58% of HBV-positive inmates were also positive for HCV (11).

These results showed that HBV and HCV have some similar predictors such as intravenous drug use and history of hepatitis. However, some of the predictors are not shared, such as tattooing and age, which were risk predictors for HBV but not for HCV. A large proportion of anti-HCV-positive individuals carries the HCV virus (14,15). Our results indicate that HCV may not be as infectious as HBV. The lack of an association with tattooing may indicate that needlestick exposures to HCV are not as likely to result in infection. The lack of association with age may indicate a cohort effect, but this also may be a marker for other risk factors such as sexual transmission.

Overall, the comparison of HCV with HBV risk predictors indicates that HCV is being transmitted to individuals in correctional institutions and intravenous drug use is the major risk factor. Tattooing, as carried out in institutions, is a risk factor for HBV but not HCV, indicating that HCV may require larger amounts of fluid transfer for infection to occur and hence a lower risk of infection following needlestick exposures. There is a need to clarify the transmission routes for HCV in order to inform inmates and staff of potential risks. HCV appears to have similar risk factors to human immunodeficiency virus.

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