Prevalence of hepatitis B virus infection in pregnant women in the Montreal area

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From January 1982 to June 1984, 30 315 serum specimens from pregnant women at nine hospitals in the Montreal area were screened for hepatitis B surface antigen (HBsAg). Of the specimens 103, from 98 women, were positive, a prevalence rate of 3.4 per 1000. The ethnic origin of the 98 women and the number who were also positive for e antigen (HBeAg) were as follows: French-Canadian, 29 (3 HBeAg-positive); Asian, 28 (14); Haitian, 32 (0); other, 7 (0); and unknown, 2 (0). The prevalence rates of HBsAg positivity according to ethnic origin at one of the hospitals were 73.9 in Asians, 33.1 in Haitians, 0.9 in French Canadians and 8.0 in women of other extraction. If the prevalence rate found in this study is true for the 95 000 live births that occur yearly in the province of Quebec, there are an estimated 323 infants at risk for hepatitis B virus (HBV) infection each year in the province. Screening programs for detecting HBV carriage in pregnant women should be instituted, since recent studies have shown combined active–passive immunization to be effective in preventing perinatal transmission of HBV infection.

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Original Research

De janvier 1982 à juin 1984, on recherché la présence de l'antigène de surface du virus de l'hépatite B (HBsAg) dans 30 315 échantillons de sérum de femmes enceintes à neuf hôpitaux dans la région de Montréal. Il y avait 103 échantillons positifs chez 98 femmes, ce qui donne un taux de prévalence de 3,4/1000. L'origine ethnique de ces 98 gestantes et le nombre de porteuses de l'antigène e (HBeAg) se répartissent comme suit: canadienne-française, 29 (3 porteuses d'HBeAg); asiatique, 28 (14); haïtienne, 32 (0); autre, 7 (0); et inconnue, 2 (0). La prévalence de l'état de porteuse de HBsAg selon l'ethnie dans un des hôpitaux se chiffre comme suit: asiatique, 73,9; haïtienne, 33,1; canadienne-française, 0,9; et autre, 8,0. Si le taux de prévalence globale est valable pour l'ensemble des 95 000 naissances vivantes survenant au Québec chaque année, on peut estimer que 323 nouveau-nés sont exposés annuellement aux risques de la transmission périnatale du virus de l'hépatite B (HBV). Il est indiqué de mettre sur pied des programmes de dépistage de l'état de porteuse de HBV chez la femme enceinte, puisque des travaux récents démontrent l'efficacité de l'immunisation active et passive dans la prévention d'une telle transmission.

Both hepatitis B immune globulin and hepatitis B vaccine, alone or in combination, have been shown to reduce the rate of infection with hepatitis B virus (HBV) in offspring of carrier mothers.[1-9] The development of these methods for preventing perinatal transmission of HBV has raised important questions about the screening of pregnant women. Who are the high-risk groups? Should all women be screened, or should screening be limited to high-risk groups?

In the process of a study to evaluate the effectiveness of hepatitis B vaccine combined with

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passive immunization in infants born to carrier mothers, we screened over 30 000 pregnant women in the Montreal area. We outline the results of this screening program and provide data that will help answer questions concerning screening policies.

Methods

Nine hospitals participated in the study. All serum specimens submitted to the hospitals' laboratories for routine prenatal serologic testing for rubella and syphilis were sent to hôpital Sainte-Justine and tested for hepatitis B surface antigen (HBsAg). All specimens were tested with either solid-phase radioimmunoassay (Ausria II, Abbott Laboratories, Montreal) or enzyme-linked immunoassay (Auszyme II, Abbott Laboratories). All reactive specimens were tested for antibody to core antigen (anti-HBc) with commercially available methods (Corab or Corzyme, Abbott Laboratories). To be considered positive a specimen had to contain both HBsAg and anti-HBc. All positive specimens were tested for e antigen (HBeAg) and anti-HBe by radioimmunoassay (Ausria, Abbott Laboratories) or enzyme-linked immunoassay (HBe EIA, Abbott Laboratories).

Information on ethnic origin and history of hepatitis was obtained for all patients with positive results. A standard questionnaire was completed for patients of French-Canadian origin during a telephone interview. It included questions about history of hepatitis, blood transfusions, household contact with cases of hepatitis B, occupation, travel abroad, rejection as a blood donor and residence in an institution; the patients were also asked whether they had been adopted. The same questionnaire was mailed to 565 consecutively screened pregnant French-Canadian women who were HBsAg-negative and who gave birth at hôpital Sainte-Justine.

Information on ethnic origin was obtained for all patients screened at hôpital Sainte-Justine. Therefore, it was possible to calculate the prevalence of HBsAg positivity among various ethnic groups seen at the hospital.

The 95% confidence intervals of the prevalence rates were calculated with the use of confidence limit tables for the Poisson distribution.

Results

From January 1982 to June 1984, 30 315 serum specimens were screened. The prevalence of HBsAg positivity in the total population was 3.4 per 1000 (Table I). Three HBsAg-positive women were screened twice during pregnancy, and two were screened during each of two successive pregnancies; there were therefore 103 positive specimens from 98 patients. Positivity was confirmed in 84% of the patients by obtaining a subsequent positive serum specimen, usually within the following 3 months; in the remaining 16% confirmatory serum specimens could not be obtained.

The ethnic origin and the HBeAg and anti-HBe status of the HBsAg-positive women are shown in Table II. The 28 women of Asian descent included 12 Vietnamese, 12 Cambodians, 3 Laotians and 1 Mauritian of Chinese ancestry. Of the seven women in the "other" category, two came from Italy and one each from Morocco, Syria, Senegal, Portugal and Trinidad. Of the three French-Canadian women who were HBeAg-positive, two had acute hepatitis during pregnancy, one during the first trimester and the second at 26 weeks' gestation. The nine women in the "other" and "unknown" categories were all anti-HBe-positive; none had a history of hepatitis.

The prevalence rate of HBsAg positivity per 1000 specimens at hôpital Sainte-Justine varied from 73.9 in Asians to 0.9 in French Canadians (Table III).

The questionnaire was completed for 25 of the 29 HBsAg-positive women of French-Canadian origin. Of the 25, 14 gave a positive response to one or more questions. Six patients had a history

Table I—Prevalence rates of positivity for hepatitis B surface antigen (HBsAg) in serum samples from pregnant women at nine hospitals in the Montreal area

Hospital	No. of specimens	No. (and rate per 1000) of HBsAg-positive specimens (and 95% confidence interval [CI])
Sainte-Justine	8 015	48 (6.0) (4.4–7.9)
Fleury	2 344	11 (4.7) (2.3–8.4)
Notre-Dame	1 797	8 (4.5) (1.9–8.8)
Saint-Luc	2 731	10 (3.7) (1.8–6.7)
Saint-Michel	2 789	9 (3.2) (1.5–6.1)
Sacré-Coeur	1 911	6 (3.1) (1.2–6.8)
Maisonneuve–Rosemont	1 333	2 (1.5) (0.2–5.4)
Centre hospitalier régional de Lanaudière	3 692	4 (1.1) (0.3–2.8)
Charles-Lemoyne	5 703	5 (0.9) (0.3–2.0)
Total	30 315	103* (3.4) (2.7–4.1)

*From 98 women (see results section).

of hepatitis, four were orphans and had been placed in an institution at an early age, four worked in a hospital and had occupational exposure to hepatitis B, two had lived in sub-Saharan Africa and one each had received many blood transfusions, had had household contact with hepatitis and had been rejected as a blood donor.

Of the questionnaires sent to 565 HBsAg-negative women 65 were returned marked "wrong address". Of the remaining 500, 371 were completed, a response rate of 74.2%. Of the 371 respondents 96 (25.9%) declared that they had one or more of the recognized risk factors for HBV infection: occupational exposure to HBV (44 women), history of hepatitis (29), rejection as a blood donor (23), household contact with hepatitis (18), many blood transfusions (10), childhood institutionalization (6) and lengthy residence in a tropical country (2).

Discussion

In our study the prevalence rate of HBsAg positivity per 1000 serum specimens was 3.4. We feel that this rate can be viewed as the prevalence rate of HBV carriage in the pregnant women for the following reasons. First, although we could not verify the identity of each specimen to avoid testing more than one specimen from the same patient, inadvertent retesting occurred only three times in the HBsAg-positive patients. Since a similar amount of duplicate testing probably occurred in the HBsAg-negative women, this factor likely had a marginal influence on the final results.

Second, although knowledge of their status might have lowered the fertility rate of HBsAg-positive women, thereby artificially reducing the prevalence rate, this factor probably played a minor role during the 30 months of the screening program. This is suggested by the fact that the prevalence rate was 2.5 per 1000 in the first 19 000 specimens screened and thereafter increased to 3.4, instead of decreasing.

It was impossible for us to know the number of HBsAg-negative women who had more than one pregnancy during the study period and who therefore were screened more than once. In the HBsAg-positive group this occurred only twice. However, given the low fertility rate of French-Canadian women (who accounted for the great majority of screened women), this was probably not a frequent event.

The prevalence rate of HBV carriage in our study was somewhat higher than that found in female volunteer blood donors in western Quebec from 1971 to 1972, 1.9.[10] Our higher rate is possibly explained by the fact that seven of the participating hospitals were inner-city medical centres serving a population in which certain high-risk ethnic groups were overrepresented. The prevalence rate in the patients of French-Canadian origin seen at hôpital Sainte-Justine, 0.9, was lower than that reported in western Quebec.

The prevalence rates in the various hospitals varied from 6.0 to 0.9. The hospitals with a high rate, such as Sainte-Justine, serve a population that includes high-risk ethnic groups or low socioeconomic groups or both, whereas the hospitals with a low rate, such as Charles-Lemoyne and the Centre hospitalier régional de Lanaudière, serve a suburban, socioeconomically privileged population. The latter serves a mixed rural and urban population in Joliette, 100 km northeast of Montreal.

It is clear that the overall prevalence rate of HBV carriage found in our study must be considered only as an estimate of the rate in pregnant

Table II—Ethnic origin and results of testing for hepatitis B e antigen (HBeAg) and anti-HBe in the HBsAg-positive women

Ethnic origin	No. (and %) of women	No. (and %) positive for HBeAg	No. (and %) positive for Anti-HBe	No. (and %) negative for HBeAg and anti-HBe
French-Canadian	29 (29.6)	3	22	4
Asian	28 (28.6)	14	12	2
Haitian	32 (32.7)	0	31	1
Other	7 (7.1)	0	7	0
Unknown	2 (2.0)	0	2	0
Total	98 (100.0)	17 (17.3)	74 (75.5)	7 (7.1)

Table III—Prevalence rate of HBsAg positivity at hôpital Sainte-Justine, by ethnic origin

Ethnic origin	No. of specimens	No. (and rate per 1000) of HBsAg-positive specimens (and 95% CI)
Asian	257	19 (73.9) (44.5–115.4)
Haitian	543	18 (33.1) (19.6–52.3)
French-Canadian	6593	6 (0.9) (0.3–2.0)
Other	622	5 (8.0) (2.6–18.8)
Total	8015	48* (6.0) (4.4–7.9)

*From 46 patients.

women in the province of Quebec. However, despite the fact that our calculated prevalence rate is probably too high, it is among the lowest ever reported in populations of pregnant women. The rate among pregnant women in 14 studies conducted since 1970 varied from 150.0 to 1.2;[11-24] in each study the rate paralleled that found in the general population of the country where the study was done.

Ethnic origin was the major risk factor for HBV carriage in our study. Only 29.6% of the carriers were of French-Canadian origin, despite the fact that the great majority of the women screened were French Canadian. The prevalence rate found in women of Asian origin at hôpital Sainte-Justine, 73.9, is in agreement with data reported in a national study of Indochinese refugees.[25] The rate in Haitian women, 33.1, places them in an intermediate-risk category. Montreal has a big Haitian community, which explains the large proportion of Haitians (32.7% of the HBV carriers) in our study. Other studies done in low-prevalence areas have also shown that most carriers are foreign-born and come from higher-prevalence areas.[17,23]

Most of the 17 HBeAg-positive women were of Asian extraction. Asian HBV carriers are known to be frequently HBeAg-positive.[25-29] HBeAg positivity in a woman has been found to be correlated with increased risk of perinatal transmission of HBV to her offspring, whereas anti-HBe positivity is associated with a much lower risk of transmission.[8,9,27-30]

A standard questionnaire, particularly if self-administered, has obvious potential advantages in a busy obstetric practice as a means of determining who should be screened for HBV infection. Since information on ethnic origin, the major risk factor in our study, is usually easily obtained in clinical practice, we decided to concentrate our efforts on evaluating the responses of French-Canadian women to the questionnaire on recognized risk factors. The variation in the method of administering the questionnaire and the somewhat low response rate in noncarriers limit to a certain extent our interpretation of the data obtained. However, despite these limitations the results give a good approximation of the usefulness of such an approach.

We found that only 56% of French-Canadian HBV carriers reported having one or more risk factors for HBV infection. This rate was not improved by a subsequent in-depth interview. Almost 26% of women negative for HBsAg also gave a positive answer to one or more of the questions; this rate could have been somewhat improved by rewording certain questions to make them more specific (for example, the question about working in a hospital would list recognized high-risk categories of jobs). Questions about illicit drug use or repeated episodes of venereal disease were not included, although these are recognized risk factors, because we feared that their inclusion might decrease the rate of response to the mailed questionnaire.

On the basis of the results, we estimated that a prenatal detection program to selectively screen certain women would have detected about 85% of the HBV carriers found in our study. These women include those of certain ethnic backgrounds, particularly Asians, sub-Saharan Africans and Haitians, and those with risk factors such as a history of acute or chronic hepatitis, work in certain high-risk hospital and institutional environments (e.g., hemodialysis units and institutions for the mentally retarded), rejection as a blood donor, childhood institutionalization, many transfusions of blood or blood products, illicit drug use and household contact with an HBV carrier.[31] Furthermore, the program would theoretically have detected all but one of the high-risk (i.e., HBeAg-positive) carriers. Such a program would reduce the proportion of women in whom screening should be done to between 25% and 35%.

What are the implications of HBV infection in pregnant women in the province of Quebec? If the prevalence rate found in our study is true for the 95 000 live births that occur each year in the province, an estimated 323 infants are at risk for HBV infection per year. If it is assumed that 17% of the carriers are HBeAg-positive and that 85% of their infants will become chronic carriers,[27-30] 47 newborns would contract chronic HBV infection each year. A few cases of fulminant hepatitis B would also occur.

If a more conservative estimate of the prevalence rate is used (say, 2.0, close to that found in western Quebec in the early 1970s[10]), there would be 190 infants at risk, and 28 infants would become chronic carriers. Considering that combined active–passive immunization is about 90% effective in preventing perinatal transmission of HBV infection,[6,7] we feel that there are compelling arguments to start a screening program. Whether a selective or a universal program would be preferable remains to be evaluated through cost–benefit analysis and assessment of the efficacy of a selective program.

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