Hepatitis B in Wisconsin Male Prisoners: Considerations for Serologic Screening and Vaccination

ROBERT F. ANDA, MD, MS, SCOTT B. PERLMAN, MD, MS, DONN J. D'ALESSIO, MD, JEFFREY P. DAVIS, MD, AND VERNON N. DODSON, MD

Abstract: To develop a protocol for prevention of hepatitis B virus (HBV) transmission in Wisconsin prisons, we interviewed 619 male prisoners at incarceration to obtain information on hepatitis B risk factors. We defined previous infections by the presence of hepatitis B surface antigen (HBsAg), antibody to hepatitis B surface antigen (anti-HBs), or antibody to hepatitis B core antigen (anti-HBc). Logistic regression was used to develop a model of relative risk (RR) of HBV infection. Use of illicit intravenous (IV) drugs was the most important risk factor because of a high prevalence of IV drug use and an RR which ranged from 2.93–7.47. Other important risk factors were: prior hepatitis or jaundice (RR = 6.28), race (RR = 2.54 for Blacks, RR = 3.28 for Latinos), transfusion (RR = 3.00), and age. Previous imprisonment was not an independent risk factor for HBV, hence selective serologic screening and vaccination of prisoners are justified rather than mass screening and vaccination. Based upon prevalence of hepatitis B markers in subgroups, it is necessary to screen prisoners with prior hepatitis or jaundice, prior transfusion, and users of IV drugs. The identification of HBsAg carriers by such screening could prevent infection of "household" contacts. Users of IV drugs who are susceptible to HBV infection should be vaccinated. The remaining prisoners constitute a low-risk group for HBV infection and do not require serologic screening or vaccination. (*Am J Public Health* 1985; 75:1182–1185.)

Introduction

The Immunization Practices Advisory Committee (ACIP) of the Centers for Disease Control has classified male prisoners as an intermediate-risk population for hepatitis B virus (HBV) infection[1] (Table 1) based upon the prevalence of hepatitis B markers among male prisoners.[2–7] Because of this increased prevalence of hepatitis B markers, screening and vaccination for HBV in prisons have been suggested.[1,8]

This study used hepatitis B serology and prisoner interviews to identify high-risk subgroups and investigate previous imprisonment as an HBV risk factor. We developed a protocol for HBV control that will use selective serologic screening and administration of the inactivated HBV vaccine[9–11] to incoming male prisoners.[1]

Methods

Study Participants

Every adult male prisoner entering the Wisconsin state prison system undergoes a medical history, physical examination, and screening for communicable diseases at Dodge Correctional Institution in Waupun, Wisconsin. Between February and August of 1983, 876 male prisoners entered the system. Of these, 646 were examined by two of the authors (Anda and Perlman) and asked to participate in this study; 96 per cent (619/646) consented, 2 per cent (15/646) refused, and 2 per cent (12/646) non-English speaking prisoners were not included because of potential problems with interpreter confidentiality. The remaining 230 men, who were examined by two other physicians and a physician assistant, were not interviewed. Thus, the participants included 70.7 per cent (619/646) of the prisoners entering during the study period.

Data Collection

Interviews—Information obtained from each participant included: demographic characteristics[12] (age, race, city of residence, immigration to the United States including country and year of immigration), education (high school graduate or graduate equivalent, years of college), prior jaundice or diagnosis of hepatitis, prior hepatitis contact (any contact with persons who ever had hepatitis and the type of contact), tattooing (including number of tattoos), prior hospital employment (including job description and duration of employment), transfusion (whole blood or packed red cells), IV drug use (any injection or "shooting up" of illicit drugs, estimate of total number of injections, number of years of drug use), homosexual contact (any contact, number of contacts), current sexual preference, and previous imprisonment (any previous imprisonment, number of months and location of imprisonment).

Laboratory: Blood samples for hepatitis B serologic testing were tested by the Immunology Laboratory, Wisconsin State Laboratory of Hygiene. Radioimmunoassay methods were used to test the samples for HBsAg, anti-HBs and anti-HBc (Ausria II, Ausab, Corab; Abbott Laboratories, North Chicago, Illinois).

Data Analysis

If any of the three serologic markers was present, the participant was classified as marker positive. A participant who had ever used illicit parenterally administered drugs was classified as a user of IV drugs. All variables were entered into a logistic regression, with marker positivity as the dependent variable. The SAS Statistical System [13,14] was used.

Results

Prevalences of HBsAg and marker positivity among the study participants were 1.1 per cent and 19 per cent, respectively. There were 166 users of IV drugs, representing 27 per cent of the study participants, but they accounted for 58 per cent (67/115) of all participants with positive markers. The prevalence of marker positivity was 40 per cent (67/166) among users of IV drugs and 11 per cent (48/453) among non-users of IV drugs.

From the Department of Preventive Medicine, University of Wisconsin, Madison (Anda, Perlman, D'Alessio, Davis and Dodson), and the Bureau of Community Health and Prevention, Wisconsin Division of Health (Davis). Address reprint requests to Robert F. Anda, MD, Division of Disease Surveillance, Michigan Department of Public Health, 3500 N. Logan, Lansing, MI 48909. This paper, submitted to the Journal September 7, 1984, was revised and accepted for publication May 22, 1985.

Editor's Note: See also related editorial p 1134 and article p 1213.

TABLE 1—Expected Hepatitis B Virus (HBV) Prevalence in Various Population Groups

Population Groups	Prevalence of Serologic Markers of HBV Infections	
	% HBsAg	% All Markers
High-risk Groups		
Immigrants/refugees from areas of high HBV endemicity	13	70–85
Clients in institutions for the mentally retarded	10–20	35–80
Users of illicit parenteral drugs	7	60–80
Homosexually active males	6	35–80
Household contacts of HBV carriers	3–6	30–60
Patients of hemodialysis units	3–10	20–80
Intermediate-risk Groups		
Prisoners (male)	1–8	10–80
Staff of institutions for the mentally retarded	1	10–25
Health-care workers (frequent blood contact)	1–2	15–30
Low-risk Groups		
Health-care workers (no or infrequent blood contact)	0.3	3–10
Healthy adults (first-time volunteer blood donors)	0.3	3–5

SOURCE: MMWR 1982; 31:317–328.[1]

The racial distribution of the participants was 58 per cent White, 32 per cent Black, 5 per cent Native American, 4 per cent Latino, and 1 per cent other races. The prevalence of marker positivity was 27.4 per cent for Blacks and 13.2 per cent for Whites (95 per cent C.I. for the difference in proportion positive: .06 − .22).

IV drug abuse, prior hepatitis or jaundice, blood transfusion, hepatitis contact, and previous imprisonment were associated with marker positivity. However, previous imprisonment and hepatitis contact were associated with marker positivity only among users of IV drugs (Table 2).

Age was associated with marker positivity. The mean ages of the marker positive and marker negative groups were 28.2 and 24.8 years respectively (95 per cent C.I. for the difference in ages: 2.0 − 4.6).

Duration of imprisonment was associated with marker positivity only for users of IV drugs. Among users of IV drugs, the mean duration of previous imprisonments for the marker positive and marker negative groups were 38.0 and 19.8 months, respectively (95 per cent C.I. for the difference: 10.2 − 26.2). However, among non-users of IV drugs, the mean duration of imprisonments for the marker positive and marker negative groups were 17.6 and 14.1 months respectively (95 per cent C.I. for the difference: −1.7 − 12.6).

Four per cent of the participants admitted any prior homosexual contact. No participant indicated a current homosexual preference.

TABLE 2—Predictors of the Presence of Hepatitis B Markers* in Wisconsin Male Prisoners

Variable†		N	Proportion Marker Positive	95% Confidence Interval for Difference in Proportion Positive
IV drug abuse	yes	166	.40	(.12, .46)
	no	453	.11	
Prior hepatitis or jaundice	yes	32	.59	(.22, .64)
	no	587	.16	
Prior blood transfusion	yes	46	.46	(.13, .47)
	no	573	.16	
Prior hepatitis contact	yes	120	.32	(0.6, .26)
	no	499	.16	
Previous imprisonment	yes	325	.24	(0.4, .18)
	no	294	.13	

*Positive for HBsAg, anti-HBs, or anti-HBc.
†All variables were also stratified by usage of IV drugs (not shown).

TABLE 3—Multiple Logistic Regression Model for Prediction of Hepatitis B Markers in Wisconsin Male Prisoners

Variable	Relative Risk† Estimates (95% Confidence Interval)
IV drug user	2.93 (1.38–6.23)
IV drug user and previous imprisonment	2.55 (1.16–5.61)
Prior hepatitis or jaundice	6.58 (2.84–15.25)
Prior transfusion	3.17 (1.48–6.79)
Race†	
Black	2.44 (1.44–4.15)
Latino	3.07 (1.06–8.91)
Age	— —
Tattoos (any)	0.53 (0.31–0.92)

†Whites are the referent group.

Multivariate Analysis

The relative risk (RR) of HBV infection was estimated from the logistic regression model (Table 3). Because univariate analysis indicated that the relation between previous imprisonment and marker positivity was affected by use of IV drugs, the model includes an interactive term for use of IV drugs and previous imprisonment. In the model, the RR of HBV infection for users of IV drugs was 2.93 and the RR for the interactive term was 2.55. Thus, a user of IV drugs who had been imprisoned previously had a RR which was 7.47 (2.93 × 2.55) times higher than a non-user of IV drugs.

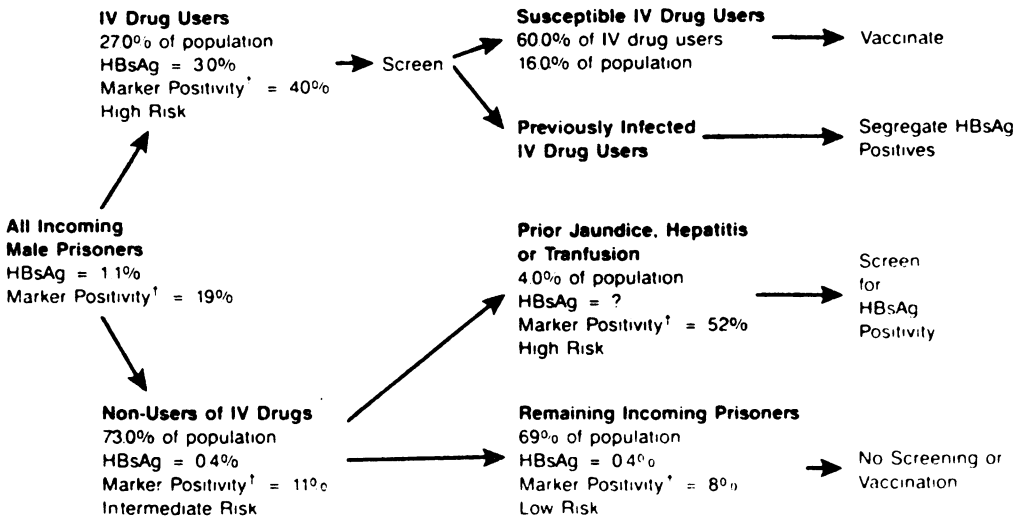
Despite the high RR for prior hepatitis or jaundice and transfusion, these variables were related to only a small proportion of cases. Only 5 per cent (32/619) of the participants reported ever having hepatitis or jaundice, and only 7 per cent (46/619) had received transfusions.

The RR of HBV infection for Latinos and Blacks were 3.28 and 2.54 times greater than for Whites, respectively. Other variables associated with increased risk of HBV infection were: prior hepatitis or jaundice (RR = 6.28), transfusion (RR = 3.00), and age. A decrease in RR was seen for prisoners with tattoos (RR = 0.53).

Discussion

Screening and vaccination of prisoners is justified only if imprisonment is a risk factor for infection with HBV. We investigated the contribution of known risk factors and previous imprisonment to the presence of hepatitis B markers among Wisconsin male prisoners; imprisonment did not independently increase the risk of marker positivity. High-risk subgroups of prisoners were easily identified using known risk factors and can be targeted for serologic screening and vaccination (Figure 1).

Use of illicit IV drugs was the overwhelming contributor to marker positivity among study participants; the strength of the association between previous imprisonment and marker positivity was dependent on IV drug use. Users of IV drugs accounted for 58 per cent of all marker positive persons and their RR of HBV infection was 2.93 or 7.47 times higher than for non-users of IV drugs, depending on previous imprison-



*Based on the prevalence of hepatitis B markers among subgroups of study participants

†Positive for HBsAg anti-HBs or anti-HBc

FIGURE 1—Proposed Scheme for Hepatitis B Screening and Vaccination for Incoming Male Prisoners in Wisconsin*

ment. The suggestion has been made that imprisonment might reduce the risk of hepatitis B infection for users of IV drugs by reducing or eliminating access to drugs, needles, and syringes.[15] However, the limited availability of needles and syringes in prisons may result in their use by multiple persons, increasing the probability of acquiring or transmitting HBV while in prison.

The findings of our survey are similar to a recent survey of Tennessee prisoners by Decker, *et al.*[16] In their sample of 759 male prisoners, 0.9 per cent were HBsAg positive and 29.5 per cent were positive for any HBV marker. Logistic regression analysis of their data showed that the contribution of incarceration to risk of HBV infection did not seem to warrant mass immunization of prisoners.

The prevalence of HBsAg in the general US population has been estimated to be 0.1–0.5 per cent.[1,8,17] Based on our data, serologic screening of IV drug users should reduce the prevalence of unidentified HBsAg positive prisoners to 0.4 per cent (Figure 1). If this is accomplished, a prisoner's risk of infection from an unidentified HBsAg carrier[18,19] would probably not be greater than that of the general US population. Additional screening of prisoners with prior hepatitis, jaundice, or transfusion might identify additional HBsAg positive prisoners (Figure 1).

Prevention of HBV infection in Wisconsin could be accomplished by vaccination of male prisoners who are users of IV drugs to provide immunity for this high-risk group. Prisoners with a history of hepatitis, jaundice, or blood transfusion could be screened to identify HBsAg carriers. The remaining prisoners have a marker prevalence of 8 per cent (34/426) and would not need to be considered for vaccination based upon HBV risk alone (Figure 1).[1,17]

The cost of serologic screening for every male prisoner entering Wisconsin prisons (about 2,500 men/year) followed by immunization of the 81 per cent who are susceptible to HBV would be approximately $270,000/year, based on present costs of screening and vaccination. Our selective protocol would result in the serological screening of approximately 31 per cent of incoming prisoners. Vaccination could then be offered to users of IV drugs who are susceptible to HBV, who represent 16 per cent of incoming prisoners (Figure 1). The cost of the selective program would be approximately $60,000/year, nearly 80 per cent less than the cost of mass screening and vaccination.

ACKNOWLEDGMENTS

We thank Mari Palta, PhD, and Theresa Young, PhD, for their statistical assistance with this research.

REFERENCES

1. Centers for Disease Control, Immunization Practices Advisory Committee: Inactivated hepatitis B virus vaccine. MMWR 1982; 31:317–328.
2. Krotoski WA: Hepatitis in prisoner blood donors. (Letter) N Engl J Med 1972; 286:159.
3. Muniz FJ, Malyska H, Levin WC: Au antigen in blood from prisoners. (Letter) N Engl J Med 1971; 284:502–503.
4. Kliman A: Australia antigen in volunteer and paid blood donors. (Letter) N Engl J Med 1971; 284:109.
5. Watson PG, Watts JR, Nelson M: The incidence of Australia antigen and antibody in male prisoners of two Sydney penitentiaries. Med J Aust 1973; 2:421–423.
6. Koplan JP, Walker JA, Bryan JA: Prevalence of hepatitis B surface antigen and antibody at a state prison in Kansas. J Infect Dis 1978; 137:505–506.
7. Chiaramonte M, Trivello R, Renzulli G, *et al:* Hepatitis B virus in prisons: a seroepidemiological survey in prisoners and attending staff. J Hyg Camb 1982; 89:53–58.
8. Krugman S: The newly licensed hepatitis B vaccine: characteristics and indications for use. JAMA 1982; 247:2012–2015..
9. Szmuness W, Stevens CE, Harley EJ, *et al:* Hepatitis B vaccine: demonstration of efficacy in a controlled clinical trial in a high-risk population in the United States. N Engl J Med 1980; 303:833–841.
10. Francis DP, Hadler SC, Thompson SE, *et al:* The prevention of hepatitis B with vaccine: report of the Centers for Disease Control multi-center efficacy trial among homosexual men. Ann Intern Med 1982; 97:362–366.
11. Chin JC: The use of hepatitis B virus vaccine. N Engl J Med 1982; 307:678–679.
12. Szmuness W, Harley EJ, Ikram H, Stevens C: Sociodemographic aspects

of the epidemiology of hepatitis B. *In:* Viral Hepatitis. Philadelphia: Franklin Institute Press, 1978; 297–320.
13. SAS Institute Inc: SAS User's Guide: Statistics, 1982 Ed. Cary, NC: SAS Institute Inc, 1982.
14. SAS Institute Inc: SAS Supplemental Library User's Guide, 1980 Ed. Cary, NC: SAS Institute Inc, 1980.
15. Kaufman ML, Faiver KL, Harness JK: Hepatitis B markers among Michigan prisoners. (Letter) Ann Intern Med 1983; 98:558.
16. Decker MD, Vaughn WK, Brodie JS, *et al:* Seroepidemiology of hepatitis B in Tennessee prisoners. J Infect Dis 1984; 150:450–459.
17. Maynard JE: Prevention of hepatitis B through the use of vaccine. Ann Intern Med 1982; 97:442–444.
18. Peters CJ, Purcell RH, Lander JJ, Johnson KM: Radioimmunoassay for antibody to hepatitis B surface antigen shows transmission of hepatitis B virus among household contacts. J Infect Dis 1974; 134:218–223.
19. Perrillo RP, Gelb L, Campbell C, *et al:* Hepatitis B e antigen, DNA polymerase activity, and infection of household contacts with hepatitis B virus. Gastroenterology 1979; 76:1319–1325.

17th Century Nun's Prayer

LORD Thou knowest better than I know myself that I am growing older and will someday be old. Keep me from the fatal habit of thinking I must say something on every subject and on every occasion. Release me from craving to straighten out everybody's affairs. Make me thoughtful but not moody; helpful but not bossy. With my vast store of wisdom, it seems a pity not to use it all, but Thou knowest Lord that I want a few friends at the end.

Keep my mind free from the recital of endless details; give me wings to get to the point. Seal my lips on my aches and pains. They are increasing, and love of rehearsing them is becoming sweeter as the years go by. I dare not ask for grace enough to enjoy the tales of others' pains, but help me to endure them with patience.

I dare not ask for improved memory, but for a growing humility and a lessing cocksureness when my memory seems to clash with the memories of others. Teach me the glorious lesson that occasionally I may be mistaken.

Keep me reasonably sweet; I do not want to be a Saint—some of them are so hard to live with—but a sour old person is one of the crowning works of the devil. Give me the ability to see good things in unexpected places, and talents in unexpected people. And, give me, O Lord, the grace to tell them so.

AMEN

—Contributed to the Journal's pages by Sir George Godber.
The title of this prayer is traditional; the source is unknown.