Original Article

Prevalence of antibodies to human immunodeficiency virus (HIV), hepatitis B and hepatitis C and risk factors in prisoners in Lebanon

Ziyad Mahfoud[1], Kassem Kassak[2], Khalil Kreidieh[3], Sarah Shamra[3], Sami Ramia[3]

Departments of [1]Epidemiology and Population Health, [2]Health Management and Policy, [3]Medical Laboratory Sciences, Faculty of Health Sciences, American University of Beirut, Lebanon

Abstract

Background: People admitted to correctional facilities often have a history of risky behaviours which frequently lead to transmission of blood-borne viruses, such as human immunodeficiency virus (HIV), hepatitis B virus (HBV) and hepatitis C virus (HCV). Our aim was to determine the prevalence of HIV, HBV and HCV infections among prisoners in Lebanon.

Methodology: Conducted between August 2007 and February 2008 in Roumieh Prison, Lebanon, the study included a total of 580 male prisoners aged 16 and above who were randomly selected from four prison blocks. Peripheral blood was collected by a finger prick, blotted onto high-quality filter paper, dried and later eluted to be tested for markers of HIV, HBV and HCV infections.

Results: A significantly higher seroprevalence of HBV (2.4%) and HCV (3.4%) was found among prisoners compared to the seroprevalence of these virus infections reported in the general Lebanese population (< 1% for HBV and HCV). Only one of the 580 prisoners tested (0.17%) was confirmed as anti-HIV-positive. The majority (89%) of anti-HCV-positive prisoners had a history of previous imprisonment and were injecting drug users (IDUs). Tattooing was also associated with HCV transmission: all nine anti-HCV-positive prisoners had tattoos compared to only 60% who were anti-HCV-negative. Only HCV genotypes 1 and 3 were detected.

Conclusions: We provide evidence for an outbreak of HCV and HBV occurring in Roumieh prison. In addition to vaccinating prisoners against HBV, collaborations should develop between the prison's administration, academic institutions, and community-based organizations to provide HCV prevention services within the prisons.

Key words: HIV; HBV; HCV; risk factors; prisoners; Lebanon

J Infect Dev Ctries 2010; 4(3):144-149.

(Received 16 September 2009- Accepted 28 February 2010)

Introduction

People admitted to correctional facilities often have a history of injecting drug use, needle-sharing, and high-risk sexual behaviors [1-3]. These risky behaviors frequently continue during incarceration [4-6] and hence lead to a high transmission of blood-born viruses, such as human immunodeficiency virus (HIV), hepatitis B virus (HBV), and hepatitis C virus (HCV) in this group of people [7-9]. Other risk factors identified for the high prevalence of these infections in prisoners include previous imprisonment, tattooing, and the inconsistency of prison health services [10-12]. There is concern over the potential for correctional facilities to serve as a reservoir of the above-mentioned infections in that, once released, inmates could become a source of infection for the general population. Undoubtedly a better knowledge of the prevalence rates of these infections in correctional facilities would help disease prevention and management program planning [13,14].

To the best of our knowledge there is no published data regarding the burden of HIV, HBV and HCV infection among prisoners in Lebanon. Recently HIV and HBV testing was implemented upon prison admission, but there is no policy regarding HCV. The aim of this study, therefore, was to determine the prevalence of HIV, HBV and HCV infections among prisoners in Lebanon and try to identify the risk factors associated with these infections in this specific population.

Materials and methods

Study site

The study was conducted between August 2007 and February 2008 in Roumieh Prison. It is the largest male prison and considered the main prison facility in Lebanon. About 3,500 prisoners are currently incarcerated in Roumieh prison. They are

distributed among four blocks (three buildings and a central area). The cells in these buildings are overcrowded, accommodating 8 to 10 prisoners at a time, whereas the maximum capacity should be 6 to 8 prisoners per cell.

Study population

A total of 580 male prisoners aged 16 and above participated in the study. In the three buildings, participants were randomly selected from the cells. In the central area, prisoners were selected randomly from large rooms that constitute such a central area. The exclusion criteria included prisoners who do not comprehend English or Arabic language, prisoners in the psychiatry unit, violent prisoners, and political prisoners.

Questionnaire

Offered in the colloquial Arabic language and the English language, the questionnaire used in the study was drafted and reviewed by the study team and the members from the collaborating non-governmental organizations (NGOs). The questionnaire covered information related to demographics, sexual history and drug use, in addition to knowledge and attitudes regarding HIV. The questionnaire attempted to explore the prisoners' behaviors before and during incarceration.

Sample collection

Peripheral blood was collected by a finger prick with a single use Lancet and then blotted onto high-quality filter paper (Schleicher & Scheull 903). The blood spots were allowed to air dry to be used as Dried Blood Spots (DBS) for further testing. The DBS samples were sent to the Molecular Biology Research Laboratory at the Faculty of Health Sciences, American University of Beirut (AUB). Between August 2007 and February 2008, DBS samples were collected from 580 prisoners [15].

Elution procedure

For each serological test, one DBS disc was cut and placed in the well of a flat-bottomed uncoated micro plate. The blood was then eluted out in phosphate buffered saline containing 0.05% Tween and 0.005% sodium azide. After 12 to 16 hours of incubation at 2-8°C, the resultant eluates were used for further testing [15].

Anti-HIV type 1 detection and confirmation

Human Immunodeficiency Virus Type 1 (Viral Lysate and *E. coli* Recombinant Antigen) *Genetic System*^{TM} *rLAV EIA* (Bio Rad, USA), licensed to be used on DBS, was used in accordance with the manufacturer's instructions for detection of anti-HIV type 1 by ELISA. Samples that turned out to be positive were confirmed true positive using Calypte HIV-1 BED Incidence EIA (IgG-Capture HIV-EIA) (Calypte Biomedical Corporation) [16].

HBsAg and anti-HBcAg detection

Samples from 250 randomly chosen prisoners were tested for hepatitis B surface antigen and anti-hepatitis B core antigen using modified ELISA protocols for Monolisa HBsAg ULTRA and Monolisa anti-HBc PLUS (Bio Rad).

Anti-HCV detection

Three hundred fifty randomly selected eluates were also tested for anti-HCV by ELISA using a modified protocol for Monalisa Anti-HCV PLUS (Bio Rad). Anti-HCV positive DBS samples were then subjected to RNA extraction for further qualitative HCV detection and genotyping.

RNA extraction

To yield enough quantity of nucleic acid, two DBS discs were cut and placed in 1.5 ml micro tubes and eluted using the same elution procedure previously employed. The resulting eluates were then processed using QIAamp MiniElute Virus Spin (QIAGEN) which is comprised of four steps to ensure pure isolated viral RNA: lyse, bind, wash and elute.

HCV qualitative detection

Cobas Ampliocor Hepatitis C Virus Test, version 2.0 (v2.0) was used for qualitative *in vitro* diagnostic HCV detection in the RNA extracted samples using Cobas Amplicor Analyzer (Roche). The test utilizes reverse transcription of target RNA to generate complementary DNA (cDNA), amplification of target cDNA using HCV specific complementary primers by Polymerase Chain Reaction (PCR), hybridization of the amplified products to oligonucleotide probes that permit independent identification of HCV amplicon, and detection of the probe-bound amplified products by colorimetric determination.

HCV genotyping

Table 1. Prevalence of antibodies to human immunodeficiency virus (anti-HIV), hepatitis B surface antigen (HBsAg), hepatitis B core antigen (HBcAg), antibodies to hepatitis C virus (anti-HCV) in prisoners in Lebanon.

	Prisoners Prevalence Table		
	Total Number Tested	**Negative Samples**	**Positive Samples (%)**
Anti-HIV	580	579	1 (0.17%)
HBsAg	250	244	6 (2.4%)
Anti-HBcAg	250	244	6 (2.4%)
Anti-HCV	350	338	12 (3.43%)
HCV RNA	12	6	6 (50.00%)

Qualitatively positive HCV aliquots of denatured amplicon by Cobas Amplicor were transferred to an appropriate well of the typing tray that contains hybridization buffer and a single LINEAR ARRAY HCV Genotyping strip (LINEAR ARRAY Hepatitis C Virus Genotyping Test - Roche) which is coated with a series of oligonucleotide probes specific for various HCV genotypes. After the hybridization reaction was completed, Streptavidin-Horseradish Peroxidase Conjugate was added to bind to the biotin-labeled amplicon hybridized to the genotype specific oligonucleotide probe on the strip which after several washes catalyzed the oxidation of the 3,3',5,5'-tetramethylbenzidine (TMB) added to form a blue-colored complex that precipitated at the probe position where hybridization occurred. The strip was then read visually by comparing the pattern of blue bands to a reference table of genotype patterns [17].

Ethical considerations

The study protocol was revised and approved by the American University of Beirut Institutional Review Board (IRB) in June 2007. Thorough discussions took place with the collaborating NGO and with the prison authorities to ensure access to all prison facilities. In addition, oral consent was taken from participants upon explaining the study to them and approving their enrollment. Finally, participants' names were not recorded but serial numbers were generated to identify participants for confidentiality. If they so desired, participants were informed of their results by the responsible NGO. Prison authorities did not have access to the questionnaires, blood samples or test results.

Statistical analysis

Descriptive statistics using frequency distributions were computed. Demographic variables as well as risky behaviors were compared between those who were HCV positive and HCV negative using the Wilcoxon rank sum test for continuous variables and Fisher's exact test for categorical variables. Analyses were done using Statistical Package for Social Sciences (SPSS, version 16, Chicago Illinois, USA). Significance was set at the 5% level.

Results

Prevalence of antibodies to HIV, HBV and HCV are summarized in Table 1. Prevalence of antibodies to HCV was the highest (3.4%) followed by HBsAg (2.4%) and HIV (0.17%). HCV genotype 1 was the most predominant genotype (80%) followed by genotype 3 (20%). Comparison between prisoners positive for HCV and those who were anti-HCV-negative showed that the majority of those who were anti-HCV positive were previously imprisoned, had used recreational drugs and injected drugs, and had tattoos (Table 2). Similarly, the majority (66%) of the HBs-Ag positive prisoners reported tattooing outside the prison and 50% of them admitted having anal sex. The fact that these prisoners were from one cell indicated that perhaps high-risk behaviors and homosexuality may contribute to the transmission of HBV among prisoners. The HIV positive person was 26 years old never married with an elementary education. He also was tattooed, had a history of previous imprisonment, and engaged in anal sex and selling anal sex outside the prison. Information on injecting drug for this prisoner was missing.

Discussion

The present study, which is to our knowledge the first in Lebanon on prisoners, provides definite evidence for an outbreak of HCV and HBV occurring in the largest prison in the country. The results showed a significantly higher seroprevalence of HBV (2.4%) and HCV (3.4%) among prisoners compared to the seroprevalence of these virus infections reported in the general Lebanese population (< 1% for HBV and HCV) [18-20]. In contrast, the low prevalence of HIV in our prison population (0.17%)

Table 2. Comparing characteristics and behaviors between anti-HCV positive and anti-HCV negative prisoners in Lebanon.

	HCV positive (N=9)	HCV Negative (N=257)	p-value
Age			
Mean (SD)	32.9 (10.1)	31.7 (9.9)	.72
Range	24-54	17-70	
Lebanese citizen	8 (89%)	210 (82%)	.70
Marital Status			.34
Single	7 (78%)	136 (53%)	
Married	1 (11%)	95 (37%)	
Divorced	1 (11%)	20 (8%)	
Widowed	0 (0%)	6 (2%)	
Previous imprisonment	8 (89%)	122 (48%)	.02*
Behavior outside the prison			
Used recreational drugs	9 (100%)	139 (54%)	.01*
Injecting drug	8 (89%)	30 (12%)	<.01*
Sharing needles†	2 (25%)	10 (33%)	.70
Behavior inside the prison			
Used recreational drugs	2 (22%)	51 (20%)	.99
Injecting drug	0 (0%)	1 (0.4%)	.99
Sharing needles†		0 (0%)	
Tattoo	9 (100%)	154 (60%)	.01*
Tattoo was done in prison	1(11%)	5 (3%)	.29
Ever had sex	9 (100%)	240 (93%)	.99
Ever bought sex	2 (22%)	94 (39%)	.48
Ever had anal sex	1 (11%)	22 (9%)	.57
Ever sold anal sex	0 (0%)	13 (5%)	.99
Anal sex while in prison	0 (0%)	5 (2%)	.99

°Complete information was available on only 266 patients on whom anti-HCV status was known
†Among those who injected drugs
* Significant at the 5% level

is possibly a true reflection of the very low prevalence of HIV infection in the Lebanese population [19]. Our present study supports similar studies done on prisoners in different parts of the world showing that prisoners represent a high-risk group for blood-borne diseases [21-23].

The vast majority (89%) of our anti-HCV-positive prisoners were IDUs which indicates that the significantly higher seroprevalence of HCV among prisoners in Lebanon was most likely due to the higher proportion of individuals with a prior history of injecting drugs. Furthermore, all our anti-HCV-positive prisoners used recreational drugs outside the prison compared to only 54% among those who were anti-HCV negative. The fact that the majority of our anti-HCV-positive prisoners had also a history of previous imprisonment strengthens the observation that return to prison after release is known to be particularly high among drug users, indicating that this group of individuals may be a source of interprisoner transmission of HCV. Although the number of our HCV-RNA samples was small (6 samples), genotyping of the isolates showed that genotypes 1 and 3 were the only genotypes detected, which is in agreement with our recent study on the distribution of HCV genotypes among IDUs (manuscript in preparation). This finding also strengthens the argument mentioned above that this group of individuals could be the source of interprisoner transmission of HCV. Our data showed that all our anti-HCV positive prisoners had tattoos compared to only 60% of anti-HCV-negative individuals, which is in contradiction to a recent study which showed that injecting drug use is the

most likely cause of HCV transmission inside the prison but tattooing was the most likely mode of HCV transmission among non-injectors [22]. In addition to the high-risk behaviors mentioned above, we believe that poor conditions prevailing in the prison, including crowding (leading to sexual activities) and poor hygiene practices such as sharing of unsterile needles for tattooing, may contribute significantly to the transmission of these viruses. It is estimated that the Roumieh prison accommodates at least four times the capacity it was originally designed for.

Different limitations to this study must be considered. First, the study dealt with only one prison but there are other correctional services in the country although they are smaller than the one where the present study was conducted. Second, some inmates may not have responded correctly to parts of the questionnaire relating to drug use, sexual behavior, and history of sexually transmitted diseases although confidentiality was stressed during the explanation of the purpose of the study. Finally, the questionnaire did not address socioeconomic factors such as income and education among others, which generally are good indicators of the low level of awareness of the possible modes of transmission of these viral infections in this group of individuals. In spite of the above-mentioned limitations, the results of this study suggest that activities to prevent transmission of hepatitis in a correctional setting are important and of continuing public health concern, given the impact of infected individuals beyond the prison walls in the communities to which inmates return. The American Advisory Committee on immunization [24] and the Centers for Disease Control and Prevention [25] strongly advise hepatitis B vaccinations for inmates of long-term correctional facilities and IDUs. This recommendation should be applied also in Lebanon and to all prisoners as the risk of HBV exists for both the already incarcerated population and for the newly incarcerated. It is worth mentioning that protective levels of antibody to HBV develop after two doses of the vaccine in 75% of healthy young adults [25]. In addition to vaccination against HBV, collaborations should develop between the prison's administration, academic institutions, and community-based organizations to provide HCV and HIV prevention services within the prisons.

Acknowledgements

This study was funded by the World Bank (WB), Institutional Development Fund (IDF) Grant for Strengthening the National HIV/AIDS Monitoring and Evaluation and Surveillance System in Lebanon, which is managed by the National AIDS Control Programme (NAP), Ministry of Public Health, Lebanon. Special thanks go to Drs. Francica Aya Akala, David Wilson and Sarah Hersey (WB) and Dr. Mostafa El-Nakib (NAP Manager).

The authors would also like to acknowledge the non-governmental organization (NGO) involved in this study (Association de Justice et Misericorde - AJEM), the different National Ministries, Hep Attitude positive (Mr. Nadi Shaaya), and all those who helped in supporting the implementation of the study: Miss Danielle El-Khoury (Study Coordinator), Miss Farah El-Barbir and Miss Maguy Ghanem (Research Assistants), and Ms. Maha Abul Naja (Secretary).

References

1. Liao KF, Lai SW, Chang WL, Hsu NY (2006) Screening for viral hepatitis among male non-drug-abuse prisoners. Scand J Gastoenterol 41: 961-973.
2. Rotily M, Weilandt C, Bird SM, *et al*. (2001)Surveillance of HIV infection and related risk behaviour in European prisons. A multicentre pilot study. Eur J Public Health 11: 243-50.
3. Stark K, Bienzle U, Vonk R, *et al*. (1997) History of syringe sharing in prison and risk of hepatitis B virus, hepatitis C virus, and human immunodeficiency virus infection among injecting drug users in Berlin. Int J Epidemiol 26: 1359-66.
4. Weild AR, Gill ON, Bennett D, et al. (2000) Prevalence of HIV, hepatitis B, and hepatitis C antibodies in prisoners in England and Wales: a national survey. Commun Dis Public Health 3: 121-6.
5. Centers for Disease Control and Prevention (CDC) (2006) HIV transmission among male inmates in a state prison system – Georgia, 1992-2005. MMWR 55: 421-6.
6. Calzavara LM, Burchell AN, Schlossberg J, *et al.* (2003) Prior opiate injection and incarceration history predict injection drug use among inmates. Addiction 98: 1257-65.
7. Centers for Disease Control and Prevention (1996) AIDS associated with injection drug use – United States 1995. MMWR 45: 392-396.
8. Santana Rodriguez OE, Male Gil ML, Herman-dezSantana JF, Liminana Canal JM, Martin Sanchez AM (1998) Prevalence of serologic markers of HBV, HDV, HCV and HIV in non-injection drug users compared to injection drug users in Gran Canaria, Spain. Eur J Epidemiol 14: 555-561.
9. Adjei AA, Armah HB, Gbagbo F, Ampofo WK, Ouaye IKE, Hesse IFA, Mensah G (2006) Prevalence of human immunodeficiency virus, hepatitis B virus, hepatitis C virus and syphilis among prison inmates and officers at Nsawam and Accra, Ghana. J Med Microbiol 55: 593-597.
10. Macalino G, Vlahov D, Sanford-Colby S, Patel S, Sabin K, Salas C, Rich J (2004) Prevalence and incidence of HIV, hepatitis B virus, and Hepatitis C virus infections among males in Rhode Island prisons. Am J Pub Hlth 94: 1218-1223.
11. Adjei A, Armah H, Gbagbo F, Ampofo W, Quaye I, Hesse I and Mensah G (2007) Correlates of hepatitis C virus infection among incarcerated Ghanaians: A national multicenter study. J Med Microbiol 56: 391-397.
12. Vescio M, Longo B, Babudieri S, Starnini G, Carbonara S, Rezza G, Monarca R (2008) Correlates of hepatitis C virus seropositivity in prison inmates: a meta-analysis. J Epidemiol Comm Hlth 62: 305-313.

13. Poulin C, Alary M, Lambert G, Godin G, Landry S, Gagnon H, Demers E, Morarescu E, Rochefort J, Claessens C (2007) Prevlance of HIV and hepatitis C virus infections among inmates of Quebec provincial prisons. CMAJ 177: 252-256.
14. Fox RK, Currie SL, Evans J, Wright TL, Tobler L, Phelps B, Busch MP, Page-Shafer KA (2005) Hepatitis C virus infection among prisoners in the California State Correctional System. CID 41: 177-186.
15. Parker SP, Gubilt WD (1999) The use of the dried blood spot sample in epidemiological studies. J Clin Pathol 52: 633-639.
16. Mc Dougal SJ, Pilcher CD, Parekh BS, Gershy-Damet G, Bronson BM, March K, Wiktor CZ (2005) Surveillance for HIV-1 incidence using tests for recent infection in resource-constrained counties. AIDS 19(suppl): S25-S30.
17. Saldanha J, Lelie N, Heath A, The WHO collaborative study group (1999) Establishment of the first international standard for Nucleic Amplification Technology (NAT) assays for HCV RNA. Vox Sanguinis 76: 149-158.
18. Irani-Hakime N, Tamim H, Samaha H, Almawi WY (2001)Prevalence of antibodies against hepatitis C virus among blood donors in Lebanon, 1997-2000. Clin Lab Hematol 23: 317-323.
19. Ramia S, Klayme S, Naman R (2003) Infection with hepatitis B and C viruses and human retroviruses (HTLV-I and HIV) among high-risk Lebanese patients. Ann Trop Med Parasitol 97: 187-192.
20. Nabulsi MM, El Saleeby CM, Araj GF (2003)The current status of hepatitis B in Lebanon. J Med Leban 51: 64-70.
21. Allwright S, Bradley F, Long J, Barry J, Thornton L and Parry J (2000) Prevalence of antibodies to hepatitis B, hepatitis C and HIV and risk factors in Irish prisoners: results of a national cross sectional survey. BMJ 321: 78-82.
22. Butler T, Kariminia A, Levy M, Kaldor J (2004) Prisoners are at risk for hepatitis C transmission. Europ J Epidemiol 19: 1119-1122.
23. Adjel A, Armah H, Gbagbo F, Ampofo W, Quaye I, Hesse I, Mensah G (2006) Prevalence of human immunodeficiency virus, hepatitis B virus, hepatitis C virus and syphilis among prison inmates and officers at Nsawam and Accra, Ghana. J Med Microbiol 55: 593-597.
24. Centers for disease control and prevention (1982) Recommendation of the Immunization Practices Advisory Committee (ACIP). Inactivated hepatitis B virus vaccine. MMWR 31: 317-322, 327-328.
25. Weinbaum C, Lyerla R, Margolis HS (2003) Centers for disease control and prevention. Prevention and control of infections with hepatitis viruses in correctional settings. MMWR 52 (RR-1):1-36.

Corresponding author

Sami Ramia
Department of Medical Laboratory Sciences
American University of Beirut
Beirut, Lebanon
Tel: 00961-1-350000 - Ext. 4698 - Fax: 00961-1-744470
E-mail: sramia@aub.edu.lb

Conflict of interest: No conflict of interests is declared.