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Emergent predictors of hepatitis C infection among non-injection drug users

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ABSTRACT

Background: Hepatitis C virus (HCV) presents a significant public health issue, especially among high-risk populations, such as truck drivers, prisoners, people living with HIV, people living with tuberculosis, and people who are homeless.
Methods: This cross-sectional study analyzed the data of 1600 individuals recruited from high-risk populations who denied the use of injection drugs and/or history of blood transfusion to better understand on epidemiology of HCV.
Results: The presence of HCV antibodies was independently associated with the following risk factors: age >40 years, tattoo or body piercing, sharing of personal care items, and non-injection drug use.
Conclusions: While the use of injection drugs is a prevalent mode of HCV transmission, the findings of this study indicate additional routes that lead to viral transmission among vulnerable populations. Since an HCV vaccine is not currently available, public health and education programs should be developed that specifically target high-risk populations to prevent infection acquisition and secondary transmission.

Introduction

Hepatitis C virus (HCV) presents a significant public health problem. Currently, there is an estimated 150 million carriers of chronic HCV and more than 350,000 deaths each year are attributed to HCV-related hepatic diseases such as chronic hepatitis, cirrhosis, and hepatocellular carcinoma [1]. In Brazil, a prevalence of 1.38% is estimated for HCV [2]. Between 2000 and 2015, this virus was the cause of 46,314 deaths [3].

HCV is predominantly transmitted via the parenteral route, primarily with direct exposure to blood and/or derivatives. Until the early 1990s, blood transfusion was the main mode of HCV dissemination. However, with the introduction of serological screening techniques for HCV antibodies (anti-HCV) and the more recent finding of HCV RNA in blood bank specimens in several countries, viral exposure through blood transfusion has been drastically reduced. Today, most cases of HCV are associated with sharing syringes and contaminated needles, therefore, injection drug users are considered to be the principal carriers of the viral agent [4]. However, studies involving non-injection drug users have shown a higher prevalence of HCV in this group than that of the general population [5–9]. In addition, other predictors of HCV infection, such as invasive medical procedures, tattooing/body piercing, and sharing sharp personal care objects, seem to increase the risk of virus transmission [10,11].

In recent years, new therapeutic approaches have rendered chronic HCV treatable, with reversal of liver disease [4]. With the availability of these new drugs, HCV could be eliminated within the next 15–20 years. Yet, this would require a collaborative effort of improving screening techniques, treating existing cases, and preventing new infections [12].

Since 2005, our research group has investigated HCV epidemiology among vulnerable populations at increased risk for acquisition and transmission. These populations include truck drivers, prisoners, people living with tuberculosis (PLWT), people living with HIV (PLWH), and people who are homeless. Therefore, the aim of this investigation was to analyze predictors of HCV infection among subjects recruited from high-risk populations of our previous studies who denied the use of injection drugs and/or history of

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Table 1
Risk factors associated with hepatitis C among 1600 individuals who denied previous blood transfusion and/or injection illicit drug use.

Variable	HCV				*p* Value	Adjusted OR[a] (CI: 95%)[b]
	Pos.	%	Neg.	%		
Age						
≤40 years	12	1.3	893	98.7		
>40 years	22	3.2	673	96.8	0.011	57.45 (9.40–356.03)
Years of formal education						
>9	8	1.8	441	98.2		
6–9	11	1.8	609	98.2		
<6	15	2.8	513	97.2	0.383	
Sex (%)						
Female	6	1.6	368	98.4		
Male	28	2.3	1198	97.7	0.425	
Tattooing/piercing (%)						
No	22	1.8	1212	98.2		
Yes	12	3.3	349	96.7	0.07	6.96 (1.51–32.20)
Non-injection drug use (%)						
No	15	1.5	963	98.5		
Yes	19	4.2	435	95.8	0.002	44.85 (8.67–231.96)
Sharing of personal item (%)						
No	17	1.7	1000	98.3		
Yes	16	2.8	553	97.2	0.127	4.12 (1.25–13.62)
Previous prison (%)						
No	22	1.8	1173	98.2		
Yes	12	3.0	389	97.0	0.167	1.56 (0.37–6.56)
Sex with the same sex (%)						
No	28	2.0	1356	98.0		
Yes	6	3.1	189	96.9	0.343	
Number of sexual partners						
≤5	13	1.6	804	98.4		
>5	20	2.7	728	97.3	0.136	0.72 (0.60–1.25)
Condom use (%)						
Always	6	2.1	279	97.9		
Sometimes	19	2.6	717	9.4		
Never	9	1.8	486	98.2	0.665	
Previous STI (%)[c]						
No	18	1.7	1012	98.3		
Yes	13	2.5	500	97.5	0.300	
Anti-HBc positivity (%)						
No	15	1.1	1301	98.9		
Yes	19	6.7	265	93.3	<0.0001	18.58 (4.74–72.79)

[a] Adjusted OR: Adjusted Odds Ratio.
[b] (CI 95%): (Confidence interval of 95%).
[c] STI: sexually transmitted infection.

blood transfusion in an attempt to further elucidate the complex epidemiology of HCV.

Methods

A secondary analysis was conducted using cross-sectional data collected between October 2005 and August 2015. Individuals were recruited from different settings, as previously described [13–16]. Initially, data on 2077 individuals were collected, and 641 were truck drivers, 150 were female prisoners, 505 were PLWH, 425 were PLWT, and 356 were homeless. Out of these individuals, only data from subjects who denied the use of injection drug use and/or history of blood transfusion were analyzed. In total, the study included the data for 1600 individuals.

The primary study outcome was for a positive HCV antibody (anti-HCV) test result. The following variables were common in the previous five investigations: sex, age, color, time of education, sex with the same sex, presence of tattoos/piercings, sharing of personal care items (toothbrush, cuticle scissors, etc.), previous imprisonment, non-injection drug use, condom use, previous sexually transmitted infections (STI), and positive for hepatitis B antibodies (anti-HBc).

All participant samples were tested for anti-HCV using enzyme-linked immunosorbent assay (ELISA) using commercial kits. Samples that were reactive to anti-HCV were retested using a confirmatory assay. All tests were performed at the Laboratory of Virology, Institute of Tropical Pathology and Public Health, Federal University of Goiás, Brazil (Instituto de Patologia Tropical e Saúde Pública, Universidade Federal de Goiás, Brazil).

The chi-square test or Fisher's exact test (two-tailed) was used for categorical data. For all tests, a p value <0.05 was considered statistically significant. Logistic Binary regression analysis was used to determine risk factors associated with HCV infection. Variables with a p value ≤0.20 were included in the multivariate model, adjusted by population. Analyses were performed with the statistical software SPSS. All analyses were two-sided.

This study was analyzed and approved by the Committee on Ethics in Human Research of the Federal University of Goiás, case CEP/UFG no. 1.518.667.

Results

Of the initial 2077 individuals recruited for this study, 1600 (77%) denied injection drug use and/or previous blood transfusion. Of these individuals, 578 were truck drivers, 113 were female prisoners, 396 were PLWH, 259 were PWT, and 254 were homeless. Results indicated that 34 of these individuals were positive for anti-HCV; yet, potential risk factors for HCV were analyzed in these vulnerable populations as a whole.

Table 1 presents the univariate and multivariate analyses of potential risk factors for positive anti-HCV test results. The presence of anti-HCV was statistically associated with the following risk factors: age >40 years, non-injection drug use, and HBV exposure ($p < 0.05$). These variables and those with a p value ≤ 0.20 were included in the logistic regression model. According to the model, the presence of anti-HCV was independently associated with the following risk factors: age >40 years (OR: 57.45; 95% CI: 9.40–356.03), tattoos/piercings (OR: 6.96; 95% CI: 1.51–32.20), sharing of personal care items (OR: 4.12; 95% CI: 1.25–13.62), non-injection drug use (OR: 44.85; 95% CI: 8.67–231.96), and positive for anti-HBc (OR: 18.58; 95% CI: 4.74–72.79).

Discussion

The information on non-use of injection drugs and previous blood transfusion were parameters based only on self-reported data, therefore susceptible to response or memory bias, respectively. Concerning injection drug use, many people may be recalcitrant to assume these types of drugs are considered more dangerous. Despite these limitations, the findings of the study are an important contribution to understanding the epidemiology of HCV dissemination in absence of reports of classical risk factors.

In this investigated on, age >40 years remained a predictor of HCV exposure, despite the participants denied injection drug use and previous blood transfusion. Thus, even with the present study's design limitations, a reasonable speculation can be made that individuals who are 40-years-old or older have had more opportunities for HCV exposure within their social network.

The study revealed a strict correlation between non-injection drug use and HCV. Although the type, dose volume, and time of use could not be identified for the non-injection drugs, the data supports the behavior's association with HCV dissemination. Most individuals who consume illicit drugs often share paraphernalia used to snort and/or smoke the substance, and HCV RNA has been detected in pipes, nasal secretions, and snorting apparatuses [17,18]. Further, HCV can survive on environmental surfaces for up to 16 h [19], and individuals under the influence of illicit drugs may lose their risk perception and engage in sexual and dangerous behaviors that increase their chance of HCV exposure [20].

This study showed that individuals who had tattoos/body piercings had a risk for HCV infection that was seven times higher than those who did not have tattoos/body piercings. A meta-analysis of observational studies conducted by Thome and Holmberg [10] presented no evidence of an increased risk of HCV infection when tattoos and piercings were done by professionals. Conversely, if the tattoos or piercings were applied in prison setting or by friends in impromptu settings, these practices were predictors of HCV infection among high-risk groups. However, sexual behavior was not shown to be associated with positive anti-HCV test results, supporting the assumption that HCV has a low risk of sexual dissemination.

Similar to the results of other studies [15,21], this investigation found a strict correlation between positive anti-HCV test results and the sharing of personal care items, such toothbrushes, razor blades, and other cutting instruments. These items can cause microtraumas on the skin or mucosa and can be contaminated with blood from an HCV carrier, which can then be transferred to a susceptible individual, putting them at risk for viral exposure. Many people without other risk factors can be exposed in this way, reinforcing the necessity of educating the population on possible forms of viral dissemination.

Hepatitis B virus and hepatitis C virus are globally disseminated, and both infections are hepatotropic, cause chronic liver disease, and share common modes of transmission [1]. Therefore, this study's finding of a strict association between anti-HCV and anti-HBc positive test results was expected.

Conclusions

In conclusion, variables related to potential blood exposure, such as tattooing, body piercing, sharing of personal items, such as toothbrushes and cuticle scissors, and non-injection drug use were predictors of anti-HCV infection. Thus, despite the limitations of the study design and large amplitude of the confidence interval, the sample size employed was sufficient to detect emergent predictors of HCV infection among non-injection drug users and people who had never had a blood transfusion, thereby supporting the notion that HCV can be transmitted through other vehicles of dissemination. Since an HCV vaccine is not currently available, public health and education programs should be developed that specifically target high-risk populations to prevent infection acquisition and secondary transmission.

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Competing interests

None declared.

Ethical approval

All procedures performed in the studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed consent

Informed consent was obtained from all individual participants included in the study.

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