

## HCV INFECTION THROUGH PERFORATING AND CUTTING MATERIAL AMONG CANDIDATES FOR BLOOD DONATION IN BELÉM, BRAZILIAN AMAZON

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### SUMMARY

This study evaluated epidemiological factors for HCV infection associated with sharing perforating and cutting instruments among candidates for blood donation (CBD) in the city of Belém, Pará, Brazilian Amazon. Two definitions of HCV infection cases were used: anti-HCV positivity shown by EIA, and HCV-RNA detection by PCR. Infected and uninfected CBD completed a questionnaire about possible risk factors associated with sharing perforating and cutting instruments. The information was evaluated using simple and multiple logistic regressions. Between May and November 2010, 146 (1.1%) persons with anti-HCV antibodies and 106 (0.8%) with HCV-RNA were detected among 13,772 CBD in Belém. Risk factors associated with HCV infection based on the EIA (model 1) and PCR (model 2) results were: use of needles and syringes sterilized at home; shared use of razors at home, sharing of disposable razors in barbershops, beauty salons etc.; and sharing manicure and pedicure material. The models of HCV infection associated with sharing perforating and cutting instruments should be taken into account by local and regional health authorities and by those of other countries with similar cultural practices, in order to provide useful information to guide political and public strategies to control HCV transmission.

**KEYWORDS:** HCV infection; Blood donation; Risk factor; Brazilian Amazon.

### INTRODUCTION

Hepatitis C virus (HCV) infection causes serious and chronic liver disease that may progress to cirrhosis of the liver and hepatocellular carcinoma. More than 170 million people are currently infected with HCV; most cases are asymptomatic and the victims are unaware that they have a viral infection<sup>2</sup>. Seroprevalence for HCV ranges from less than 2% (Germany, India and France) to high rates (> 10%) in parts of Africa, Asia and Europe<sup>18</sup>. In South America, Brazil is estimated to have the highest HCV seroprevalence (1.6%), which varies across different geographical regions<sup>10</sup>. The Brazilian Amazon region has the highest HCV seroprevalence (2.1%), with a high frequency of genotype 1<sup>10,20</sup>.

HCV is primarily transmitted via parenteral routes. Blood transfusions without previous HCV screening, and reuse and sharing of gloves, syringes and other material that can become contaminated are the most commonly documented routes of HCV infection<sup>1,17</sup>. Other routes of HCV infection have been reported, such as sexual and mother-to-child, but less frequently<sup>12,21</sup>. After HCV screening tests were added to the routine protocols of blood centers, and blood donors were screened clinically and epidemiologically based on knowledge of HCV transmission, the rate of post-transfusion hepatitis was significantly reduced<sup>17</sup>. However, some cases of post-transfusion hepatitis C continue to be reported, because of the 4-20-week immunological window of HCV<sup>6</sup>. Even with current

knowledge of the various forms of HCV transmission, about 20% of cases are of unknown origin<sup>2,17</sup>.

Detection and treatment of HCV-infected patients are essential public-health measures for containing viral transmission. Public awareness about the risks of specific actions also significantly contributes to reducing prevalence and to the prevention of new infections<sup>9</sup>. In the Brazilian Amazon, there have been very few epidemiological studies of HCV infection, although reports of clinical cases of hepatitis or pathologies associated with HCV infection are frequent<sup>15,16,20,22</sup>. Epidemiological studies of blood donors in the Brazilian Amazon have detected a high frequency of genotype 1 and the following risk factors for HCV infection: use of sterilized needles and syringes at home, invasive dental treatment, shared use of razors at home, sharing of disposable razors in barbershops and beauty salons, and sharing manicure and pedicure equipment<sup>13,14,16</sup>. Therefore, in order to evaluate possible risk factors for HCV infection in candidates for blood donors in the state of Pará, this study examined epidemiological factors for HCV infection associated with sharing perforating and cutting instruments among candidates for blood donation in the city of Belém, Pará, Brazilian Amazon.

### MATERIALS AND METHODS

This epidemiological study was composed of candidates for

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blood donation (HCV-infected and uninfected) seen at the Centro de Hematologia e Hemoterapia do Pará (HEMOPA) in the city of Belém, Brazilian state of Pará, Amazon. The candidates for blood donation were selected for blood collection in the hematology and hemotherapy unit and blood donation campaigns conducted in public and private institutions in Belém, from May - November 2010. As is mandated by Brazilian law, all blood donations obtained at the HEMOPA were voluntary, anonymous, altruistic, and unremunerated, either directly or indirectly<sup>5</sup>. The Research and Ethics Committee of the Centro de Hematologia e Hemoterapia do Pará reviewed and approved the study.

Blood (5 mL) was collected in plain tubes, allowed to clot, and centrifuged at room temperature. The sera were then tested for the presence of anti-HCV antibodies by enzyme immunoassay (EIA). The Murex anti-HCV version 4.0 (Murex Biotech SA, Kyalami, South Africa) was used to measure anti-HCV antibody levels. Nonreactive samples were considered negative for HCV infection. Reactive samples by EIA were submitted to RNA extraction, reverse transcription, and real-time polymerase chain reaction (PCR) with primers complementary to the conserved area of the 5' untranslated region (UTR) of HCV<sup>13</sup>.

During the process of blood donation the application of epidemiology questionnaire was held in order to obtain information about possible risk factors for HCV infection. This instrument for information collection was previously tested in an epidemiological study of HCV infection among blood donors<sup>14</sup>. This questionnaire included questions about age, use of home-sterilized needles and syringes (exclusively for the use of medications, not for the use of illicit drugs), invasive dental treatment (root canal and surgical tartar removal), shared use of razors at home, shared use of disposable razors in public places (beauty salons,

barbershops, etc.), and sharing manicure and pedicure material. Simple and multiple logistic regressions were done to assess the independent effect of variables, as described elsewhere<sup>14</sup>. The fit of the final model was assessed using the Hosmer-Lemeshow goodness-of-fit test. Risk factors listed by multiple logistic regression were quantified and evaluated by the chi-square test, with expected equal proportions as the criterion to distinguish between infected and uninfected groups. Two definitions of HCV infection cases were used: (i) anti-HCV positivity shown by EIA, and (ii) HCV-RNA detection by real-time PCR. All statistical analyses were carried out using IBM SPSS version 18.0.

## RESULTS

Between May and November 2010, the HEMOPA attended to 13,772 candidates for blood donation in Belém, Brazilian Amazon. One hundred and forty-six (1.1%) candidates for blood donation were positive for anti-HCV antibodies, and 13,626 were negative for anti-HCV antibodies. One hundred and six (72.6%) of these 146 had HCV-RNA detected by PCR. The majority of candidates for blood donation were male (77.9%), single (40.0%), aged between 30-39 years (30.1%), and had not completed high school (35.0%). Table 1 shows the characteristics of candidates for blood donation in this study.

Moreover, the statistical modeling of this study was conducted with groups containing the same number of candidates for blood donation. Information from 146 candidates for blood donation not infected by HCV (anti-HCV antibody-negative and HCV RNA-negative) was randomly selected among 13,626 candidates. This procedure was adopted in order to avoid statistical bias due to sample n being significantly larger than one group. Thus, age appeared to be a risk factor for infection with HCV. In

**Table 1**  
Profile of candidates for blood donation seen at the HEMOPA in the city of Belém, Pará, Brazilian Amazon

Variables	Candidates for blood donation			
	Anti-HCV+ (n=146)	Anti-HCV- (n=13,626)	Total (n=13,772)	
Gender	Female	47	2,998	3,045
	Male	99	10,628	10,727
Marital status	Married	55	5,042	5,097
	Single	61	5,450	5,511
	Not declared	29	3,134	3,163
Schooling	Incomplete elementary school	19	1,497	1,516
	Concluded elementary school	39	3,543	3,582
	Incomplete high school	47	4,769	4,816
	Concluded high school	29	2,453	2,482
	Incompleted/completed undergraduate studies	12	1,364	1,376
Age	18-22 years old	10	2,861	2,871
	23-29 years old	20	3,407	3,427
	30-39 years old	61	4,088	4,149
	40-49 years old	46	2,861	2,907
	50-60 years old	9	409	418

the infected candidates group, the median age was 38.5 years, whereas it was 31.5 years in the uninfected candidates. Candidates for blood donation over 35 years of age were significantly more likely to be infected than those under 35 (Table 2). Using univariate analysis, several variables associated with HCV infection were identified: age > 35 years, use of home-sterilized needles and syringes, shared use of razors at home, and shared use of disposable razors in public places (Table 2). However, the risk factors for HCV infection only became clearer after multiple logistic regression analysis. Risk factors for HCV infection among candidates for blood donation were: use of home-sterilized needles and syringes, shared use of razors at home, and shared use of disposable razors in public places (Table 3). The Hosmer-Lemeshow goodness-of-fit test showed a good fit for the final model 1 ( $\chi^2_{HL} = 5.1; p = 0.4$ ) and model 2 ( $\chi^2_{HL} = 4.4, p = 0.5$ ).

The results provided by EIA (model 1) indicated that 69.2% of the candidates for blood donation infected with HCV had 3 or 4 risk factors. The results provided by PCR (model 2) indicated that 83.0% of the candidates for blood donation infected with HCV also had 3 or 4 risk factors. On the other hand, 81.5% of the uninfected candidates for blood donation (anti-HCV antibody-negative and HCV RNA-negative) had 0-2 risk factors, based on multiple logistic regression. Most of the candidates for blood donation had three or more risk factors (model 1:  $\chi^2 = 21.5; p < 0.01$ ; model 2:  $\chi^2 = 46.2; p < 0.01$ ).

## DISCUSSION

Timely transfusion of blood saves millions of lives, but unsafe

**Table 2**  
Epidemiological factors associated with HCV infection among blood donors in Belém, Brazilian Amazon

Epidemiological factors	N	Anti-HCV+ n (%) <sup>a</sup>	OR (CI 95%)	HCV-RNA+ n (%) <sup>a</sup>	OR (CI 95%)
<b>Age</b>					
> 35 years	151	116 (76.8)	12.3 (7.1 - 21.3)	86 (57.0)	8.0 (4.5 - 14.2)
≤ 35 years	141	30 (21.3)		20 (14.2)	
<b>Use of home-sterilized needles and syringes</b>					
Yes	80	70 (87.5)	12.6 (6.1 - 25.7)	65 (81.3)	18.1 (9.4 - 33.2)
No	212	76 (35.8)		41 (19.3)	
<b>Invasive dental treatment</b>					
Yes	102	48 (47.1)	0.8 (0.5 - 1.4)	40 (39.2)	1.2 (0.7 - 2.0)
No	190	98 (51.6)		66 (34.7)	
<b>Shared use of razors at home</b>					
Yes	107	71 (66.4)	2.9 (1.8 - 4.8)	63 (58.9)	4.7 (2.8 - 7.9)
No	185	75 (40.5)		43 (23.2)	
<b>Shared use of disposable razors in public places</b>					
Yes	181	112 (61.9)	3.7 (2.2 - 6.1)	83 (45.9)	3.2 (1.9 - 5.6)
No	111	34 (30.6)		23 (20.7)	
<b>Sharing manicure and pedicure material</b>					
Yes	153	106 (69.3)	5.6 (3.4 - 9.2)	87 (56.9)	8.3 (4.7 - 14.9)
No	139	40 (28.8)		19 (13.7)	

<sup>a</sup>Percentage of HCV-positive donors within a category in parentheses.

**Table 3**  
Risk factors associated with HCV infection based on EIA (model 1) and PCR (model 2) results

Risk factors	Model 1		Model 2	
	OR (CI 95%)	p	OR (CI 95%)	p
Use of home-sterilized needles and syringes	8.3 (4.6 - 12.2)	<0.01	10.3 (3.9 - 19.7)	<0.01
Shared use of razors at home	1.8 (1.1 - 3.0)	0.03	2.6 (1.5 - 3.9)	0.01
Shared use of disposable razors in public places	2.1 (1.2 - 3.3)	0.01	1.9 (1.1 - 2.9)	0.01
Sharing manicure and pedicure material	3.9 (2.1 - 5.7)	0.02	5.1 (2.6 - 7.8)	0.01

transfusion practices place millions of people at risk of transfusion-transmissible infections such as HCV and HIV<sup>4</sup>. Donor selection begins with education of the public about transfusion-transmissible diseases. Each potential donor is given an information pamphlet explaining the risk factors for viral transmission, the inability of current testing to eliminate all possibility of disease transmission, and the inadvisability of donating simply to undergo testing for infectious disease. After reading the information pamphlet, donors complete a standardized questionnaire. The questionnaire is designed to protect potential donors who may be at risk of an adverse consequence of blood donation, and to increase the safety of the recipients, such as patients with chronic hematologic disease<sup>6</sup>. Four risk factors for HCV infection associated with the sharing of sharps and perforators were identified in this study. However, none of the factors are used during donor selection by blood banks in the Brazilian Amazon. It is likely that a candidate for blood donation, newly infected with HCV through the sharing of sharp and piercing instruments, may be considered fit to donate blood, and therefore blood infected with HCV will be transfused. Although the risk is low, HCV transmission could therefore occur. Some studies in the Brazilian Amazon have suggested the possibility of transmission of HCV associated with sharing perforating and cutting instruments<sup>14,16</sup>. The risk of HCV infection is also apparent from the distribution and frequency of the viral genotypes between blood donors and multitransfused patients in Pará. The high frequency of genotype 1 in blood donors led to a complete dominance of genotype 1 in multitransfused patients, which was probably transferred by blood/blood product transfusion<sup>20</sup>.

The epidemiological factors examined in this study are parenteral procedures that can be avoided if the population is aware of the risks of transmitting microorganisms. Shaving or trimming nails can generate trauma or microtrauma on the skin surface, resulting in exposure to HCV on blades or nail scissors contaminated by asymptomatic infected family members or other people who are unknowingly infected and who frequent barbershops and beauty salons. In Brazil, Italy, Pakistan and Nigeria, HCV transmission by sharing razor blades and other cutting instruments, as well as other forms of viral dissemination due to a lack of public awareness, have been reported as risk factors for infection<sup>3,8,11,14,16</sup>.

The detection and treatment of HCV-infected patients are essential public-health measures for containing viral transmission. However, increasing public awareness about the risks of specific actions also significantly contributes to reducing prevalence and to the prevention of new infections<sup>9</sup>. In Brazil, disposable perforating and cutting materials for health procedures began to be used on a large scale during the second half of the 1980s. This situation, together with a lack of knowledge about HCV transmission, likely accounts for infection being more common among persons over 35 years, since transmission could have occurred through sharing of inadequately sterilized syringes and needles in homes with individuals who were asymptomatic and unaware that they were infected. Administering injectable medication without adequately sterilizing syringes or needles has been the main cause of HCV transmission worldwide, especially in developing countries<sup>2,7,19</sup>. The final models of HCV infection based on multiple logistic regression showed that the analyzed variables should be taken into account by local and regional health authorities and by those of other countries with cultural practices similar to the population in the Brazilian Amazon, in order to provide useful information to develop political and public strategies to control HCV infection.

This study determined risk factors for HCV infection associated with sharing perforating and cutting instruments among candidates for blood donation in the city of Belém, Brazilian Amazon. The results serve to alert health authorities about the risk that these epidemiological factors may represent for the maintenance of HCV transmission, especially through blood transfusion.

## RESUMO

### **Infecção pelo HCV através de materiais cortantes e perfurantes entre candidatos à doação de sangue em Belém, Amazônia Brasileira**

Este estudo avaliou fatores epidemiológicos para infecção pelo HCV associados ao compartilhamento de instrumentos cortantes e perfurantes em candidatos à doação de sangue (CDS) na cidade de Belém, Pará, Amazônia Brasileira. Duas definições de infecção pelo HCV foram utilizadas: positividade por anti-HCV detectada por EIA, e HCV-RNA detectado por PCR. CDS infectados e não-infectados preencheram questionário sobre possíveis fatores de risco associados com o compartilhamento de instrumentos cortantes e perfurantes. As informações foram avaliadas usando regressão logística simples e múltipla. Entre maio e novembro de 2010, 146 (1,1%) indivíduos com anticorpos anti-HCV e 106 (0,8%) com HCV-RNA foram detectadas entre 13.772 CDS em Belém. Os fatores de risco associados à infecção pelo HCV baseado em resultados de EIA (modelo 1) e PCR (modelo 2) foram: uso de agulhas e seringas esterilizadas em casa, uso compartilhado de lâminas em casa, compartilhamento de lâminas em barbearias, salões de beleza, etc., e compartilhamento de material de manicure e pedicure. Os modelos de infecção pelo HCV associados com o compartilhamento de instrumentos cortantes e perfurantes devem ser considerados pelas autoridades de saúde local e regional e de países com práticas culturais semelhantes, a fim de fornecer informações úteis para direcionar estratégias e políticas públicas de controle da transmissão do HCV.

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## CONFLICT OF INTEREST

All authors declare that they have no conflict of interest.

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