Luiz Alberto de Souza Ciorlia[I]

Dirce Maria Trevisan Zanetta[II]

Hepatitis C in health care professionals: prevalence and association with risk factors

ABSTRACT

OBJECTIVE: To evaluate the prevalence and risk factors for hepatitis C virus infection among health care professionals.

METHODS: The study was carried out at a university hospital in the municipality of São José do Rio Preto, Southeastern Brazil, between January 1994 and December 1999. There were included 1,433 health care professionals, 872 administrative workers, and 2,583 blood donor candidates. Data were collected during admission examinations, periodic screenings, and after occupational accidents. Occupational and non-occupational information was obtained by means of a questionnaire. Data were analyzed using Chi-square and Kruskal-Wallis tests and logistic regression analysis.

RESULTS: Prevalence of hepatitis C infection among health care professionals (1.7%) was significantly higher than among administrative workers (0.5%; p=0.007) and blood donor candidates (0.2%; p=0.001). Regarding occupational factors, time in the job was significantly longer (p=0.016) among health care professionals with positive serology than among those with negative serology. Multiple regression analysis showed a 50% increase in risk for every five years of age. There was a significant association between blood transfusion and positive serology among health care workers.

CONCLUSIONS: Health care professionals show greater prevalence of hepatitis C than administrative workers and blood donation candidates. Among those with positive serology, occupational and non-occupational factors of greatest risk were age, time in the job, and blood transfusion.

KEYWORDS: Hepatitis C, epidemiology. Health personnel. Risk factors. Occupational risks. Seroepidemiologic studies. Cross-sectional studies.

INTRODUCTION

Hepatitis C is an important public health problem worldwide, not only due to the large number of individuals infected with the Hepatitis C virus (HCV). A considerable proportion of these individuals is informed of his or her disease status only when donating blood, which makes them an important link in the viral transmission chain, thereby perpetuating the disease. Over 180 million people globally are chronic carriers of HCV, 2 million of which are in Brazil.

HCV infection is universally distributed, and can be transmitted both sexually and from mother to child.[16] High prevalence is associated with the so-called "risk groups" – including hemophiliacs, hemoldiayzed patients, multiply transfused patients, and drug addicts.[4]

The epidemiological profile of HCV infection is as complex as the natural history of the disease caused by this viral agent. Present in blood in low titers,

[I] Serviço de Medicina Ocupacional. Faculdade de Medicina de São José do Rio Preto (Famerp). São José do Rio Preto, SP, Brasil

[II] Departamento de Epidemiologia e Saúde Coletiva. Famerp. São José do Rio Preto, SP, Brasil

Correspondence:
Luiz Alberto de Souza Ciorlia
Rua Santo Agostinho, 281
15025-220 São José do Rio Preto, SP, Brasil
E-mail: ciorliampo@yahoo.com.br

Received: 16/8/2005
Reviewed: 26/5/2006
Approved:29/11/2006

the major mechanisms of transmission are infected blood and blood products.

In the United States, prospective studies conducted by the National Institutes of Health[1] show a decrease in HCV infection following the introduction of anti-HCV testing. According to a study by Chiaramonte,[6] the risk of infection by blood transfusion is currently 1:103,000 – i.e., almost null – very different from what was seen between 1960 and 1991. In Brazil, the distribution of incidence and prevalence of HCV is not known. Infection is known to be predominant among young adults, and susceptibility seems to be general. Recent studies have identified that 75% of individuals with HCV were infected by the parenteral route, and that infection may be apparent, unapparent, direct, or indirect.[7] HCV transmission by the unapparent direct parenteral route is likely to be related to the familial environment. On the other hand, parenteral unapparent indirect transmission may be related to contact with instruments of personal use or to the use of tools or instruments contaminated with infected blood.*

The concern about biological hazards began with the realization that professionals who worked in laboratories where microorganisms were manipulated were at greater risk of infection. However, only with the onset of the AIDS epidemic in the 1980's did security norms for the work environment become firmly established.[22] On the other hand, the risk of transmission of HCV after a needlestick injury can be up to 10 times greater than that of HIV, and, in contrast to the latter, post-exposure preventive measures are unavailable for HCV.[10,14,20]

Although small in number, cases of infection by percutaneous exposure have been documented,[11] including infection through contamination of the conjunctiva with blood.[21] The rate of transmission of Hepatitis C after occupational exposure ranges from 0 to 10%.[18,23]

Risk factors for occupational transmission are still poorly defined. There is also, to this date, no information on the survival of HCV virions in any given environment.

The occurrence of HCV among health care professionals ranges from 2% to 10%, and risk of infection is correlated with time in the job, performing invasive procedures, and history of percutaneous accidents. Such variation in incidence may be related to the method used for diagnosis, especially after accidents involving HCV-positive patients.[18]

The aim of the present study was to explore the magnitude of HCV infection and determine its prevalence among health care professionals, as well as to investigate potential risk factors for infection, including blood transfusions, parenteral substance use, accidents with biological material, and others.

METHODS

The study sample comprised different categories of professionals working in a teaching hospital in São José do Rio Preto, in the state of São Paulo, Southeastern Brazil, and blood donor candidates from the same city. This is a medium-sized hospital, comprising 554 beds.

Between January 1994 and December 1999, 1,444 health professionals worked in the hospital. These professionals either had direct contact with, or manipulated objects used by, patients and worked in areas of disease diagnosis and patient accommodation. Professionals on leave due to disease (N=11) were excluded from the sample, totaling 1,433 subjects.

For comparison of the prevalence of HCV infection, we used two control groups. The first consisted of employees of the hospital's administrative area (N=872), who had no contact with patients, or with material used by them. The second group comprised blood donor candidates (N=2,583) who were tested for the presence HCV antibodies between 1-31 May 1999. The donor candidates had no connection to the hospital. Information regarding the serological status of donor candidates was provided by the blood center.

To determine the prevalence of Hepatitis C, we collected data obtained during admission examinations, yearly follow-up tests, or tests performed following work accidents. These data were available in medical charts compiled by the hospital's occupational medicine sector. Time in the job was defined as duration of employment in that hospital.

Sectors were classified according to risk of contamination into maximum risk (hemodialysis, blood center, hemodynamics, blood bank, infectious-contagious diseases, emergency room, laboratory, intensive care unit, transplantation unit); medium risk (clinical, surgical, and pediatric infirmary, outpatient service, endoscopy, laundry (dirty area), peritoneal dialysis, and surgical center), and minimum risk (operational central, graphic methods, cleaning/hygiene center, radiology center, chemotherapy, and garbage collection).

All health care professionals had provided blood samples for anti-HCV testing. Laboratory diagnosis was carried out by second-generation enzyme-linked immunosorbent assay (ELISA) for serum anti-HCV antibodies.

* Alter HJ. Blood donors with hepatitis C. In: Program and Abstracts of NIH Consensus, Devolopment Conference: Management of hepatitis C; 1997 Mar 24-26; Bethesda, Maryland.

Work accidents were defined as those taken place and notified during the subject's work hours at the hospital. These were characterized as any percutaneous injury with a sharp object, contact with biological materials (blood, liquor, amniotic and pleural fluid, urine, or feces) on non-integral or mucosal epithelium, and patient bites.

In case of work accidents, professionals were administered HCV testing on three occasions: on the date of the accident and six and twelve months after exposure to biological material from known or unknown source-patients.

We interviewed all health care professionals with notified work accidents and who tested positive for HCV. In this interview we collected specific data on the accident, including the serology of the source-patient, type of exposure and biological material, and use of personal protection equipment. We also investigated non-occupational epidemiological variables, such as contact with close relatives with Hepatitis C, hepatitis after age 12, homosexuality, sexual promiscuity, blood transfusion prior to 1993, intravenous drugs, and alcoholism.

In univariate analysis, groups were compared using chi-squared, ANOVA, and Kruskal-Wallis tests. When more than two groups were compared, Bonferroni's correction for multiple comparisons was used. The models used for multivariate analysis by logistic regression included all variables with significant association in univariate analysis. We also included the most important variables from the clinical (sex, age, professional category, sectors according to risk, positive anti-HCV serology) and non-occupational (sexual promiscuity, hepatitis after age 12, alcoholism, blood transfusion prior to 1993) perspectives. We evaluated two models that analyzed dependent variables *positive anti-HCV antibodies* and *work accidents with biological material*, using adjusted odds ratios and their respective confidence intervals (IC). The level adopted for statistical significance was 5%.

RESULTS

The age of health care professionals ranged from 20 to 65 years (36.8 ± 8.3 years). Most professionals were female (70.8%; N=1,014). In the administrative area, the age of employees ranged form 18 to 50 years (34.6 ± 7.4 years), and 82.6% (N=720) of these workers were female. Most blood donor candidates were male (74.7%; N=1,998).

Table 1 presents the distribution of health care professionals according to the risk of contamination of the sector in which they worked.

The prevalence of HCV among health care professionals, administrative workers, and blood donor candidates is presented in Table 2. Health care professionals showed significantly greater prevalence of infection than blood donor candidates (χ^2=27.52; p=0.001) and administrative workers (χ^2=7.22; p=0.007).

Time working in the hospital among professionals positive for HCV was significantly greater (p=0.016) than among those with negative serology. According to multivariate analysis, the odds of infection increased by 50% for every five years of age among health care

Table 1 – Distribution of health care professionals according to the risk of contamination of the sectors in which they work. São José do Rio Preto, Southeastern Brazil, January 1994 – December 1999.

Risk	N	%
Maximum	599	41.8
Medium	590	41.2
Minimum	244	17.0
Total	1,433	100.0

Table 2 - Prevalence of hepatitis C among health care professionals, administrative workers, and blood donor candidates. São José do Rio Preto, Southeastern Brazil, January 1994 – December 1999.

Group	N	%	Infected
Health care professionals[a]	1,433	1.7	25
Administrative workers[b]	872	0.5	4
Blood donor candidates[c]	2,583	0.2	6
Total	4,888	0.7	35

a x b → p = 0.007 a x c → p = 0.001

Table 3 – Final multivariate analysis model for health care professionals with positive anti-HCV serology. São José do Rio Preto, Southeastern Brazil, January 1994 – December 1999.

Variable	OR	95% CI	p
Age*	1.49	1.10 ; 2.02	0.005
Transfusion	8.99	3.01 ; 26.90	0.001

* calculated OR for every five years of age

Table 4 – Occurrence of accidents according to risk of contamination and sector of activity. São José do Rio Preto, Southeastern Brazil, January 1994 – December 1999.

Risk of contamination	Work accidents		Total
	Yes	No	
Maximum	238 (39.7%)	361 (60.3%)	599 (100%)
Medium	148 (25.0%)	442 (75.0%)	590 (100%)
Minimum	70 (28.7%)	174 (71.3%)	244 (100%)
Total	456	977	1,433

professionals, whose ages ranged from 20 to 65 years (OR=1.49; 95% CI: 1.10;2.02; p=0.005). By the same analysis, blood transfusion prior to 1993 was significantly associated (p<0.001) with positive anti-HCV serology (OR=9.74; 95% CI: 3.09;30.7) (Table 3).

Of all health care professionals evaluated (N=1,433), 342 (23.9%) were involved in a total of 456 notified work accidents with biological material. Of the source patients for these accidents, 21% had positive serology for HIV, HBsAg, or anti-HCV; 15.6% (N=71) were negative, and status was unknown for 63.4% (N=289).

According to risk of contamination (Table 4), more accidents were notified (52.2%;N=238/456) in maximum risk sectors, followed by medium risk (32.4%; N=148/456) and minimum risk (15.4%; N=70/456) sectors. The awareness of risk in the maximum and medium risk sectors may result in slight underreporting in these areas, which is not likely to have occurred in the minimum risk area.

Accidents with biological materials among health care professionals were mostly due to percutaneous injury (78.9%), followed by contact with mucosae (16.9%), non-integral epithelium (3.7%), and patient bites (0.5%).

Accidents most frequently involved blood (70.2%), followed by other bodily fluids (20%). We were unable to identify the biological material involved in 9.8% of cases.

Regarding the use of personal protection equipment, professionals were wearing gloves in 74.3% of notified accidents.

HCV serology on the date of the accident identified 2.3% of professionals as positive for anti-HCV. Follow-up tests indicated no cases of serologically demonstrated infection.

Evaluation of work accidents by multivariate analysis showed that males are 28% more protected from work accidents than females (OR=0.724; 95% CI: 0.528;0.993; p=0.044). Compared to the sector of minimum risk, risk of accidents is 1.14 times higher in the maximum risk sector (OR=2.14; 95% CI: 1.34;3.42; p<0.001) and 0.92 times higher in the medium risk sector (OR=1.92; 95%: 1.10;3.33; p=0.020). Regarding time in the job, the chance of suffering an accident increases 4% for each additional year of work (OR=1.04; 95% CI: 1.01;1.08; p=0.014).

DISCUSSION

Health care professionals in the studied hospital showed 1.7% prevalence of positive anti-HCV serology, which is close to that reported in the literature using second generation tests. Prevalence was significantly greater than that found among administrative workers and blood donor candidates, confirming that health care professionals are at higher risk of HCV infection.[11,18,23] Figueredo et al,[8] in an analysis of the literature on the subject, found that the frequency of HCV among health care professionals was relatively low.

Manipulation of material contaminated with blood or secretions is inherent to the field of health care. What is problematic, however, is that professionals often manipulate materials incorrectly, thereby increasing the risk of accidents. The serological follow-up of professionals following work accidents, which lasted for at least one year after exposure, failed to detect any instances of seroconversion.

Health care professionals with positive serology had worked in the institution for longer periods, and had 50% greater chance of being anti-HCV-positive for every five years in the job. This result suggests that daily interaction with patients may contribute to increased prevalence of HCV infection. Moreover, this risk may be even greater if professionals manipulate patients incorrectly.

The presence of work accidents was not significantly associated with positive anti-HCV, corroborating the findings of Polish et al.[17] Also according to these authors, needlestick injuries were an independent risk factor for positive anti-HCV among health care professionals. Mitsui et al also detected such an association.[14]

Positive anti-HCV was associated with blood transfusion prior to 1993, when specific serological testing for HCV-induced antibodies was not yet available. In Brazil, Medeiros et al[13] (2004) found similar results among hemodialyzed patients. Alter,[2] in a recent study of transfusions and transplantation, reports that this risk has been practically eliminated.

Work accidents occurred not only due to the manipulation of material contaminated with blood or bodily fluids (needles and other sharp instruments), but also due to contact with mucosae, non-integral skin, and patient bites. The transmission of HCV by human bites has been reported, especially in case of deep bites administered by HIV-positive source patients.[2]

In the present survey, the proportion of occurrence of injuries involving blood or bodily fluids was high. However, it is known that many of these accidents are not notified. The proportion of health care professionals that had suffered accidents was 12.7% lower than that found in a survey with a random sample of 254 professionals carried out at the beginning of the study to evaluate underreporting.

Regarding age, there was no significant difference in mean age between health care professionals that did or did not suffer work accidents. It was expected that the younger group, considered to be less experienced, could be at higher risk. Underreporting of work accidents may have been higher in this group due to fear of dismissal.

On the other hand, this was not the case for time in the job, with professionals who suffered accidents showing significantly greater permanence. With the increasing experience that results from the years of work in the institution, nursing professionals usually perform tasks of greater risk. This may contribute to greater exposure to risk situations for work accidents. Therefore, it is necessary to carry out recycling programs addressing issues of universal precautions, and continued education aiming at preventing accidents. In addition, multivariate analysis showed that risk of accidents increases 4% for every additional year in the job.

In the present study, males were 28% more protected from work accidents than females. In certain sectors, male health care professionals perform specific tasks requiring physical strength as well as the care for male patients (catheterization, bathing, moving, and others). Carrying out such tasks may reduce exposure to sharp objects, suggesting that risk increases along with the frequency of contact with such objects.

In the present study, the hemodialysis unit is among those with greatest frequency of accidents. Procedures in this unit are constant, and a high percentage of dialyzed patients are positive for Hepatitis B and C. Another important sector is the emergency room, especially given that the studied hospital is a reference center for the entire Northeastern Region of Sao Paulo State. The large number of patients and the emotional stress inherent to emergency care contribute enormously to the high risk of accidents observed in this sector. The maximum risk sector, which includes emergency, hemodialysis, intensive care, and other sectors, accounted for 52.2% of accidents. The chance of suffering a work accident in these sectors was 1.14 times higher than in the minimal risk sector (the reference category). According to Lee et al,[12] emergency and surgery rooms are the sectors with highest risk of accidents, which is justified by the type of procedures and techniques employed in these sectors.

It is important to characterize the types of work accidents suffered by health care professionals, so as to avoid high risk situations. In the present study, we found that 78.9% of accidents involved percutaneous injuries. This result is in agreement with data from the literature, which indicate sharp objects as the major source of work accidents among health care professionals.[15,19] This can be explained by the type of service provided by these professionals, especially medical and nursing activities, which show high rates of accidents related to invasive procedures. Therefore, the use of devices that prevent the manipulation or recapping of sharp objects such as needles should be encouraged. According to Garner,[9] such devices can reduce by 50% the occurrence of percutaneous lesions.

Blood was the source of infection in 70.2% of accidents. The risk of work accidents involving large amounts of blood and deep lesions, as in the case of hollow needles of large caliber, also increase the risk of seroconversion.[5]

The universal precautions recommended by the Centers for Disease Control and Prevention are in use since 1987. These recommendations include the use of gloves for manipulating blood and secretions, of lab coats when there is risk of contamination of the professional's skin or clothing, ant the use of goggles and mask in case of risk of splattering of blood or secretions on oral, nasal, or ocular mucosae. Many accidents can be prevented by the use of such barriers.

The present study showed that the majority of subjects (74.3%) wear gloves, although a proportion of these do so only in maximum risk sectors (emergency and surgery rooms, hemodialysis, etc.), an distinction which does not make sense given the profusion of asymptomatic carriers. Studies in the literature suggest that this frequency could be higher still if educational measures were adopted.[18]

There were no cases of HCV seroconversion among the accidents reported in this survey. A similar result was found by Baldo et al.[3] Seroconversion will depend on work accidents involving sharp objects, on the percentage of non-use of safety equipment, and on the amount of accidents involving blood. A total of 78.9% of work accidents were percutaneous injuries, of which 70.2% involved blood, and 25.7% of professionals involved were not using safety equipment, both of which could favor seroconversion. However, seroconversion was not detected. The probability of seroconversion following exposure to biological material from source-patients positive for Hepatitis C ranges from zero to 7%.[18,23]

Given the reasons presented above, and the documented transmission of pathogens through small lesions, the use of gloves and other safety equipment is recommended as one of the primary components of universal precautions. Also, the use of instruments and needles that include safety devices, especially if within the context of a wide-ranging prevention program, can lead to an important re duction in risk of exposure. A medium-term cost-benefit analysis will certainly be able to provide evidence of the relevance of occupational and preventive medicine.

REFERENCES

1. Alter HJ, Purcell RH, Shih JW, Melpolder JC, Houghton M, Choo QL, et al. Detection of antibody to hepatitis C virus in prospectively transfusion recepients with acute and chronic non-A, non B hepatitis. *N Engl J Med*. 1989;321:1494-500.
2. Alter HJ. Prevention of spread of hepatitis C. *Hepatology*. 2002;36(5 Suppl 1):S93-8.
3. Baldo V, Floreani A, Dal Vecchio L, Cristofoletti M, Carletti M, Majori S, et al. Occupational risk of blood-borne viruses in healthcare workers: a 5-year surveillance program. *Infect Control Hosp Epidemiol*. 2002;23:325-7
4. Brandão-Mello CE, Basilio de Oliveira CA, Gonzaga AL. Hepatitis C and liver disease in Hemophilia. *Hepatology*. 1994;19:441-3.
5. Centers for Disease Control and Prevention. Case-control study of HIV seroconversion in health-care workers after percutaneous exposure to HIV-infected-blood: France, United Kingdom and United States, January 1988-August 1994. *MMWR Morb Mortal Wkly Rep*. 1995;44:929-33.
6. Chiaramonte M, Stroffolini T, Caporaso N, Coppola R, Craxi A, Gaeta GB, et al. Hepatitis C virus infection in Italy: a multicenter epidemiological study. *Ital J Gastroenterol*. 1991;23:555-8.
7. Conry-Cantilena C, VanRaden M, Gibble J, Melpolder J, Shakil AO, Viladomiu L, et al. Routes of infection, viremia, and liver disease donors found to have hepatitis C virus infection. *N Engl J Med*. 1996;334:1691-9.
8. Figueredo ECQ de, Cotrim HP, Tavares-Neto J. Freqüência do vírus da hepatite C em profissionais da saúde: revisão sistemática da literatura. *GED Gastroenterol Endosc Dig*. 2003;22:53-60.
9. Garner JS. Guideline for isolation precautions in hospitals. *Infect Control Hosp Epidemiol*. 1996; 17:54-80.
10. Gerberding JL. Incidence and prevalence of human immunodeficiency virus, hepatitis B virus, hepatitis C, and cytomegalovirus among health care personnel at risk for blood exposure final report from a longitudinal study. *J Infect Dis*. 1994;170:1410-7.
11. Henderson DK. Maniging occupational risks for hepatitis C transmission in the helth care setting. *Clin Microbiol Rev*. 2003;16:546-68.
12. Lee JM, Botteman MF, Xanthakos N, Nicklasson L. Needlestick injures in the United States: epidemiologic, economic, and quality of life issues. *AAOHN J*. 2005;53:117-33.
13. Medeiros MT, Lima JM, Lima JW, Campos H de H, Medeiros MM, Coelho Filho JM. Prevalence and associated factors to hepatitis C in hemodialysis patients in Brazil. *Rev Saúde Pública*. 2004;38:187-93.
14. Mitsui T, Iwano K, Masuko K, Yamasaki C, Okamoto H, Tsuda F, et al. Hepatitis C virus infection in medical personnel after needlestick accident. *Hepatology*. 1992;16:1109-14.
15. Montella M, Crispo A, Grimaldi M, Ruffolo P, Ronga D, Izzo F, et al. An assesment of hepatitis C virus infection among health-care workers of the National Cancer Institute of Naples Southern Italy. *Eur J Public Health*. 2005;15:467-9.
16. Ohto H, Terazawa S, Sasaki N, Sasaki N, Hino K, Ishiwata C, et al. Transmission of hepatitis C virus from mother to infant: the Vertical Transmission of Hepatitis C Virus Collaborative Study Group. *N Engl J Med*. 1994;333:744-50.
17. Polish LB, Tong MJ, Co RL, Coleman PJ, Alter MJ. Risk factors for hepatitis C virus infection among health care personnel hospital. *Am J Infect Control*. 1993;21:196-200.
18. Proietti L, Malaponte G, Libra M, Navolanic PM, Bevelacqua Y, Travali S, et al. Analysis of hepatitis C virus infection among health-care workers: an observational study. *Minerva Gastroenterol Dietol*. 2005;51:255-9.
19. Pruss-Ustun A, Rapiti E, Hutin Y. Estimation of global burden disease attributable to contaminated sharps injures among health-care workers. *Am J Ind Med*. 2005;48:482-90.
20. Puro V, Petrosillo N, Ippolito G. Risk of hepatitis C seroconversion after occupational exposures in health care workers. Italian Study Group on Occupational Risk of HIV and other Bloodborne Infeccions *Am J Infect Control*. 1995;23:273-7.Rosen HR. Acquisition of hepatitis C by a conjunctival splash. *Am J Infect Control*. 1997;25:242-7.
21. U. S. Public Health Service. Centers for Disease Control and Prevention. Updated US Public Health Service Guidelines on the management of occupational exposures to HBV, HCV, and HIV and recommendations for exposure prophylaxis. *MMWR Recomm Rep*. 2001;50(RR-11):1-67.
22. Yazdanpanah Y, De Carli G, Migueres B, Lot F, Campins M, Colombo C, et al. Risks factors for health care workers after occupational exposure: a European case-control study. *Clin Infect Dis*. 2005;41(10): 1423-30.

Article based on the Doctoral Thesis of LAS Ciorlia, presented to the *Programa de Pós-Graduação em Ciências da Saúde of the Faculdade de Medicina de São José do Rio Preto*, in 2003.