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Hepatitis C virus infection in health-care settings: Medical and ethical implications

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ABSTRACT

Hepatitis C is a major public health issue. It infects about 200 million people worldwide and is a major cause of chronic liver disease. Its transmission in medical facilities is a topic of increased concern, as outbreaks of the disease had raised the attention of media and medical authorities. To date, evidence suggests that infection from in which a health-care worker is involved is mostly result of bad injecting practices as well as the result of shared medical devices. Furthermore, the infection caused by physicians is rare and very few well documented cases exist on the literature. Among countries, different definitions and legislation exist, in that mode that the responsibility of this issue almost is a an obligation of individual institutions. Nonetheless, Hepatitis C virus transmission in medical facilities is an important source of new cases, and as treatments options are very limited, its recommendable that institutions as well as governments implement policies to avoid Hepatitis C spread in a almost fully preventable setting.

Key words. Health care worker. Hepatitis C. Prophylaxis. Ethics. Percutaneous wound.

INTRODUCTION

Hepatitis C virus (HCV) infection is a global public health problem. Although the virus was first cloned in 1989 and its true behavior is not known, it is estimated that it causes infection in about 170 to 200 million people worldwide.[1, 2] An asymptomatic acute phase of infection fails to clear the virus in a majority of patients (about 80%) and consequently, progression to a chronic infection explains the nature of the disease, of which the long-term course is not completely understood.[1] Infection rate disease has a great variability in different countries, as low as 0.1% in Canada and as high as 18.1% en Egypt according to data from World Health Organization (WHO). In Latin America, Bolivia has the highest rate of infection (11.2%), followed by Suriname (5.5%) and Trinidad and Tobago (4.9%); on the contrary the lowest rates have been reported in Dominican Republic (2.4%), Perú (1.6%) and México (0.7%).[1, 3] Evidence from different series have defined certain groups at higher risk for HCV infection such as patients transfused with blood products before 1992 or coagulation concentrates before 1987, hemophiliacs, injecting drug users, patients in hemodialysis centers, people administrating or receiving acupuncture and/or tattooing with unsterile devices, patients with multiple sexual contacts and infants born to infected mothers as well as health care workers(HCW).[3-5] Within this later group the estimated prevalence of HCV ranges from 1 to 10%,[6] and therefore, it is a major concern in infection transmission. As transmission from patient-to-patient and patient-to-HCW in hospital and non-hospital facilities are proven scenarios,[7-24] another less reported and gaining attention is the HCW-to-patient transmission. The risk of transmission by this modality was considered uncommon, with approximately 200 cases reported in the literature[25, 26] with only a few properly documented. Nonetheless, this issue has raised attention because of the ethical, medical and legal implications as represented by cases of Anesthesiologists,[27-30] Gastroenterologists[17,31] and Surgeons.[32-34] With very few effective treatment modalities available, avoidance of infection remains the

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main strategy to prevent one of the main causes of liver disease world wide.[35]

DEFINITION OF EXPOSURE AND TRANSMISSION MODES

According to the Centers for Disease Control and Prevention, (CDC) an exposure event with risk of HCV infection is defined as a percutaneous injury (needle-stick or cut with a sharp object) contaminated with blood or another fluid as well as contact with a mucous membrane or non-intact skin with blood, tissue or other body fluid that is potentially infectious (semen, vaginal secretions, cerebrospinal, synovial, pleural, peritoneal, pericardial, and amniotic fluids; however feces, nasal secretions, saliva, sputum, sweat, tears, urine, and vomit are not included unless they contain visible blood).[36] Nonetheless, this definition does not include the risk of transmission from performing an exposure-prone procedure (EPP). The definition of these procedures is variable in the literature, and probably the most accurate is that states invasive procedures where there is risk that injury to the HCW may result in the expose of the patient's open tissues to the blood of the HCW (so called bleed-back).[37] This issue is best addressed on the consensus published by Dr. Angelique M Reitsma, *et al*,[38] which defined risk categories and evidence decision-making for HCW infected with HCV (Table 1).

Although the above definitions explain the patient-to-HCW and HCW-to-patient transmission, the last group that should be considered is the patient-to-patient infection in medical facilities. This mode of transmission is commonly manifested as outbreaks, and is usually explained by inadequate infection control practices (such as bad injection practices or sharing of medical devices). The typical scenarios are hemodialysis wards, oncology units, long-term stay facilities and outpatient clinics.[26, 39-46]

EPIDEMIOLOGY AND RISK FACTORS OF INFECTION IN MEDICAL FACILITIES

Data regarding the prevalence of HCV in HCW is scarce and a numerical risk is difficult to estimate. A study performed in Mexico City on risk factors and prevalence of hepatitis virus B and C serum markers among nurses at a tertiary- care found a prevalence of 0.8% (one positive case).[47] Similar results were shown in other series[48-53] but other studies found higher rates, ranging from 1.6 to 4%.[54-56] In spite of these figures, the transmission from a HCW-to-patient is still considered rare as only few cases had been adequately documented in literature; nonetheless, the consequences of this are devastating.[25,27,57] HCV transmission in medical settings is mainly percutaneous, by means of contact with contaminated blood, sharing of infected needles or devices[1,57,58] However, HCV is not effectively spread through occupational exposures of blood, such as accidental percutaneous injury, with a calculated risk of 1.8% (range 0 - 7%).[59] In addition, not all injuries seem to confer the same risk. In a multivariate analysis of a prospective case-control study, the factors associated to HCV transmission were the use of hollow-borne suture needles, placement in a patient artery or vein, the severity (depth) of the injury[60] as well as viremia detected by polymerase chain reaction.[61] However, an identifiable high risk groups have been described. For example, data from the National Surveillance System for Healthcare Workers in United States have identified nurses as the group which accounted for the higher number of exposition events (41%), followed by physicians (31%). This is partly explained since nurses usually outnumber physicians in a hospital.[15] Furthermore, although frequently underreported, the highest risk groups by occupation are those related to surgical and gynecological staff, as well as nursing and medical students, most lesions occurring within the operating room.[60, 62-70]

On the other hand, its estimated that approximately 2 million of HCV infections annually are acquired from contaminated syringes in medical settings.[71] The estimation is raised to 4.7 million when considering medical facilities in developing countries.[72] This is an almost fully preventable route of transmission, with high economic cost and significant morbidity and mortality, usually affecting susceptible or debilitated populations.[8, 19, 73, 74]

STRATEGIES TO PREVENT HCV TRANSMISSION IN HEALTH CARE SETTINGS

Due to few treatments available, the absence of effective post-exposure prophylaxis regimen and the high proportion of patients developing a chronic infection, prevention stands as the main measure in precluding HCV infection.[23, 26, 75]

Measures previous to HCV exposure

The major goal of a preventive program is to trying to identify patients at risk for chronic HCV

Table 1. Risk categorization for an exposure-prone procedure (EPP) and recommended conduct in HCV infected HCW. (adapted from Reitsma A, *et al.*).[38]

Category	Examples
Category I Minimal risk of viral transmission **(No emergency or violence prone settings)**	- Regular history-taking and/or physical examinations, including gloved oral. examination with a mirror and/or tongue depressor. - Routine rectal or vaginal examinations. - Minor surface suturing. - Elective peripheral phlebotomy. - Sigmoidoscopy and colonoscopy. - Hands-off supervision during surgical procedures and computer-aided remote or robotic surgical procedures. - Psychiatric evaluations.
Category II Viral transmission risk possible but unlikely	**Procedures that warrant general attention.** - Locally anesthetized ophthalmologic surgery. - Minor local procedures under local anesthesia. - Percutaneous cardiological procedures. - Percutaneous and other minor orthopedic procedures. - Subcutaneous pacemaker implantation. - Bronchoscopy. - Insertion and maintenance of epidural and spinal anesthesia. - Minor gynecological procedures. - Male urological procedures. - Upper gastrointestinal tract endoscopic procedures. - Minor vascular procedures. - Amputations, including major limbs and minor amputations. - Mamma augmentation. - Minimum-exposure plastic surgical procedures. - Thyroidectomy and/or biopsy. - Endoscopic ear, nose, and throat surgery. **Procedures that warrant special attention** - Assistance with at uncomplicated vaginal delivery (except episiotomy, category III). - Laparoscopic procedures (conversion to open surgery warrants category III). - Thoracoscopic procedures (conversion to open surgery warrants category III). - Nasal endoscopic procedures (conversion to open surgery warrants category III). - Routine arthroscopic procedures (open-joint or power instruments used requires category III classification). - Plastic surgery (major bones or vasculature and/or deep body cavities requires category III classification). - Insertion of, maintenance of, and drug administration into arterial and central venous lines. - Endotracheal intubation and use of laryngeal mask.
Category III **Exposure-prone procedures (EPP)**	- Anesthesiology: Administration of general anesthesia, preparation of narcotic drugs, placement of venous and arterial catheters, intubation of patients, and artificial respiration. - Cardiothoracic surgery: valve replacement, coronary artery bypass. - grafting, other bypass surgery, orthoptic heart transplantation, repair of congenital heart defects, thymectomy, open-lung biopsy. - Open extensive head and neck surgery involving bones. - Oncological procedures and amputations. - Neurosurgery Craniotomy and intracranial procedures and open-spine surgery. - Nonelective procedures performed in the emergency department. - Open resuscitation efforts, vaginal or rectal examination in presence of pelvic fracture, deep suturing to arrest hemorrhage, and internal cardiac massage. - Surgery involving transvaginal obstetrical and gynecological procedures. involving hand-guided sharps. - Plastic surgery Extensive cosmetic procedures. - Psychiatric evaluations and care of violent and/or biting patients. - Transplantation surgery. - Trauma surgery (open head injuries, extensive soft-tissue trauma, and ophthalmic trauma). - Interactions with patients in situations during which risk of biting of physician is significant. - Any open surgical procedure of 13 h in duration, probably necessitating glove change.

Category	Viral Load	
	Detectable but < 10^6 virions/mL	High viral load (≥10^6 virions/mL)
I	No restrictions	No restrictions
II	No restrictions	Do not attempt
III	Do not attempt	Do not attempt

infection. Currently, based on epidemiological data the indications for routine HCV testing is recommended in patients with history of injected illegal drug use, transfusion of blood before 1992 or blood products before 1987, in hemodialysis or with evidence of liver disease. For medical staff, since HCW-to-patient transmission is rare,[26] the current United States recommendation is to screen staff that has been exposed to blood from a HCV-positive patient.[76] On the contrary, several health systems in europe propose that prevention should be based on the screening for antibodies to HCV of all HCW who perform EPPs and, if positive, proceed to perform polymerase chain reaction testing for hepatitis C ribonucleic acid, to further determine their infectivity. This procedure is repeated after every exposure event.[25]

Other general useful measures are the Universal Measures (developed in response to HIV/AIDS epidemic)[77] and Body Substance Isolation[78] recommendations. These guidelines assume that every patient is a possible source of infection until proven the contrary.[23] A comprehensive guideline of recommendations has been published by the CDC and is available elsewhere (Table 2).[79] These directives should be supported by administrative, financial and specialized human resources, as well as educational programs directed to every level of attention (medical students, nurses, physicians, volunteers, social workers, etc) held in the medical facility addressed.[75, 80] These recommendations apply for prevention of transmission between patients and HCW as they intend to prevent any contact with HCV.

Measures posterior to a HCV exposure event

Although several guidelines exist for the management of a HCW exposure, every institution is responsible for each preventive medicine policy.[81] Once the exposition has occurred, aid should be given as prompt as possible to the exposed worker. This implies a reporting system not only to identify this kind of lesions, but also to recognize hazards in workplaces in order to perform preventive measures. These systems should not only give ready access to experts in the field but also to protect the confidentiality of the affected HCW.[23, 81]

Fist aid care should be offered in every case as soon as possible. Percutaneous injuries should be washed by soap and water as well as vigorously flushed with water. Contact with intact skin requires wash with soap and water. As at least one case had been documented by conjunctival inoculation[82] eyes should be irrigated with clean water, saline or sterile irrigants. There is no evidence that supports the use of antiseptics/disinfectants to reduce HCV transmission, but their use is not contraindicated; but the use of caustic agents or injection of antiseptics/disinfectants is not recommended. [23, 83, 84]

Next step is to assess the degree of exposure should be addressed. Figure 1 shows a suggested algorithm in classifying an exposure event. The highest risk patient for contagion is those who have HCV viremia detected by third generation PCR.[61] This test is almost 100% sensitive to detect seroconversion 4 to 10 weeks after infection. Delayed detection and false-negative results are seen in patients with renal failure, HIV infection and extra-hepatic manifestations of HCV infection, therefore special emphasis on follow up should be guaranteed when considering patients in these groups.[85] For every case, both HCW and patient baseline HBV, HCV and HIV status should be tested, since post-exposure prophylaxis exist for HIV and HBV exposures.[86] For vaccinated or naturally immunized HCW, testing for HVB superficial antigen could be spared. When source of infection cannot be tested or refuse to be tested, it should be considered as infected.[84] Furthermore, CDC recommends that following a occupational HCV exposure the following measures should be taken:[59, 76]

- For the source, perform testing for ant-HCV
- For the HCW exposed to a HCV-positive source:
  - Perform baseline testing for anti-HCV and ALT activity
  - Follow-up testing (4-6 months) for anti-HCV and ALT
  - Confirm diagnosis with either HCV-RNA or anti-HCV RIBA™ (recombinant immunoblot assay).

There is no recommendation for activity restriction during post-exposure follow-up period, until there is a proven infection. In this regard, the consensus for HCV infected HCW presented on table 1 could be a useful guide for providing medical attention.[38] Nonetheless, in Germany, there is no activity restriction for HCW HCV-positive until viral load of 1×10^3 IU/mL.[25] Other countries in Europe follow similar conducts.[84, 87] It is a duty of the HCW that is known to have HCV infection to comply with the working restrictions as well as regular evaluation designed by the Preventive Medicine Department of each institution.

Table 2. Standard precautions for the care of all patients in all healthcare settings.[79]

Component	Recommendations
Hand hygiene	After touching blood, body fluids, secretions, excretions, contaminated items; immediately after removing gloves; between patient contacts .
Personal protective equipment (PPE)	
Gloves	For touching blood, body fluids, secretions, excretions, contaminated items; for touching mucous membranes and non-intact skin.
Gown	During procedures and patient-care activities when contact of clothing/exposed skin with blood/body fluids, secretions, and excretions is anticipated.
Mask, eye protection (goggles), face shield*	During procedures and patient-care activities likely to generate splashes or sprays of blood, body fluids, secretions, especially suctioning, endotracheal intubation
Soiled patient-care equipment	Handle in a manner that prevents transfer of microorganisms to others and to the environment; wear gloves if visibly contaminated; perform hand hygiene.
Environmental control	Develop procedures for routine care, cleaning, and disinfection of environmental surfaces, especially frequently touched surfaces in patient-care areas.
Textiles and laundry	Handle in a manner that prevents transfer of microorganisms to others and to the environment.
Needles and other sharps	Do not recap, bend, break, or hand-manipulate used needles; if recapping is required, use a one-handed scoop technique only; use safety features when available; place used sharps in puncture-resistant container.
Patient resuscitation	Use mouthpiece, resuscitation bag, other ventilation devices to prevent contact with mouth and oral secretions.
Patient placement	Prioritize for single-patient room if patient is at increased risk of transmission, is likely to contaminate the environment, does not maintain appropriate hygiene, or is at increased risk of acquiring infection or developing adverse outcome following infection.
Respiratory hygiene/cough etiquette (source containment of infectious respiratory secretions in symptomatic patients, beginning at initial point of encounter e.g., triage and reception areas in emergency departments and physician offices)	Instruct symptomatic persons to cover mouth/nose when sneezing/coughing; use tissues and dispose in no-touch receptacle; observe hand hygiene after soiling of hands with respiratory secretions; wear surgical mask if tolerated or maintain spatial separation, >3 feet if possible.

* During aerosol-generating procedures on patients with suspected or proven infections transmitted by respiratory aerosols (e.g., SARS), wear a fit-tested N95 or higher respirator in addition to gloves, gown,and face/eye protection.

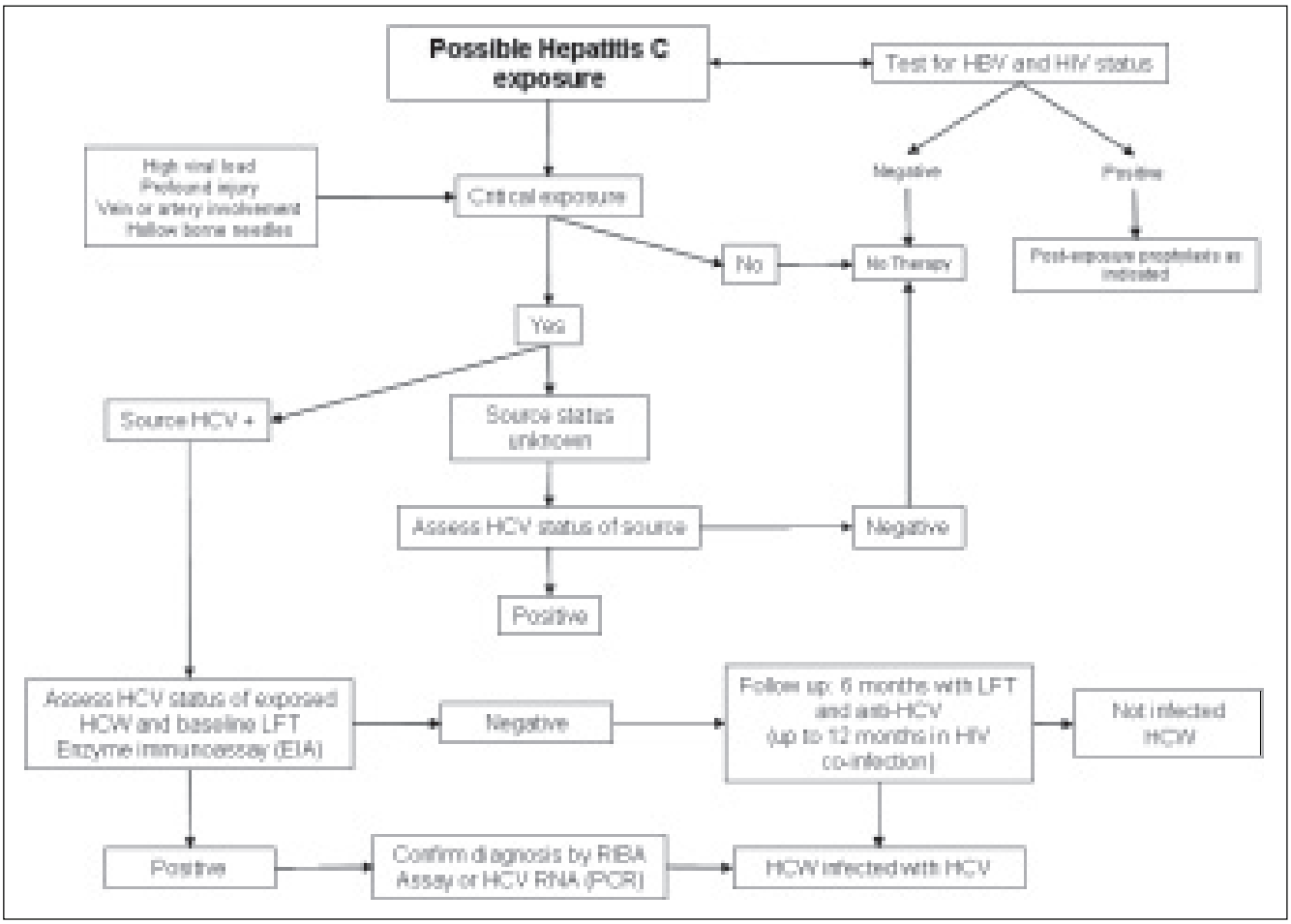

***Figure 1**. Algorithm suggested to evaluate and management in a HCV exposure. (Adapted of data from [60, 84, 92]) . HBV: Hepatitis B virus; HIV: Human immunodeficiency virus; HCV: Hepatitis C virus, HCW: Health-care worker; LFT: liver function tests, RNA: ribonucleic acid; PCR: polymerase chain reaction.*

CONCLUSIONS

Until new anti-HCV therapeutic options such as new HCV serine protease and polymerase inhibitors,[88, 89] neutralizing antibodies to hepatitis C virus[2, 90] or an anti-HCV vaccine are available,[91] the main opportunity in avoiding liver disease from HCV remains the prevention of infection. While public health programs focus on identify population at risk, prevention of HCV spread in medical facilities represents one of the most important national public health tasks, especially in developing countries.

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