



Prioritizing High-Risk Practices and Exploring New Emerging Ones Associated With Hepatitis C Virus Infection in Egypt

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Abstract

Background: The aim of this study was to identify and prioritize the risky behaviors and explore the newly emerging practices related to Egyptian habits that may lead to HCV transmission.

Methods: From January 2011 until January 2012, a case control study matched on socio demographic factors was conducted comparing 540 hepatitis C patients and their contacts who were HCV serologically negative (102 subjects). The subjects were randomly selected from six governorates representing Upper Egypt, Lower Egypt, Middle and Canal region. A questionnaire covered demographic data, risk exposures, behaviors, and practices for HCV infection. Focus group discussions were done with groups of professionals in Hepatology to discuss the observed emerging risk practices in Egypt.

Results: In univariate analysis, invasive medical procedures, wound stitches, illiteracy and marriage were significantly associated with HCV infection. Among women, delivery at home by traditional birth attendant was associated with 3 times (OR=1.23-6.98) and 4 times (OR=3.94, CI=1.44-11.35) increase in HCV risk than delivery at hospital and by doctors respectively. Among males, shaving at barbershops was associated with 2 fold increase in the risk of infection (OR=2.6, CI=1.44-4.7). Newly observed emerging risk practices were: sharing scarves' pins by veiled women in same houses, sharing loofah for personal cleaning and sharing toothpaste among family members.

Conclusion: Increasing risk of HCV infection in Egypt reinforces the need for strict implementation of effective HCV prevention programs according to the prevailing risk behaviours.

Key words: Hepatitis C, Risk factors, Risk practices, Emerging practices

Introduction

Hepatitis C virus (HCV) is a major global health problem as 130-170 million people are chronically infected with HCV worldwide and more than 100,000 new cases of liver cancer that occur annually are caused by HCV (1,2).

Egypt is the country with the largest hepatitis C virus epidemic in the world. The high level of HCV infection has been attributed to the use of inadequately sterilized needles during mass campaigns undertaken to treat schistosomiasis in the 1960's and early 1980's. In 2008, a Demographic Health Survey (DHS) was carried out in Egypt,

and provided for the first time an estimate of HCV prevalence on a nationwide representative sample of individuals (6,578 women and 5,430 men). The DHS showed that 15% of the Egyptian DHS respondents age 15-59 had antibodies to the HCV in their blood, indicating that they had been exposed to the virus at some point. Ten percent were found to have an active infection. Men were more likely to be infected than women and, the levels of infection increased sharply with age among both women and men (3,4). It is important to identify the current risk factors for

HCV infection among the Egyptian population so that intervention programs would be appropriately focused. Moreover, digging deeper into identifying the characteristics of individuals who committed the risk practices is an essential step towards eradication of HCV.

The objective of this study was to identify and prioritize the high risk practices associated with transmission of HCV infection among Egyptians and identify newly emerging practices that is related to the Egyptian habits as well as to explore the individual and socioeconomic characteristics of those who committed the risk practices

Methods

In order to identify and prioritize the current risky behaviors that may lead to transmission of HCV infection, we conducted a case control study from six governorates representing upper, lower, middle and canal region of Egypt. This study is part of a project funded by Science and Technology Development Fund (STDF) and implemented by National Research Centre in collaboration with the Ministry of Health as a contribution for reduction of HCV endemicity in Egypt.

Interviewed participants and questionnaire

From January 2011 to January 2012, 540 HCV case patients and 102 of their family contacts who were HCV negative were interviewed. They were randomly selected from six governorates out of the 17 governorates in Egypt that included 9 National Viral Hepatitis Treatment Reference Centers of the National Committee for Control of Viral Hepatitis- established by the Egyptian Ministry of Health (MOH) with approximately 55 patients and 12 contacts from each treatment centre. These centres were selected as representatives to four locations within Egypt: Benisuef and Assuit as representative to urban and rural Upper Egypt, Dakahlia and Gharbia as representative to urban and rural Lower Egypt, Cairo as representative to middle Egypt and Ismailia as representative to the canal region. Both cases and con-

trols were distributed along the six governorates as follows: 22.2% cases versus 18.6% contacts in Upper Egypt, 22.2% versus 24.5% in lower Egypt and 11.1% versus 21.6% in the canal region.

Cases are referred to these centres by a general practitioner, a specialist or on their own. Cases were the patients with serological evidence of HCV infection and received the treatment recommended by the referral centres, according to the national guidelines, and were selected from the outpatients' department. Controls were the family contacts of the cases without serological evidence with HCV infection.

Detection of anti-HCV antibodies was performed using the 4th generation qualitative ELISA test (Dia Sorin, Murex). However, reverse transcription polymerase chain reaction (RT-PCR) which is the accurate and standard technique for detection of HCV was performed for all positive ELISA cases only.

In order to limit the potential information bias because case patients, contacts and interviewers were not blinded to HCV status, cases and contacts were questioned about risk behaviors for HCV infection using a standardized questionnaire exploring the risk factors. The structured questionnaire included questions on demographic data, personal history, self-reported histories or family history of hepatitis B virus (HBV) infection, hepatitis A virus (HAV), HCV and or HIV/AIDS, risk factors for blood exposure (history of blood transfusions, needle stick exposure, needle sharing, tattooing practices and body piercing, sharing of sharp objects, dental treatment, history of hospitalization, previous therapeutic injections, hemodialysis, sharing personal care items, such as razors or toothbrushes, that may have come in contact with the blood of an infected person), drug use history, sexual risk practices measured over the lifetime (a history of sexually transmitted diseases, unprotected sexual activity, and sexual activity with multiple partners), imprisonment history, and health-related occupations. The questionnaire was filled out during face-to-face interviews with cases and contacts.

We also conducted focus group discussions in each of the nine-targeted National Treatment

Reference Centers. Each group consisted of 6-8 experts to obtain a comprehensive picture of their experiences and opinions on issues related to behaviors behind endemicity of HCV within the community. By the completion of the discussion, 79 experts had participated in the focus group. Development of the core questions was based not only on a literature review of risk factors for HCV but also on their experience. The expert group consisted of 10 professionals; head of the center, one or two professors in hepatology, professor in epidemiology and prevention of infectious diseases, senior epidemiologist, one medical doctor specialized in infectious diseases and tropical medicine and one expert from each of the following departments: Gynecology and Obstetrics, Orthopedics, Urology, ENT and Endoscopy.

Ethics

Before the interview, an orientation about the objectives of the study was carried out, followed by verbal consent taken from every interviewee. Confidentiality was maintained all through the study. Ethical approval was taken from the MOH ethical review board.

Statistical analysis

Descriptive statistics were computed for demographic variables for cases and controls. Categorical and continuous variables were compared across the two groups using chi-square and Student T test. All exposures were tested for association with HCV infection in univariate analysis.

Data were analyzed using statistical package of social software program (SPSS), version 16.

Results

Demographic characteristics of the surveyed population

Cases comprised of 359 (66.5%) males and 181 (33.5%) females while in contacts 51 (50%) were males and 51 (50%) were females. The mean age of HCV patients was 42.38 ± 11.39 years and that of contacts was 35.52 ± 13.39 years. The age group

≥ 50 represents the highest percentage of cases and contacts (28.5% & 18.6%) respectively. The highest percentage of cases and contacts were married (84.4% and 63.7% respectively) (Table 1).

Univariate analysis

In univariate analysis, illiteracy (P value=0.000) and marriage (P value=0.000) were significantly associated with HCV infection (Table 1). Iatrogenic risk factors as hospital admission before onset of HCV infection (OR=1.5, CI=1.01-2.48), endoscopy (OR=5, CI=1.5-16.44), laparoscopy (OR=2.2, CI=1.07- 4.87), organ biopsy (OR=23.6, CI=8.56-65), treatment of piles (OR=3.5, CI=1-11.4), wound stitches (OR=1.9, CI=1.19-3), cannula (OR=2.2, CI=1.41-3.64) were found to be associated with an increase in HCV risk (Table 2).

Among males, shaving at barbershops was associated with a 2 fold increase in the risk of infection (OR=2.6, CI=1.44-4.89) (Table 3). Among women, previous delivery/abortion was associated with an increase in HCV risk. Moreover delivery at home was associated with 3 times increase in HCV risk (OR=2.91, CI=1.23-6.98) than delivery at hospital. In addition, delivery/abortion done by days was associated with a 4 fold increase in the risk of HCV infection (OR=3.94, CI=1.44-11.35). Ever used IUD or injections as a method of contraception was responsible for an approximately 2.5 fold increased risk of HCV (OR=2.5, CI=1.33-4.74) (Table 4).

Regarding history of other diseases of the surveyed group (Table 5); the findings imply minor accompanied risk with HCV that was only significant for the history of bilharziasis. Nevertheless, treatment of bilharziasis with injections was not significant. Whereas, cases had higher percentage of history of bilharziasis than contacts (53% versus 13.7%) and the difference was statistically significant (P value=0.00). The in-depth analysis of the relation between some risk behaviors are shown in Table 6.

Table 1: Demographic characteristics by HCV status, Egypt

| Characteristics | Cases (HCV +ve) (n=540) | | Contact (HCV -ve) (n=102) | | P value |
|---|----------------------------|-------|------------------------------|-------|---------|
| | No | % | No | % | |
| Age (yr) | | | | | |
| 15-19 | 4 | 0.7 | 15 | 14.7% | 0.000 |
| 20-24 | 36 | 6.7 | 10 | 9.8 | |
| 25-29 | 47 | 8.7 | 15 | 14.7 | |
| 30-34 | 58 | 10.7 | 12 | 11.8 | |
| 35- 39 | 53 | 9.8 | 12 | 11.8 | |
| 40 – 44 | 93 | 17.2 | 10 | 9.8 | |
| 45-49 | 95 | 17.6 | 9 | 8.8 | |
| ≥50 | 154 | 28.5 | 19 | 18.6 | |
| Mean age | 42.38 ± 11.396 | | 35.52 ± 13.393 | | 0.000 |
| Marital status | | | | | |
| 1. Married | 456 | 84.4 | 65 | 63.7 | 0.000 |
| 2. Single | 55 | 10.2 | 32 | 31.4 | |
| 3. Divorced | 11 | 2.0 | 3 | 2.9 | |
| 4. Widow | 17 | 3.1 | 2 | 2.0 | |
| Education | | | | | |
| 1. Illiterate | 161 | 29.8 | 20 | 19.6 | 0.000 |
| 2. Read and write | 69 | 12.8 | 4 | 3.9 | |
| 3. Primary | 43 | 8.0 | 3 | 2.9 | |
| 4. Preparatory | 33 | 6.1 | 5 | 4.9 | |
| 5. Secondary or equivalent (technical-vocational) | 165 | 30.6 | 40 | 39.2 | |
| 6. University or more | 65 | 12.0 | 29 | 28.4 | |
| Employment: | | | | | |
| 1. Not working | 237 | 43.9% | 55 | 53.9% | 0.095 |
| 2. Working | 298 | 55.2% | 45 | 44.1% | |
| Mean number of rooms | 3.27 ± 1.537 | | 3.36 ± 1.299 | | 0.600 |
| Mean number of people | 5.70 ± 3.052 | | 5.50 ± 2.067 | | 0.546 |

Table 2: Risk factors associated with Hepatitis C infection, Egypt

| Risk Factors | Cases (HCV +ve) (n= 540) n (%) | Contact (HCV-ve) (n= 102) n (%) | OR (95% CI) | p-value |
|---|--------------------------------------|--|---------------------|---------|
| | Travelling outside Egypt. | 216 (40.06) | 31(30.4) | |
| Joining military service (men only): (n= 410) | 198 (55.8) | 22(43.1) | 1.621(0.89-2.93) | 0.10 |
| Spending some time in prison | 14 (2.6) | 0 | undefined | |
| Admission/examination at the hospital before onset of HCV infection | 331(61.3) | 51(50) | 1.58 (1.01-2.48)* | 0.02 |
| Surgical operations previously done | 292(54) | 47(46) | 1.378 (0.9-2.1) | 0.06 |
| Dental examination/operation | 378(70) | 65(63.7) | 1.328 (0.85-2) | 0.10 |
| Catheter | 5 (10) | 8(7.8) | 1.31 (0.58 -3.07) | 0.25 |
| Laparoscopy | 88 (16.3) | 8 (7.8) | 2.288 (1.07- 4.87)* | 0.03 |
| Cannula | 243 (45) | 27 (26.5) | 2.273 (1.41-3.64)* | 0.00 |
| Wound stitches/sutures | 226 (42) | 28 (27.5) | 1.9 (1.19-3)* | 0.00 |
| Abscess drainage | 109(20) | 17(16.7) | 1.2 (0.72- 2.21) | 0.49 |
| Endoscopy | 72(13.3) | 2(3) | 5 (1.5-16.44)* | 0.001 |
| Sclerotherapy for varices | 15(28) | 2(2) | 1.4 (0.32-6.34) | 1.00 |
| Tapping ascites | 32(6) | 1(1) | 6.36 (0.86-47) | 0.04 |
| Treatment of hemorrhoids | 52(9.6) | 3(2.9) | 3.5 (1-11.4)* | 0.03 |
| X ray with injection | 93(17.2) | 12(11.8) | 1.56 (0.79-3.13) | 0.08 |
| Electromyogram | 23(4.3) | 3(3) | 1.46 (0.43-4.98) | 0.78 |
| Organ biopsy | 265(49) | 4(4) | 23.6 (8.56-65)* | 0.00 |
| Blood donation | 133(24.6) | 17(16.7) | 1.63 (0.93-2.85) | 0.04 |
| Blood transfusion | 89(16.5) | 11(10.8) | 1.63 (0.83-3.17) | 0.18 |
| Direct contact/exposure to blood at work | 5(0.9) | 4(3.9) | 0.47 (0.16-1.37) | 0.04 |

* = OR is Sig.

The older the age (≥ 40 years) in those with previous delivery/abortion (OR=7.28, CI= 3.08-17.39) and those with previous use of IUD or injections as contraception methods (OR=3.85, CI= 1.38-10.87) the higher the risk of HCV infection. Similarly, illiteracy increases the risk of infection between the previous 2 groups. Out of the new emerging behaviors mentioned during the group discussion and which are cultural sensitive to Egyptians and might be behind the endemicity of HCV in Egypt are:

- 1- Always sharing the use of scarves' pins by the veiled women in the same houses, which might be contaminated, with infected blood by HCV, which result in piercing scalp injury and expose the non-infected women to HCV infection.
- 2- Always sharing the loofah for personal cleaning which if contaminated with

HCV-infected blood might penetrate injured skin of any part of the body exposing non-infected persons to HCV infection. This is particularly true in rural areas with the scanty amount of water.

- 3- Sharing the use of the same toothpaste between the HCV infected and non-infected individuals with improperly washed or unwashed toothbrushes or the use of toothpaste directly by hands.
- 4- Sharing the same syringe used for insulin injections for those having diabetes with other family members.
- 5- The habit of chewing foods by grandfathers and grandmothers to their grandsons and granddaughters less than 2 years to facilitate swallowing of their food.

Table 3: Risk practices associated with Hepatitis C infection, Egypt*

| Risk Practices | Cases (HCV +ve) (n= 540) n (%) | Contact (HCV-ve) (n= 102) n (%) | OR (95% CI) | p-value |
|--|---------------------------------------|---------------------------------------|-------------------|---------|
| Sharing personal grooming items(nail clip-pers/razors/ toothbrushes/shaving equipments) with family members | 158 (29.3) | 27 (26.5) | 1.1 (0.73- 1.85) | 0.56 |
| Shaving beard at the barber | 151 (28.0) | 13 (12.7) | 2.6 (1.44-4.89)** | 0.001 |
| Manicure/Pedicure at the hairdresser/barber | 53(9.8) | 9 (8.8) | 1.1 (0.53-2.35) | 0.75 |
| Extramarital sexual relationships | 17(3) | 4 (4) | 0.79 (0.26-2.41) | 0.68 |
| Needle piercing | 87 (16) | 16 (15.7) | 1 (0.57-1.84) | 0.003 |
| Ever Injections or vaccination in outpatient clinic | 230 (42.6) | 35 (34.3) | 1.4 (0.9-2.19) | 0.05 |
| Ever used recreational drugs | 40 (7.4) | 5 (4.9) | 1.5 (0.6-4) | 0.6 |
| Acupuncture | 6 (1.1) | 2 (2) | 0.56 (0.1-2.8) | 0.62 |
| Hijama | 44 (8) | 3 (2.9) | 2.9 (0.89-9.61) | 0.06 |

*for cases who always or usually committed the practices versus who did not commit them/**=OR is sig.

Table 4: Risk of exposure through obstetric history of the surveyed women by HCV status, Egypt

| | Cases (HCV +ve) (n= 181) n (%) | Contact (HCV-ve) (n= 51) n (%) | OR (95% CI) | P-value |
|--|-----------------------------------|-----------------------------------|--------------------|---------|
| Previous Delivery/ Abortion | 159 (87.8) | 35 (68.6) | 3.3 (1.57-6.93)* | 0.001 |
| Delivery/Abortion done by: 1-Doctor | 74 (48.7%) | 25 (75.8%) | 0.30 (0.12-0.76)** | 0.026 |
| 2-Nurse | 7 (4.6%) | 2 (6.1%) | 0.75(0.13-5.49) | |
| 3-Daya | 71 (46.7%) | 6 (18.2%) | 3.94 (1.44-11.35)* | |
| Place of Delivery/Abortion | | | | 0.007 |
| 1-Home | 93 (60.4%) | 11 (34.4%) | 2.91 (1.23-6.98)* | |
| 2-Hospital | 61 (39.6%) | 21 (65.6%) | | |
| Ever used IUD or injections as a method of contraception | 122 (67.4) | 22 (45) | 2.5 (1.33-4.74)* | 0.0006 |
| Ever had Cautey | 32 (17.7) | 7 (13.7) | 1.35 (0.55-3.26) | 0.5 |
| Ever had Myometrial biopsy | 17(9.4) | 4 (7.8) | 1.2 (0.39- 3.79) | 0.73 |
| Ever had Dilatation and Curettage | 33(18.2) | 9 (17.6) | 1 (0.46-2.34) | 0.9 |

*=OR is Sig. **=OR is sig and protective

Table 5: History of diseases of the surveyed groups by HCV status, Egypt

| | Cases (HCV +ve) (n= 540) n (%) | Contact (HCV -ve) (n= 102) n (%) | OR (95% CI) | p-value |
|---|---------------------------------------|---|--------------------|---------|
| Ever had diseases other than HCV infection | 136 (25.2) | 29(28.4) | 0.84 (0.52-1.35) | 0.862 |
| Ever had Bilharziasis | 287 (53) | 14 (13.7) | 7.18 (3.98-12.94)* | 0.000 |
| Those who had bilharziasis before were treated from it by injection | 142(49.5) | 6(43) | 1.24 (0.42-3.67) | 0.71 |
| History of or currently on Renal Dialysis | 4 (0.7) | 4 (7.8) | 0.84 (0.81-0.86) | 0.51 |
| Having Diabetes | 47 (8.7) | 11 (10.8) | 0.78 (0.39-1.57) | 0.77 |
| Sharing insulin injections with other person | 1 (4.3) | 1 (20) | 0.18 (0.00-3.54) | 0.43 |
| History of or currently having Sexually Transmitted Diseases (STDs) | 8 (1.5) | 0 | 0.83 (0.81-0.86) | 0.24 |

*=OR is Sig.

Table 6: In-depth analysis for the individual and socio-demographic characteristics of significant risk factors, Egypt

| Characteristics* | Cases (HCV +ve) n (%) | Contacts (HCV -ve) n (%) | Pvalue | OR (95% CI) |
|---|-----------------------------|--------------------------------|---------|----------------|
| Shaving at the barber | | | | |
| Age | | | | 4.16 |
| ≥40 | 65 (43.0%) | 2 (15.3%) | | (0.83-28.2) |
| <40 | 86 (57.0%) | 11 (84.7%) | 0.09 | |
| Education | | | | |
| 1. Illiterate and less than secondary | 69 (46.2 %) | 4 (30 %) | 0.43 | 1.94 |
| 2. Secondary or more | 80 (53.8 %) | 9 (70 %) | | (0.51-7.88) |
| Employment | | | | |
| 1. Not working | 41 (27.2%) | 3 (23%) | 0.99 | 1.24 |
| 2. Working | 110 (72.8%) | 10 (77%) | | (0.92-1.12) |
| Ever used IUD or injections as a method of contraception | | | | |
| Age | | | | 3.85 |
| ≥40 | 93 (76.2%) | 10 (45.4 %) | 0.003* | (1.38-10.87)* |
| <40 | 29 (23.8%) | 12 (54.6 %) | | |
| Education | | | | |
| 1. Illiterate and less than secondary | 96 (78.6%) | 9 (40.9%) | 0.0002* | 5.33 |
| 2. Secondary or more | 26 (21.4%) | 13 (59.1%) | | (1.87-15.44)* |
| Employment | | | | |
| 1. Not working | 107 (87.7%) | 18 (81.8%) | 0.45 | 1.59 |
| 2. Working | 15 (12.3%) | 4 (18.2%) | | (0.39-5.94) |
| Previous Delivery/ Abortion | | | | |
| age | | | | 7.28 |
| ≥40 | 129 (81.1%) | 13 (37.1%) | 0.000* | (3.08-17.39)* |
| <40 | 30 (18.9%) | 22 (62.9%) | | |
| Education | | | | |
| 1. Illiterate and less than secondary | 131 (82.3%) | 14 (40.0%) | 0.000* | 7.02 |
| 2. Secondary or more | 28 (17.7%) | 21 (60.0%) | | (2.98-16.72)* |
| Employment | | | | |
| 1. Not working | 137 (86.2%) | 28 (80%) | 0.35 | 1.56 |
| 2. Working | 22 (13.8%) | 7 (20%) | | (0.54-4.33) |

- Percent was calculated out of those who committed the practices/*=OR is Sig.

Discussion

The objective of this case control study was to identify and prioritize the relationship between hypothesized risk factors and HCV infection in Egypt.

In this study, hospital admission before the onset of HCV infection, endoscopy, laparoscopy, organ biopsy, treatment of piles, previous delivery/abortion, and cannulation were direct mechanisms of HCV infection which represented invasive health care procedures. Moreover, wound stitches were significantly associated with being an HCV case in this study. In addition, a community exposure like shaving at the barbershop was a dominant risk factor in our study. In addition, an indirect mechanism of transmission as illiteracy was also associated with HCV infection.

Many published studies to identify HCV transmission in Egypt have been conducted either in rural areas in Upper Egypt (5, 6), rural villages in Nile Delta (7, 8), or urban areas of Cairo (9, 10). Whereas, a key strength of this study is the representative sample of cases and contacts from urban and rural areas of six different governorates of Egypt distributed along the upper, lower, middle and the canal region of Egypt.

This study supported the important role played by invasive health care procedures in HCV transmission, which is well documented in many studies in different countries (1, 5-7, 10-14). Their association with HCV infection was highly significant which reflects the fact that health care procedures remain a source of HCV infection in Egypt and this stresses the need to increase the efforts related to blood borne infection control in the medical settings.

Similar stitches, which involve repeated percutaneous infractions of the skin with the same needle (15), proved to be efficient in transmitting HCV in our study. One recent publication in Cairo explored the association between stitches and HCV spread, and was consistent with our results (10). On the contrary, a study in Sharkia governorate, Egypt (16) and another in France (14) showed no significant association between stitches and HCV infection.

Similar to other studies in Egypt, Turkey, Iran, Tunisia and Libya (10, 17-21) dental care was not associated with HCV transmission in our study. However, contrasting to our results, dental visits emerged as a risk factor for HCV transmission in other studies (22-24). Conflicting results suggest that there might be a small increase in the risk of acquiring HCV infection due to these procedures. Consequently, dental care might have a minor role in HCV transmission

Surprisingly, this study did not show a significant association between HCV transmission and illicit drug use. This might be due to the sensitive nature of this question as it carries social stigma and respondents tend to underreport deliberately such behavior.

Shaving at the barbershops is a well-known risk factor not only for HCV infection but also for HBV infection (15). As anticipated, shaving at the barbershop in this study was highly significantly associated with HCV infection. Barbers in developing countries are usually unaware of the concept of blood-borne transmission, and razors and scissors are used repeatedly for different customers without intervening sterilization (25). Many published studies were in concordance with our results (1, 16, 25, 26), calling for targeted educational programs and future studies focusing on evaluating the impact of such educational intervention. Furthermore, the country should enforce the laws to sterilize the barbershop's equipment.

"Hijama" or "Cupping", where blood is drawn by vacuum from a small skin incision for therapeutic purposes, is being widely done now in Egypt and there were no studies in the literature that explored its association with HCV spread. The current study is considered the first to explore this association. Although Hijama did not emerge as a risk for HCV transmission in this study, it should be considered one of the potential risk factors that need to be further explored in future studies as HCV infection can occur if inadequately sterilized equipment is used.

Blood transfusion is an important past and potential risk for HCV in developing countries where anti HCV screening is limited by financial and technical factors and it is well documented in many studies (3, 6,7,12, 16, 21, 27). Blood transfu-

sion was not a significant risk factor in this study. This may be due to the enforcement of diagnostic screening for HCV serological markers for a number of years in this country, which probably led to a corresponding decrease in blood transfusion associated HCV transmission.

Extramarital sexual transmission was explored in our study among males and it was not significant. Despite the number of studies conducted on this topic and their various designs, the evidence for sexual transmission of HCV infection is not consistent in all studies (11, 27, 28). The possibility of sexual transmission of HCV infection is supported by the isolation of HCV RNA from semen and cervical smears in some studies (29, 30).

More difficult to interpret is our finding that illiteracy is a risk factor for HCV infection, especially since controls came from the same socioeconomic background. However, illiteracy is not in itself a specific mechanism for HCV transmission but could pave the path for other risk factors, such as community exposures or high-risk habits, to occur. The Egyptian DHS in 2008 showed an increased risk between lack of education and HCV infection (3). Recent studies in Egypt and Turkey agreed with our results (10, 17). Moreover, deeper analysis of the relation between illiteracy and other risk factors as previous delivery/ abortion and previous use of IUD or injections as a method of contraception showed that illiteracy was of higher significance as a risk factor of HCV transmission. More attention should be given to providing health education about risk factors and prevention of infections to the general population and all should be informed that this disease can affect any age, persist for one's whole life and infected people may remain asymptomatic and develop chronic complications.

The newly emerging behaviors suggested by the experts in the group discussion will be tested as risk factors during our second phase implementation of the project, which is a community survey and will be included in the design of the questionnaire of the community survey.

In conclusion, this case control study confirmed some independent risk factors for HCV infection described in other studies. Increasing the risk of HCV infection in health care settings enforce sur-

veillance activities to monitor disease trends and effectiveness of the medical and preventive interventions and stress the need for strict implementation of effective HCV prevention programs. Expanding health education efforts to increase knowledge of the public and persons at risk for HCV infection is necessary and finally outreach and community-based activities that decrease high-risk behaviors and identify persons who to be tested need should be considered. Educational efforts should target the underprivileged. The media should target people at risk and increase their awareness about the risky behavior and practices (i.e. those who seek the traditional midwives for delivery and abortion, those who shave at the barbers).

Conclusion

This study showed that invasive health care procedures played a significant role in the current HCV transmission among the Egyptian population, highlighting the importance of strengthening infection control practices.

Ethical considerations

Ethical issues (Including plagiarism, Informed Consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc) have been completely observed by the authors.

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