Hepatitis C virus exposure rate among health-care workers in rural Lower Egypt governorates

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ABSTRACT

Background and Objectives: Studies on hepatitis C virus (HCV) in Egypt supported a strong role for various exposures in the health-care setting. In this study, we attempted to estimate the frequency of HCV exposure among Egyptian health-care workers (HCWs). **Methods:** Five hundred and sixty-four (564) HCWs were included in this study. Two hundred and fifty-eight (45.74%) were health-care providers and 306 (54.25%) were non-health-care providers. All HCWs completed both the study questionnaire and provided a blood sample for anti-HCV testing by third-generation enzyme-linked immunosorbent assay. Subsequently, anti-HCV-positive samples were tested for HCV RNA using nested polymerase chain reaction (PCR). **Results:** The mean age of included HCWs was 33.0 ± 9.8 years; of them, 319 (56.56%) were males and 245 (43.44%) were females. The mean duration of health-care work was 9.3 ± 6.7 years. The frequency of antibody against hepatitis C virus (anti-HCV) among included HCWs was 8.7% ($n = 49$). Old age and prolonged duration of health-care work were significantly associated with anti-HCV seropositivity. Forty (81.63%) of 49 with anti-HCV-positive HCWs had positive hepatitis C viremia. The frequency of HCV RNA positivity increased with age. The frequency of eradicated past infection among nurses (36.85%) was markedly higher than that (6.7%) detected in non-health-care providers. **Conclusion:** High rate of HCV infection is detected in Egyptian HCWs in rural Lower Egypt governorates. Health-care providers seem to eradicate HCV infection more frequently than non-health-care providers. National screening and treatment of infected HCWs are recommended.

Key words: anti-HCV, HCV RNA, health-care workers, rural, lower Egypt

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INTRODUCTION

The latest national survey of antibody against hepatitis C virus (anti-HCV) prevalence was 10%, and the estimate of hepatitis C virus (HCV) RNA was 7% in Egyptian general populations aged 15–59 years [1]. HCV prevalence in Egypt increases strongly with age and indicates uneven geographic distribution, with higher HCV prevalence in rural areas compared to urban settings [2–4] and in Lower Egypt compared to the rest of the country.[5,4] The

cumulative data [6–10] showed that Egypt has the largest HCV epidemic in the world and the epidemic is ongoing.

The origin of HCV epidemic is not clear but thought to be due to the past and ongoing iatrogenic exposure [4, 5] in the health-care settings. Direct percutaneous exposure to blood represented the primary route of HCV transmission from patients to health-care providers.[11–13] Accidental occupational needle stick in Egypt is a significant risk for HCV exposure.[14] In 2006, Talaat *et al.*

showed a complete lack of infection control practices in health-care facilities in Egypt. Moreover, the presence or absence of infection control programs was an index of iatrogenic exposure to HCV infection.^[14]

On the basis of 2015 estimate of anti-HCV,^[1] and given a national population of about 90 million persons, 9 million were estimated to be exposed to HCV infection in Egypt. The prevention and control of HCV in a community with this high burden of exposure is complex and challenging in terms of describing and determining the drivers and risk factors of HCV exposure. Studying the prevalence of HCV exposure in the health-care workers (HCWs), a population with the high probability of HCV transmission, would provide data on the priority of anti-HCV treatment and prevention in Egypt.

The distribution and determinants of HCV exposure and related risk factors are fundamental for rational allocation of resources for the intervention by reducing exposure to HCV infection.^[15] In this study, we aimed to estimate the HCV exposure rate among HCWs in an area related to rural Lower Egypt governorates.

METHODS

Study population

A cross-sectional study was conducted between June 2014 and June 2015 among HCWs at rural Lower Egypt governorates. The residence of included HCWs related to Gharbia ($n = 505$), Monufia ($n = 26$), Beheira ($n = 12$), Kafr El Sheikh ($n = 6$), and other governorates ($n = 15$). All currently employed staffs were invited to the study during an eight-week period. All those aged more than 16 years were eligible for the study. Medical and nursing students were ineligible for recruitment.

Study recruitment

The recruitment of HCWs was based on the study enrolment acceptance without any random selection. All included HCWs ($n = 564$) completed both the study questionnaire and provided a blood sample for testing. A single study-trained researcher collected data from all study participants. Data on personal demographics and risk factors of HCV infection were collected.

Blood sampling

For each study participant, 5 ml of venous blood was collected. Each sample was centrifuged within 6 h of collection into two serum aliquots for storage at -21°C and further testing later.

Anti-HCV serology

All HCWs tested for the presence of anti-HCV by third-generation enzyme-linked immunosorbent assay.

HCV RNA isolation and nested PCR

Anti-HCV-positive samples ($n = 49$) were tested for HCV RNA by nested polymerase chain reaction (PCR). Viral RNA was extracted using the viral RNA mini kit (Qiagen, Hilden, Germany) according to the provided protocol. The first strand of complementary DNA (cDNA) was synthesized. Initial denaturation was performed at 95°C for 5 min. PCR amplification was carried out at 94°C for 1 min, at 57°C (annealing temperature) for 1 min, and 72°C for 1 min for a total of 40 cycles and the final extension at 72°C for 7 min. The primer sequences are as follows: forward 5'CGCGCGACTAGGAAGACTTC3' and reverse 5'ACC CTCGTTTCCGTACAGAG3'.

Following testing, all staffs are provided with test results on an individual basis. All procedures performed in the study were approved by Al-Azhar University ethics committee and in concordance with the 1964 Helsinki declaration and its later amendments. Informed consent was obtained from all individual participants included in the study.

Statistical analysis

SPSS version 17 was used for the analysis. Differences in frequency between groups were compared with the chi-square test or the Fisher exact test. A P value of <0.05 was considered significant.

RESULTS

Characteristics of HCWs

Five hundred and sixty-four (564) HCWs were enrolled. While 258 (45.74%) of the included workers provided direct health care to patients, 306 (54.25%) were non-health-care providers. Among included HCWs, 245 (43.44%) were females and 319 (56.56%) were males. The mean age of the study population was 33.0 ± 9.8 years (range 16–64). The mean duration of health-care work was 9.3 ± 6.7 years (range 1–30). About 9, 13, and 15 HCWs had a history of HCV infection, parenteral antischistosomal therapy (PAT), and history of type II diabetes mellitus, respectively. None of the included HCWs had a history of prior surgery, blood transfusion, or hemodialysis.

Anti-HCV among HCWs

Anti-HCV seropositivity was detected in 49 (8.7%) of enrolled HCWs. Among the 461 HCWs registered in the governmental hospital, anti-HCV was detected in 40 individuals (8.67%); of them, 18 (45%), 16 (40%), and 6 (15%) related to tertiary, secondary, and primary care facilities, respectively. The frequency of anti-HCV among governmental HCWs (8.67%) was comparable to that in non-governmental HCWs [8.73% ($n=9/103$)]. Although anti-HCV was not detected in any of the physician or laboratory technicians, it was detected in 7.94% ($n=19/239$) of nurses.

About 9.8% ($n=30/306$) of non-health-care providers tested positive for anti-HCV. Indeed, anti-HCV was detected in 9.67% ($n=15/155$) of ward workers, 11.76% ($n=8/68$) of officers, 10% ($n=4/40$) of security workers, 5.88% ($n=2/34$) of drivers, and 11.11% ($n=1/9$) of cooks.

Old age, prolonged duration of health-care work, the presence of diabetes mellitus, and history of PAT were significantly associated with anti-HCV seropositivity (Table 1).

HCV RNA among HCWs

Among 49 anti-HCV seropositive HCWs, 40 (81.63%) were HCV RNA positive by nested PCR. The frequency of viremia among anti-HCV seropositive governmental HCWs was 82.5% ($n = 33/40$). On the other hand, the frequency of viremia among anti-HCV-positive non-

governmental HCWs was 77.77% ($n=7/9$). While 63.15% ($n=12/19$) of anti-HCV-positive nurses had positive viremia, 93.33% ($n=28/30$), of anti-HCV-positive non-health-care providers had positive viremia.

HCV infection in different age groups

The anti-HCV frequency steadily increased with age (Table 2). All HCWs younger than 25 years ($n=104$) were seronegative for anti-HCV. While 4.3% (15/347) of HCWs younger than 35 years were anti-HCV seropositive, 15.66% ($n= 34/217$) of HCWs aged 35 years or older were positive for anti-HCV. The rate of active HCV infection increased with age (Table 2). The frequency of active HCV infection among anti-HCV-positive HCWs younger than 45 years was 75.8% ($n=22/29$). In contrast, the frequency of active HCV infection in anti-HCV-positive HCWs aged 45 years or older was 90% ($n = 18/20$).

Table 1: Factors associated with hepatitis C virus exposure in health-care workers

	Antibody against hepatitis C virus		<i>t/x²</i>	<i>P</i>
	Negative	Positive		
Age	32.19 ± 9.23	42.04 ± 10.78	7.030	<0.001*
Females	228(44.3%)	17(34.7%)	1.671	0.196
Males	287(55.7%)	32(65.3%)		
Duration of health-care work	8.70 ± 6.14	15.17 ± 8.43	6.796	<0.001*
Diabetes mellitus	11(2.1%)	4(8.2%)	6.285	0.010*
Parenteral antischistosomal therapy	2(0.4%)	11(22.4%)	96.714	<0.001*
Governmental health-care workers	421(81.74%)	40(81.63%)	0.000	0.984
Non-governmental health-care worker	94(18.25%)	9(18.36%)		
Health-care provider	246(47.76%)	12(24.48%)	6.37	0.012*
Non-health-care provider	269(52.24%)	37(75.51%)		

* Statistically significant.

Table 2: Distribution of hepatitis C virus markers in different age groups of health-care workers

Age group	Anti-HCV	HCV RNA
16–24 years ($n = 104$)	0	0
25–34 years ($n = 243$)	15 (6.2%)	12 (4.9%)
35–44 years ($n = 142$)	14 (9.85%)	10 (7%)
45–54 years ($n = 53$)	12 (22.64%)	11 (20.75%)
55–64 years ($n = 22$)	8 (36.36%)	7 (31.8%)
Total 564	49	40

Anti-HCV: antibody against hepatitis C virus; HCV RNA: hepatitis C virus ribonucleic acid.

DISCUSSION

The worldwide prevalence of anti-HCV among HCWs ranges from 0% to 9.7%.^[16] Based on the four case control studies, the anti-HCV prevalence in HCWs is comparable with that of the general populations of the same country^[17-20] In 2008, a cross-sectional study was performed on 1,770 HCWs at Cairo and the prevalence of anti-HCV was found to be 8%.^[21] This was comparable to the anti-HCV prevalence in the general populations of Cairo governorate in 2008.^[22] Going with this notion, the anti-HCV prevalence (8%) among HCWs was approximately similar to that (7.39%) in general populations of rural Lower Egypt governorates on 2015.^[1] The high anti-HCV prevalence among Egyptian HCWs suggests mass screening of all HCWs dealing with infectious secretions or tissues and those performing exposure prone procedures (EPPs). The comparable anti-HCV frequency among HCWs and general populations infer that the Egyptian HCWs may not on the need for prioritized treatment interventions.

The prevalence of anti-HCV among general populations (aged 15–59 years) in rural Lower Egypt governorates reported being declined from 12%^[22] to 7.3%^[1] between 2008 and 2015. This decline was largely attributed to the aging of the initially infected cohort, as the bulk of HCV infection took place between 1960 and 1980.^[1] On the other hand, Cuadrose *et al.*^[23] identified significant HCV prevalence among subjects older than 30 years and those younger than 30 years and supported the interpretation of considerable ongoing HCV infection in Egypt.^[23] Unlike Cuadrose *et al.*^[23] findings, the prevalence of anti-HCV among HCWs younger than 35 years (4.32 %) was significantly lower than that (15.66%) detected in HCWs aged 35 years or older in our study. Moreover, the prevalence of anti-HCV steadily increases parallel to aging and increased duration of health-care work. Indeed, the mean age of anti-HCV-positive HCWs (42.04 ± 10.78) was significantly higher than that of anti-HCV-negative HCWs (32.19 ± 9.23). The pre-service education of safe health care and prevention of blood-borne pathogen carried out since 2008, and targeting HCWs, may provide the explanation for the lower anti-HCV prevalence in HCWs younger than 35 years in our study compared with the young (<30 years) general populations in Cuadrose *et al.*'s study. This explanation may be supported by the fact that anti-HCV was more prevalent in manual workers, cooks, drivers, and security officers, HCWs with poor educational level^[21, 24] and not usually involved in the pre-service education programs of safe health care.

Based largely on indirect evidence,^[5, 25-28] it was believed that an extensive iatrogenic exposure to HCV occurred during the mass PAT campaign in Egypt. These campaigns were

phased out across Egypt by the late 1970s and early 1980s. This association between PAT and HCV infection was further reported among Egyptian HCWs.^[24, 21] Based on our findings, the history of PAT exposure was also identified as a risk for HCV infection among HCWs, where 84.6% of HCWs with PAT were HCV infected. Egypt Health Issue Survey study suggested that the marked reduction in HCV prevalence among Egyptian general population is mainly attributed to the aging of the group infected during the mass antischistosomal treatment campaign.^[1] On the other hand, the majority (77.55%) of HCV-infected HCWs in our study denied any history of PAT exposure. Furthermore, the mean age of anti-HCV-positive HCWs with PAT exposure (41.27 ± 8.9 years) and those without PAT exposure (42.26 ± 11.36 years) was comparable. These findings support the conclusion that PAT is only one factor among others that driven HCV transmission among Egyptian general population^[23] and HCWs.^[21]

Anti-HCV seropositivity in the absence of HCV RNA mostly indicates eradicated past infection. The frequency of eradicated past infection (36.85%) among nurses was markedly higher than that (6.7%) detected in non-health-care providers in our study. Munier *et al.* reported that 48.8% of anti-HCV-positive HCWs were negative for HCV RNA and concluded that the cellular and innate immune responses to frequent occupational blood exposure might be associated with protection against HCV persistence in HCWs.^[29]

The rate of persistent HCV infection among our anti-HCV-positive HCWs was 81.6%. The frequency of HCV RNA positivity increased with age (Table 3). The higher susceptibility of old age HCWs to persistent HCV infection was previously reported by Munier *et al.* Old age could be associated with a decreased immunity, with the T-cell repertoire potentially exhausting over time after multiple stimulations.^[29]

CONCLUSION

Egyptian HCWs have no increased anti-HCV rate compared with the general population in rural Lower Egypt governorates. Older Egyptian HCWs have increased rate of active HCV infection. Nurses may have more protection against HCV persistence compared with non-health-care providers. PAT is only one factor, among others, that determined HCV risk among Egyptian HCWs. The high rate of HCV infection suggests mass screening of Egyptian HCWs.

Conflict of Interest

All other authors declare no competing interests.

Ethical approval

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

Informed consent

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

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