

Maria Gańczak¹, Marcin Korzeń², Barbara Owsianka³, Zbigniew Szych⁴

CONCERNS OF OCCUPATIONAL HIV INFECTION AMONG SURGICAL STAFF IN THE LIGHT OF ANTI-HIV SERO-STATUS AND THE DISTRIBUTION OF $\Delta 32$ ALELLE OF THE CCR5 GENE: A CROSS-SECTIONAL STUDY*

¹Department of Public Health, Pomeranian Medical University, Szczecin, Poland

²Department of Methods of Artificial Intelligence and Applied Mathematics, Westpomeranian University of Technology, Szczecin, Poland

³Tertiary Referral Hospital, Zgorzelec, Poland

⁴Department of Computer Science and Education Quality Research, Pomeranian Medical University, Szczecin, Poland

ABSTRACT

Surgical staff might be considered at most risk of accidental viral infection due to their higher exposure to blood.

AIM. To evaluate surgical staff concerns about occupational HIV infection, to determine contributing factors, to assess their sero-status regarding this pathogen, and the frequency of the $\Delta 32$ allele of the CCR5 gene.

METHODS. With the use of a self-administered anonymous questionnaire a cross-sectional sero-survey was conducted from February 2009-January 2010 among doctors/nurses from the surgical/ gynaecological wards of 16 randomly selected hospitals in Western Pomerania, Poland. Fear level was measured by the use of the VAS scale (range 0-10). Serum samples were tested by ELISA. Genotyping was performed using a PCR-AFLP assay.

RESULTS. Response rate 84.9%; 427 participants, 88.3% females; 84.8% nurses, 15.2% doctors (median age 42 years, range 22-61 years). More than two thirds of respondents (67.2%) overestimated HIV single exposure risk. The median level of occupational HIV fear was 6.67. The prevalence of anti-HIV was 0.0% (95%CI: 0-0.9%); 1.2% (95%CI: 0.5%-2.9%) of participants were homozygotes $\Delta 32/\Delta 32$. The stepwise regression model revealed that job category (nurse) was associated with HIV fear ($p < 0.001$).

CONCLUSIONS. The risk of contracting occupational HIV infection remains low; no anti-HIV positive individuals were found among surgical staff, one in one hundred were resistant to HIV infection. Staff members, especially nurses, were much concerned with acquiring an occupational HIV infection, possibly due to the lack of knowledge on single exposure risk. Educational actions and better access to specialists which would help surgical staff in managing anxiety at the workplace is urgently needed.

Key words: *HIV infection; surgical staff; concerns; determinants; anti-HIV, $\Delta 32$ allele; CCR5 gene*

INTRODUCTION

Most studies define the risk of occupational infection with blood-borne viruses for health care workers (HCWs) as influenced by the prevalence of infections in the general population, a probability of transmission by single exposure, the frequency of exposure and a lack of post-exposure prophylaxis (1).

Surgical staff might be considered at most risk of accidental viral infection due to their higher exposure to blood (2-5). As an example, a study in selected British hospitals, carried out on staff who took part in operations, found that one in four members reported receiving at least one needle-stick injury during a surgical procedure in the preceding 12 months (4). By their final year of training, 99% of surgeons within residency

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programs in general surgery in the United States had experienced a needle-stick injury; for 53%, the injury involved a high-risk patient (5). Even when taking into account the comparatively low prevalence of HIV (human immunodeficiency virus) in Europe, estimates of the lifetime risk of contracting HIV as a result of a sharps injury during surgery are as high as 0.3%, mainly due to the number of blood contacts experienced (5).

The danger of blood-borne virus contraction by those members of staff who are injured fuels anxiety. Previous studies of HCWs have documented that fear is a persistent reaction to the HIV epidemic and was largely driven by the enormity of the anticipated health, as well as social consequences of having a positive HIV test result (6-8). Moreover, the evidence shows that fear of contracting HIV seems to be the driving force for the negative attitudes toward patients infected with HIV and for the demand of universal testing (7,9). Although anxiety tends to be greatest over an acquisition of HIV infection, viral hepatitis poses a greater risk (1). The risk of sero-conversion following inoculation with blood from a patient infected with HIV is approximately one hundred times lower than for the hepatitis B virus (HBV) where a patient presents HBe antigen. HIV-1 fusion with a cell is dependent on chemokine receptors CCR5 on the cytoplasmic membrane. However, in the Caucasian population the CCR5 gene variant is widely observed with 32 base pair deletion frameshift mutation (CCR5- Δ 32) (10,11). Homozygotes for the Δ 32 allele lack CCR5 expression on the cell surface. Epidemiological studies have shown that individuals homozygous for CCR5- Δ 32 have a 100-fold reduction in HIV infection incidence, whereas heterozygotes who inherit one allele which encodes the wild type protein and one CCR5- Δ 32 which displays delayed progression to AIDS compared to individuals inheriting two wild alleles (10-12). This is the result of the lower CCR5 receptor expression on the cell surface which slows down the replication process. Of note, homozygotic mutation of the CCR5 receptor does not offer complete protection from HIV infection, the virus may reach susceptible cells using some other co-receptors (11).

The paucity of studies such as this one, which aim to evaluate surgical staff concerns about occupational HIV infection, determine contributing factors, assess their sero-status regarding this pathogen, and the frequency of the Δ 32 allele of CCR5 gene, have necessitated this survey.

METHODS

The study was conducted between February 2009 - January 2010 among doctors and nurses from surgical and gynaecological wards from 16 randomly selected

hospitals (6 urban: 2 teaching, 4 other, and 10 provincial) all located in West Pomerania, Poland, which were 50% of the hospitals in the study area. A pilot study was performed in a selected teaching-urban hospital (13).

Study instrument. After signing an informed consent, all participants filled an anonymous questionnaire which included questions that queried them on demographics, knowledge on single HIV exposure risk, concerns regarding occupational HIV infection measured with the use of VAS – a Visual Analog Scale (numerical variable taking values from 0 to 10) (14).

Sero-testing and genetic testing. Blood samples were collected by venipuncture from staff present at the ward on the day the study was conducted after written consent. Enzyme immunoassay (ELISA) system version 3.0 was used to detect anti-HIV (Abbott Laboratories Inc., Abbott Park, IL, USA). All subjects were genotyped for the presence of the Δ 32 allele (32-bp deletion in the CCR5 gene). Genomic DNA was extracted from 450 μ l whole blood samples using a Genematrix Quick Blood Purification Kit (Eurz, Poland). Genotyping was performed at the Department of Pharmacology, the Pomeranian Medical University using a PCR-AFLP (*polymerase chain reaction – amplified fragments length polymorphism*) assay; slight modifications were introduced (12).

Data analysis was carried out using the STATISTICA PL software (StatSoft) Version 10 and R software (16). The outcome variable was the fear level of acquiring occupational HIV infection (numerical outcome). Univariate analysis was used to assess the possible association between: demographic characteristics (age, sex, job category), type of ward, type of hospital, work load (hours/week), number of sharp injuries sustained during the past 12 months, previous training in blood-borne pathogen infection control, and outcome variable. In univariate analysis, for categorical variables groups were compared using the chi-square test with Yates correction factor and Fisher's exact test; the Mann-Whitney test was used for numeric variables. All variables used in the univariate analyses and significant ($p < 0.05$) at the univariate level were then used to fit stepwise regression models. A standard regression model was built for the predicted outcome variable listed above. A stepwise analysis was used to select significant variable subsets. The coefficients in the regression model (betas, that are connected with the correlation coefficient), were used to assess the correlation between one of the variables and fear level.

The study was approved by the Pomeranian Medical University Research Ethics committee.

RESULTS

Response rate was 84.9%. Of the total 590 personnel eligible, 427 individuals (85.2%) consented to participate, 377 of them (88.3%) were females. The median age for the study population was 42 years (range 22-61 years). There were 84.8% (362/427) nurses and 15.2% (65/427) doctors, most of whom (76.9%) were males. More than a half (54.3%; 232/427) of the participants were from provincial hospitals, the rest - from Szczecin city hospitals (27.9%; 119 from teaching hospitals, 17.8%; 76 from other hospitals). Over a half (53.2%; 227/427) of the participants worked in surgical wards, 25.1% (107/427) in gynaecologic wards, 16.6% (71/427) in the operating room, 5.1% (22/427) in the admittance area.

The number of working hours per month was <85 for 5.4% (23/427) of respondents, 86-170 for 65.6% (280/427), >170 for 29.0% (124/427). During the preceding year one half of respondents (50.6% (216/427) sustained at least one sharps injury; the mean number of sharps injuries per HCW per year was 1.74. More than three quarter of respondents (79.6%; 340/427) were trained in the prevention of blood-borne infections.

Assessment of a single exposure to HIV risk. Only 18.7% (80/427) of participants correctly defined the risk of a single exposure to HIV, the rest overestimated the risk, assessing it as 6% (23/427; 5.4%), 30% (196/427; 45.9%) or 60% (68/427; 15.9%); 14.1% (60/427) did not know the correct answer (fig. 1).

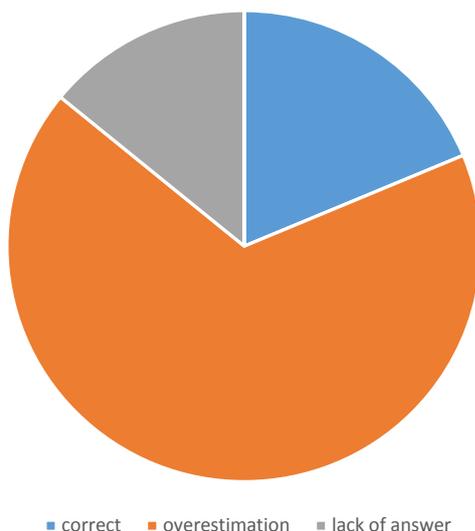


Fig. 1. Estimation of the single HIV exposure risk by surgical staff (Westpomeranian region, Poland, 2009-2010, n=427)

Concern regarding occupational HIV infection. Almost all (96.4%) surgical staff expressed concern regarding occupational HIV infection with a median

(Me) level of 6.67. Results depended on gender (5 for men, 7 for women; $p < 0.0001$) and job category (5 for doctors, 7 for nurses; $p < 0.0001$). Operating room personnel were more concerned (Me=7) than those working at surgical wards (Me=6); $p = 0.009$. Those sustaining 1-5 sharps injuries in the last 12 months were more concerned (Me=7) than those sustaining 6 and more injuries (Me=5), however the difference was not statistically significant ($p = 0.10$). No statistically significant differences ($p > 0.05$) between age, number of working hours/week, facility location or blood-borne pathogen control training were found.

After stepwise analysis 3 variables (Job category, Number of injuries in the last 12 months, blood-borne pathogen control training) - were selected for HIV fear level estimates. It revealed that job category (nurse) was associated with HIV fear ($p < 0.001$).

Prevalence of anti-HIV. No anti-HIV positive individuals were found (0%, 95%CI:0-0.9%; 0/427).

The frequency of the $\Delta 32$ allele. Out of 427 study participants, the extraction of genomic DNA failed in 24, therefore 403 individuals were finally analysed. Among 403 individuals, 71 (17.6%; 95%CI:14.2%-21.6%) were carriers of the mutated allele: 5 of these (1.2%; 95%CI:0.5%-2.9%) were homozygotes $\Delta 32/\Delta 32$ and 66 (16.4%; 95%CI:13.1%-20.3%) were heterozygotes $+\Delta 32$.

DISCUSSION

To our knowledge this is the first study to investigate the concern regarding occupational HIV, infection in the light of anti-HIV, and the frequency of the $\Delta 32$ allele among surgical staff. No anti-HIV positive individuals were found. One in six participants was a carrier of the mutated allele $\Delta 32/\Delta 32$, 1.2% were homozygotes. Knowledge about post-exposure seroconversion rates was disturbingly low. Most surgical staff feared occupational blood-borne HIV infection. The respondents' concerns of occupationally acquired viral infection were associated with job category.

According to medical literature, worldwide, the number of HIV infected HCWs who have acquired an infection at work is relatively low, when compared to HBV and HCV infections (18,19). However, the majority of surgical staff surveyed in this study feared acquiring occupational HIV infection which is in accordance with other findings (6-8). Slight or moderate concern about contracting HIV was reported by most US surgeons surveyed by *Patterson et al.*; 8% reported extreme concern, only 4% - no concern (20). *Moghim* et al. (21) conducted a study among surgeons in Iran

and found that concern about being infected with any blood-borne infection was expressed by more than 70%. The majority of Ugandan midwives and almost three quarter of Nigerian orthopaedic surgeons indicated concern over the risk of occupational acquisition of HIV (22,23). Nevertheless, the prevalence of HIV infection in the general population in Poland is 0.02% (24), much lower than among African populations, which suggests that the occupational risk for acquiring HIV for those working in the health sector is notably low. In addition, there are also recommendations on post-exposure prophylaxis in Poland (25). However, recommendations do not always mean a universal access.

Of note, HIV prevalence among hospitalized patients is low. No anti-HIV positive case was found among 1652 patients admitted to the same wards from which the staff representing our study population were recruited, and among 5712 blood donors observed at the same time (26). In addition, for a fraction of HCWs this risk of acquiring HIV is even less than for other workers due to the presence of genetic resistance: 1.2% of surgical staff were homozygotes $\Delta 32/\Delta 32$. The frequency of the $\Delta 32$ allele among surgical staff in West Pomerania was similar to that reported for the population of Polish blood donors (27) and for newborns from a regional hospital (12). The low risk of occupational acquisition of HIV can be illustrated by some studies on surgical staff conducted worldwide (18,19) and by the results of this study.

Sadly, despite the passage of time and gradual taming of the HIV/AIDS epidemic, a marked fear of acquiring HIV infection at work remains at the same level. Our previous study conducted among Polish surgical nurses from the region of West Pomerania in 2003 revealed that 96% fear acquiring a HIV infection at work (7). As reported in that study, the high level of concern about acquiring an occupational HIV infection might fuel the universal support of routine HIV testing of patients. *Chan et al.* examined the perceptions of accidental occupational exposure to HIV among nurses in Bangkok, Thailand (6). The nurses' accounts revealed that despite the acknowledgement of the low probability of occupational exposure to HIV, the fear of HIV infection remained. The perceived certainty of social ostracism was reinforced by the participants' observations of social rejection experienced by those living with HIV/AIDS both within and outside the healthcare sector.

Concern regarding the acquisition of a HIV infection at work might be correlated with the erroneous risk assessment of contracting an infection after a single exposure. What is noteworthy, despite previous training on bloodborne infections, two third of participants overestimated the risk. This points to the need of improving teaching methods, especially regarding the blood transmission risk.

This study is a self-reported questionnaire based study. Therefore, the study method is liable to recall and information bias. Secondly, results from the surgical and gynecological wards should be analyzed with caution as they may not be generalizable to the other wards, located in other regions of the country. Further studies at a national level would be of value. Thirdly, while we highlighted staff' demographic, and work-related characteristics, other factors might have also influenced occupational concerns.

The strength of the study was due to the administration of questionnaires from randomly selected hospitals with a relatively good response rate of 85%. Moreover, concerns about occupationally acquired HIV were confronted with the results of participants' serology tests and genotyping for the presence of the $\Delta 32$ allele.

In conclusion, over 30 years after the onset of the HIV/AIDS epidemic, the concern of transmission of blood-borne pathogens from patients still exists among surgical staff despite complete HBV vaccination uptake and universal access to post-exposure prophylaxis. Surgical staff seems to be ill-equipped to deal with their own fears. It might also influence an unwillingness to check personal serological status.

Successful strategies aimed at reducing the high degree of concern related to the occupational acquisition of viral infections observed among HCWs should include education on the risk factors and correct estimations of post-exposure seroconversion rates (28). It could result in an increase in reporting rates with subsequent testing for anti-HIV when required. In addition, the wide implementation of preventative methods, e.g. creating a safe workplace with adequate access to safety equipment and the strict enforcement of universal precautions to decrease the number of sharps injuries are matters of necessity. The results also point to the establishment of greater access to specialists which would help surgical staff in managing anxiety and stress in the workplace and support mental health in this group. Although the interventions should cover all HCWs, nurses and those overloaded with work should be focussed on as a group of special interest.

CONCLUSIONS

1. The occupational risk for acquiring HIV for those working at surgical wards is low; no anti-HIV positive individuals were found, one in one hundred participants was resistant to infection with R5 HIV strain.
2. Surgical staff, especially nurses, feared occupational blood-borne HIV infection which may be influenced by the lack of knowledge about single exposure risk.
3. The results point to take adequate educational actions

and to establish greater access to specialists which would help surgical staff in decreasing concern related to the workplace.

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Address for correspondence:

Maria Ganczak, MD, PhD, Professor of PUM
Department of Public Health
Pomeranian Medical University
Zolnierska 48, 71-210 Szczecin, Poland
tel. +48 91 4800995
e-mail: mganczak@pum.edu.pl

