OCCUPATIONAL EXPOSURE OF INTERNS TO BLOOD IN AN AREA OF HIGH HIV SEROPREVALENCE

A S Karstaedt, L Pantanowitz

Objective. To determine the epidemiology of work-related exposure to blood among interns.

Design. Interns were invited to complete anonymously a questionnaire concerning their past percutaneous and mucocutaneous exposures to blood.

Setting. Chris Hani Baragwanath Hospital, Soweto, and Johannesburg Hospital, Gauteng, where HIV infection is common among patients.

Results. Ninety-eight interns (96%) were surveyed. Sixty-nine per cent of interns reported one or more percutaneous exposures to blood during the intern year, and 33% of interns recalled accidental percutaneous exposure to HIV-infected blood. Forty-five per cent recalled a mucocutaneous exposure to HIV-positive blood. Only 28 (64%) of 44 percutaneous injuries from HIV-infected patients were reported. During their student clinical training, 56% of interns had suffered a penetrating injury, and 18% recollected needlestick injuries involving HIV-infected patients. The most common mechanisms of injury included unexpected patient movement (23%), needle recapping (17%), and withdrawal of the needle (17%). Half of the injuries occurred during the first 4 months of internship. Only 22% of intern percutaneous exposures could have been avoided by following universal precautions.

Conclusions. Intern and medical student exposure to blood is extremely common, but is markedly underreported. Strict compliance with universal precautions will not prevent the majority of exposures. Priorities should be the introduction of safer techniques and equipment, skills training and methods of reporting blood exposures.

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Accidental exposure to blood is a documented mode of transmission for many blood-borne diseases including herpes simplex,[1] herpes zoster,[2] hepatitis B,[3] hepatitis C,[4,5] Rocky Mountain spotted fever,[6] malaria,[7] syphilis,[8] tuberculosis,[9] cryptococcosis,[10] and HIV infection.[11,12] The risk after a percutaneous injury involving an infected patient is approximately 30% for acquisition of hepatitis B virus,[13] 3 - 10% for hepatitis C virus[14] and 0.3% for HIV.[15] These infections can also be transmitted through mucous membranes and non-intact skin, albeit at a much reduced rate. There is significant underreporting of exposures among health care workers.[16-19]

In order to prevent accidental exposure of health care workers and to promote a safe working environment, knowledge of the rates and mechanisms of occupational exposure is required. We surveyed interns in Soweto and Johannesburg, Gauteng, which is an area with a high estimated seroprevalence rate for HIV infection (22% in 1997 among antenatal clinic attenders[20]), in order to determine the epidemiology of occupational blood exposures in this group. We investigated the self-reported incidence of percutaneous and mucocutaneous exposure to patient blood, the circumstances under which needlestick injuries occur, as well as the extent of and reasons for underreporting.

SUBJECTS AND METHODS

Setting

The study was conducted between November and December 1998 at two teaching hospitals affiliated to the University of the Witwatersrand Faculty of Health Sciences, namely Chris Hani Baragwanath Hospital, Soweto, which had 64 interns, and Johannesburg Hospital, which had 38 interns. Interns at these hospitals were responsible for most instances of venepuncture, insertion of peripheral venous lines and assisting in theatre. All except 2 interns were completing their 12-month rotation through two or three of the departments of medicine, surgery, and obstetrics and gynaecology. A period in paediatrics was offered at Johannesburg Hospital only.

Data collection

All interns were invited to complete, voluntarily and anonymously, a questionnaire distributed to the wards where they were working. The study was approved by the University of the Witwatersrand's Committee for Research on Human Subjects and by the respective hospital superintendents.

Questionnaire

A needlestick injury was defined as a cutaneous cut, scratch or puncture from a needle or other sharp object that was contaminated with a patient's blood, whether or not the injury drew blood from the intern. A mucocutaneous exposure involved blood from an HIV-infected patient coming into contact with eyes, oral mucous membranes, or non-intact skin. In cases where respondents wrote 'many' mucocutaneous exposures, five exposures were recorded.

Department of Medicine, Chris Hani Baragwanath Hospital and University of the Witwatersrand, Johannesburg

A S Karstaedt, MB BCh, MMed, DTM&H
L Pantanowitz, MB BCh, BSc Hons

The questionnaire was divided into four sections. The demographic information obtained included only the date internship commenced and gender. The first section asked about the total number of percutaneous exposures to blood experienced both during the intern year and the 3 years of medical student clinical training, as well as the number of percutaneous and mucocutaneous exposures to HIV-infected blood. The second section collected information on the circumstances of the percutaneous injuries in the intern year, including the mechanism of injury, whether the injury was reported, the month of the year and the department worked in at that time, if there had been exposure to blood-borne diseases other than HIV infection, and whether post-exposure prophylaxis was taken for HIV exposure. The third section sought the reasons for not reporting percutaneous exposures. The fourth section provided the opportunity for comments on any of the issues around occupational exposures.

Statistical analysis

Comparison of proportions was performed by chi-square analysis.

RESULTS

All 98 interns, 50 female and 48 male, who were given questionnaires, completed and returned them. Four interns (4%) were not included as they were on leave at the time the survey was administered.

Frequency of exposure

Eighty-one respondents (83%) recalled at least one percutaneous injury during medical school or internship, and 42 (43%) recollected a percutaneous exposure to HIV-seropositive blood (Table I). Percutaneous exposures to blood and to HIV-seropositive blood respectively were reported in 47 (74.6%) and 21 (33.3%) of the 63 interns at Chris Hani Baragwanath Hospital compared with 21 (60.0%) and 11 (31.4%) of the 35 interns at Johannesburg Hospital, and in 32 (66.7%) and 13 (27.1%) of the 48 males compared with 36 (72.0%) and 19 (38.0%) of the 50 female interns. There was no significant difference in exposures between hospitals or between male and female interns. During student training, 5 females (10%) had had percutaneous exposures to HIV-infected patients compared with 13 males (27%) ($P = 0.029$). The house officers had a total of 177 percutaneous injuries during their intern year, of which 44 were from HIV-infected patients, and 116 mucocutaneous exposures to HIV-infected blood. As students they had experienced 90 percutaneous exposures, of which 24 involved HIV-seropositive blood, and 67 mucocutaneous exposures to HIV-infected blood (Table II). Twenty-nine interns (30%) recalled 3 or more percutaneous injuries during the intern year. A prior injury sustained as a student did not significantly affect the chances of injury as an intern.

Exposure circumstances

Table III details the type of sharp, procedure, mechanism of injury, and period of internship for percutaneous injuries in the intern year. Over half the injuries involved phlebotomy or placement of an intravenous catheter. There were similar rates of injury during and after the procedure, with the commonest mechanisms being unexpected patient movement, and withdrawal and recapping of needles. Gloves were reported to

Table I. Number of respondents with percutaneous injury or mucocutaneous exposure to blood

	Percutaneous injury (≥ 1) from any source *N* (%)	Percutaneous injury (≥ 1) from HIV-positive source *N* (%)	Mucocutaneous exposure to HIV-positive source *N* (%)	Any exposure to HIV-positive source *N* (%)
Intern year	68 (69.4)	32 (32.7)	44 (44.9)	61 (62.2)
Student years	55 (56.1)	18 (18.4)	28 (28.6)	37 (37.8)
Combined	81 (82.7)	42 (42.9)	53 (54.1)	69 (70.4)

Table II. Frequency of exposure to blood during intern year or student clinical years (3 years)

	Intern year	Student years	Student/year*
Needlestick injury/person	1.81	0.92	0.31
HIV-positive needlestick/person	0.45	0.24	0.08
HIV-positive mucocutaneous exposure/person	1.18	0.68	0.23

* Frequency of exposure as a student expressed as an annual risk to allow for comparison with intern annual risk.

Table III. Type of sharp object, procedure, and mechanism of percutaneous injury among interns

	N (%)
Sharp object (*N* = 168)*	
Hollow needle	116 (69.0)
Suturing needle	47 (28.0)
Other	5 (3.0)
Procedure (*N* = 177)	
Phlebotomy	73 (41.2)
Suturing	36 (20.3)
Intravenous catheterisation	29 (16.4)
Arterial puncture	10 (5.6)
Capillary puncture	3 (1.7)
Other	14 (7.9)
Could not recall	12 (6.8)
Mechanism (*N* = 167)*	
During procedure	83 (49.8)
Inserting needle	16 (9.6)
Unexpected patient movement	39 (23.4)
Withdrawing needle	28 (16.8)
After procedure	76 (45.5)
Recapping	29 (17.4)
Disassembly	5 (3.0)
Unattended needle	8 (4.8)
Stuck by colleague	12 (7.2)
Disposal	17 (9.6)
Other	5 (3.0)
Could not recall	8 (4.8)
Period of internship (months) ((*N* = 122)*	
1 - 4	61 (50.0)
5 - 8	40 (33.8)
9 - 12	21 (17.2)

* Information was not provided for all percutaneous exposures.

have been worn for 116 exposures (66%). If interns had followed universal precaution guidelines,[21] then 37 (22%) of the needlestick injuries caused by recapping or unattended needles could have been avoided. Unusual mechanisms of injury reported included penetration of skin by a bony fragment during open heart massage, and stabbing with a used hollow needle by a delirious patient. One intern was documented as having been exposed to syphilis. Of the 145 percutaneous injuries so noted, 66 (45.5%) were from the department of medicine, 59 (40.7%) from surgery, 19 (13.1%) from obstetrics and gynaecology, and 1 (0.7%) from paediatrics.

Reporting of percutaneous injuries

Only 28 (64%) of 44 percutaneous injuries from HIV-infected patients and 29 (16%) of 177 percutaneous exposures overall were reported by interns. There was significantly less reporting of HIV-related needlestick injuries by males (10 of 22 (45%)) compared with females (19 of 22 (86%)) ($P = 0.004$), and less initiation of post-exposure prophylaxis by males (10 of 22 (45%)) compared with females (18 of 22 (82%)) ($P = 0.012$). Fifteen (54%) of the 28 interns who started antiretroviral drugs completed the 28-day course. The most frequently cited reason for not reporting a percutaneous injury was that the injury was not perceived as a health risk, or lack of time in the case of HIV-positive exposures (Table IV).

General comments

Further comments were made by 36 interns (37%). Issues raised included fatigue and patient overload which could increase the risk of injury, problems with applying universal precautions, difficulties accessing the drugs for post-exposure prophylaxis, unsympathetic colleagues, and issues of quality of life affected detrimentally by exposure itself or by the side-effects of antiretroviral drugs.

DISCUSSION

The high incidence (69%) of interns with percutaneous injuries was similar to the range of 65 - 77% seen at institutions in other countries.[14,21-23] The recalled rate of percutaneous exposure to HIV-infected blood by the end of medical school training and internship (43%) was higher than the 36% of medical house officers and 19% of paediatric interns in New York[24] and the 19% of San Francisco interns.[14] The elevated rate in our study probably reflects the prevalence of HIV-infected patients in our hospitals, the number of venepunctures and other procedures performed by interns, and possibly suboptimal rates of compliance with infection control procedures as evidenced by one-third of injuries having occurred in ungloved hands. Student exposures over 3 years were much lower than intern exposures over 1 year, probably owing to contact with fewer patients, but this may have been partially counteracted by inexperience. It is nevertheless worrying that over half of those surveyed recalled a percutaneous exposure to blood by the time of graduation, with almost one-fifth of interns having been exposed to HIV in this way. This compares with a 22% rate of 'sharps' injuries among medical students in Australia[22] and the USA.[25]

In our study, 32 interns had a total of 44 percutaneous exposures to HIV-infected blood during the internship year. If the risk of seroconversion after an HIV-related percutaneous injury is 1:300,[15] and if no post-exposure prophylaxis is taken, then we can extrapolate that 1 intern at these two hospitals will become infected every 7 - 8 years. The period of time may be even shorter if the HIV seroprevalence of the patient population increases without a reduction in the number of exposures, and if the risks from mucocutaneous exposures (< 0.1%)[15] are included.

Almost 22% of the needlestick injuries could have been prevented, most notably by avoiding the process of needle recapping. Recapping is often necessary to avoid injuries to others while carrying a contaminated needle and for the purposes of disassembly of the needle from the tube holder.[26]

Table IV. Reasons stated for not reporting percutaneous injuries sustained during internship

Reasons given	All respondents	Respondents without HIV exposures	Respondents with HIV exposures
	N = 55	*N* = 44	*N* = 11
	N (%)	*N* (%)	*N* (%)
Not perceived as health risk	37 (67)	34 (77)	3 (27)
Too angry to report the exposure	13 (24)	9 (21)	4 (36)
Insufficient time	12 (22)	6 (14)	6 (55)
Reporting procedure unknown	10 (18)	7 (16)	3 (27)
Too depressed to report the exposure	4 (7)	3 (7)	1 (9)
Concerned about occupational discrimination	3 (6)	3 (7)	0
Too embarrassed to report the exposure	3 (6)	2 (5)	1 (9)
Too fearful of AIDS to report the exposure	3 (6)	2 (5)	1 (9)
Would rather not know own HIV status	2 (4)	1 (2)	1 (9)
Concerned about confidentiality	2 (4)	1 (2)	1 (9)

Recapping could be avoided in many instances by having a puncture-proof needle disposal box available at the bedside for unscrewing the needle and immediate disposal, or for disposal of needle and barrel as a single unit. Another method that could reduce the exposure rate is to redesign equipment so that the hands are always safely behind the needle.[26] The high rate of unexpected movement on the part of patients needs further analysis in order to differentiate inadequate doctor-patient communication from the need for restraints on the patient's arm. The fact that half the injuries occurred in the first 4 months of internship highlights the need for intensified education on procedures at undergraduate level. This could be achieved by means of skills laboratories and regular assessment of technique. A phlebotomy service should be available at all hospitals for training students and doctors as well as for service purposes.

Underreporting of occupational exposure to blood may lead to an inaccurate estimation of exposure prevalence and of the occupational risk of acquiring HIV infection. This may in turn reduce the hospital's perceived need to comply fully with universal precaution requirements, to change venepuncture equipment or to develop user-friendly procedures for reporting injuries. Failure to report an injury would also lead to forfeiture of the opportunity for post-exposure prophylaxis, which can reduce the risk of HIV seroconversion by 79%.[27] It may prevent access to counselling and support, and possible compensation in the event of seroconversion. A reporting system must ensure confidentiality and should be time-efficient.

An anonymous questionnaire based on recall of exposures has limitations. In particular, recollection may be inaccurate, resulting in possible underestimates[22] or overestimates.[18]

Although we used a broad definition of percutaneous injury, only 3 of 32 interns with an injury involving an HIV-positive patient did not perceive the exposure as a risk. We do not know to what extent these results may be generalisable to other hospitals in South Africa and to other sub-Saharan countries, but it is noteworthy that there were no significant differences between the two hospitals surveyed.

In conclusion, this study suggests that intern and medical student exposures to blood are frequent and that many such injuries are not reported. Strict compliance with universal precautions will not prevent the majority of injuries. Practical advances in safe practice include the use of one-handed recapping, single-use evacuated tube holders (making needle recapping and disassembly unnecessary), increased numbers and better location of safe needle-disposal containers, the introduction of re-sheathing needles and retractable capillary puncture devices, and eliminating the practice of changing needles before filling blood culture bottles.[28] In order to improve reporting of injuries, hospitals need to clarify whether all exposures or only HIV-related ones should be documented and need to consult their health care workers in order to develop rapid methods of reporting that also protect confidentiality. Educational campaigns to disseminate information and raise awareness about blood exposures, and strict application of universal precautions, are the only tools available to our hospitals at present.[28,29] The development and introduction of safer techniques and equipment, while expanding the role of phlebotomy services, should be a priority.

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