Research Article

Occupational Exposure to Blood among Healthcare Workers in National Capital Territory of Delhi

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Abstract

A cross-sectional study on occupational exposure to blood (OEB) among healthcare workers (HCWs) revealed that out of 416 HCWs a total of 139 HCWs encountered 174 OEBs during preceding 6 months, either in the form of high-risk OEBs (OEB-HR, n=101) or potentially risky OEBs (OEB-PR, n=73) with an occurrence rate of 0.49 and 0.35 per person year respectively. The occurrence of OEB-HR was found to be the highest among nurses followed by residents and interns although occurrence of OEB-PR was found to be the highest among laboratory technicians. The occurrence rate of OEB was found to decrease with increasing duration of working experience. Coverage of immunization against HBV and training on safety precautions were less among HCWs with shorter duration of experience. Manipulation of needle or sharp was the major type of activity associated with both OEB-HR and OEB-PR (48.5% and 60.3% respectively) while fatigue was mainly considered by the HCWs to be responsible for the subgroup of exposures in both categories that were unrelated to adherence to safety precautions. Seroconversion for HBV (HBsAg) was recorded in two exposures (one each OEB-HR and OEB-PR categories), both in private setting, from sources with unknown serostatus. The present study points out the need for due recognition of the risk involved in exposure of intact skin to blood in healthcare, expansion of HBV vaccination coverage and mandatory training on standard precautions in healthcare at the entry point in their profession.

Keywords: Occupational exposure, Blood, Healthcare workers, Training.

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Introduction

Healthcare workers (HCWs) are at increased risk of occupational exposure to blood (OEB) leading to acquisition of blood-borne infections including Human Immunodeficiency Virus (HIV), Hepatitis B Virus (HBV) and Hepatitis C Virus (HCV). The World Health Organization estimates that about 3 million high-risk (percutaneous) exposures to blood occur annually among 35 million HCWs globally with over 90% occurring in resource constrained countries as a consequence of which an estimated 66,000 hepatitis B, 16,000 hepatitis C, and up to 1000 HIV infections occur each year.[1]

The categories of medical HCWs posted in wards at junior level in government hospitals as well as in private hospitals cater to the maximum load of immediate patient care while they are relatively more prone to stressful situations in a resource-constrained country like India.[2] In addition, supportive HCWs like nurses and laboratory technicians have also been recognized to be prone to considerable degree of OEB by virtue of handling blood.[1]

To the best of our knowledge there are two published reports from India, including one from our center, on occupational acquisition of HIV-1 infection by HCWs.[3,4] In both of these instances, the exposure occurred in private healthcare setup. Yet, studies from India on assessment of OEB in healthcare have been limited only to those in government sector while there is hardly any study from India on the problem of OEB in private healthcare setup which may be outside regular surveillance on compliance of recommended guidelines for universal precautions.[5] A cross-sectional study was undertaken to assess the magnitude of the problem of OEB among medical officers and supportive HCWs from both government and private healthcare setups in the city of Delhi.

Materials and Methods

Ethical clearance of the project proposal was obtained from independent ethical committee of the National Center for Disease Control, Delhi, following which various hospitals, government and private, were approached for the study and only those from which approval could be obtained were included for the study.

The participants included HCWs with at least 6 months of employment history exclusively either in government or private setups. The medical HCWs included junior-level medical officers designated as interns, junior residents, senior residents in government setups and equivalent designations and responsibilities in private setups, while in both types of setups the supportive HCWs included in the study had common designations, viz., nurses and laboratory technicians. The HCWs in both sectors were stratified as those with experience <1 year, ≥1 to <5 years and ≥5 years.

Information was collected from the HCWs after obtaining their consent on condition of anonymity employing a pre-designed and pretested proforma that included questionnaire on number of OEBs during preceding 6 months. An exposure to blood that might place HCW at risk for HIV, HBV, or HCV infection, i.e., percutaneous injury (e.g., a needle stick or cut with a sharp object) or contact of mucous membrane or non-intact skin (e.g., exposed skin that is chapped, abraded, or afflicted with dermatitis) with blood were categorized as high-risk OEBs (OEB-HRs) in the present study.[6] Further, keeping in mind the greater transmission potential,[7] longer survival under environmental conditions of HBV in compared to HIV[8] and reports of high prevalence of HBV infection among HCWs without any definite history of OEB,[9] any exposure to few drops of blood (>10 drops or more as perceived by HCW) on visibly intact skin was additionally included in the present study as potentially risky OEB (OEB-PR). Information was collected from the HCWs on status of immunization against HBV and on prior training in the area of standard precautions including biomedical waste management.

The proforma also sought information regarding route/mode and activity involved in OEBs, circumstances considered by the HCW to have been responsible for OEBs, whether the exposures were reported to concerned authorities or not, and if reported, the result of the serological tests carried out in the exposed HCWs regarding HIV, HBV and HCV infections at the point of exposure (baseline) as well as serological test result of source blood or source individual (in case the source blood was not available). Follow up visits were undertaken to the hospitals to collect information on post-exposure seroconversion for any of the three agents in the HCWs with history of OEB. Cases that were already positive for any of the three markers at baseline or the cases who encountered OEB in any form between the baseline and follow up testing were excluded for assessment of post-exposure seroconversion. In order to find out the possibility of acquisition of HIV, HBV or HCV infections by HCWs in the absence of recognized OEB, a total of randomly selected 100 HCWs without any history of OEB in any form in the past 6 months were subjected to serological testing for HIV, HBV and HCV infections at the point of

visit (baseline) employing tests described earlier.[10] Those HCWs negative for all the markers at baseline were retested after 6 months to find out seroconversion after excluding cases sustaining OEB in any form between baseline and follow-up testing.

Data were analyzed using student's t-test for continuous variables and Chi-square test for categorical variables using Epi-info 6. A p-value of <0.05 was considered as statistically significant.

Results

In the present study out of 416 HCWs, comprising 216 from government setups and 200 from private setups, a total of 139 (33.4%) HCWs encountered 174 OEBs during preceding 6 months, either in the form of OEB-HR (n=101) or OEB-PR (n=73) with an occurrence rate of 0.49 and 0.35 per person year respectively for the two categories of exposures. The occurrence rates per person year among HCWs from private setup were higher than those from government setup, i.e., 0.60 versus 0.38 for OEB-HR type of exposures and 0.48 versus 0.23 for OEB-PR type of exposures (risk ratio of 1.58 for OEB-HR and 2.07 for OEB-PR respectively in private setups versus government setups). The occurrence of OEB-HR was found to be highest among nurses followed by residents and interns although occurrence of OEB-PR was found to be highest among laboratory technicians (Table 1). The occurrence of OEB was found to decrease with increasing duration of working experience although the trend was statistically significant in case of OEB-HR category of exposures while in case of OEB-PR category of exposure, despite significantly higher occurrence rate among HCWs with less than one year of experience compared to those with longer duration of experience, it failed to show statistically significant trend (Table 2). Majority of OEBs during first year of employment occurred within first quarter (3 months) of recruitment, i.e., 40 out of 59 (67.8%) in case of OEB-HR and 24 out of 30 (80%) in case of OEB-PR compared to other quarters (data not shown in table). Despite higher rate of OEB among the HCWs with lesser duration of work experience, the proportion of HCWs covered under immunization against HBV, full or partial, was less among the HCWs with shorter duration of experience. Regardless of the length of experience in healthcare, a small proportion of HCWs with history of HBV immunization, full or partial, checked their post-vaccinal anti-HBs titer. However, proportion of HCWs receiving formal training on standard precautions showed a significant trend in increase with length of service (Table 2).

It was observed that among the OEB-HR category of exposures, percutaneous exposure through hollow bore needle or cannula was the most common mode of exposure followed by percutaneous exposure through solid needle and injury through sharps while superficial exposure of intact mucous membrane was the least common mode of exposure (Table 3). Analysis of activities during which the OEBs occurred revealed procedures involving patient, e.g., setting up IV line/introducing cannula etc, to be the major activity associated with both OEB-HR and OEB-PR types of exposures. Inappropriate needle handling practice including recapping and cleaning the device constituted next major activity involved in OEB-HR. In more than half of the OEBs in both categories, the circumstances were not related to adherence to standard safety precautions and lack of concentration due to fatigue had a major contribution (Table 4).

A total of 69 out of 101 (68.3%) episodes of OEB-HRs were reported by the HCWs to the concerned authorities while in case of OEB-PR, only 23 out of 73 (31.5%) were reported by HCWs. The main reason for non-reporting of OEB-HRs (n=32 cases) was self-judged under-estimation about the risk involved in 16 (50%) cases while in minority of cases the reasons were ignorance about the reporting procedures in 8 (25%) and confidentiality issues in 8 (25%).

Table 1.Magnitude of OEB among HCWs Belonging to Various Categories

Category of HCW	Magnitude of OEB						
	No (%) of HCW exposed	Occurrence Rate (OR)* of Exposures					
		OEB		OEB-HR		OEB-PR	
		No	OR*	No	OR*	No	OR*
Interns (n=44)	7(15.9)	11	0.50	7	0.32	4	0.18
JR** (n=100)	34(34)	40	0.80	27	0.54	13	0.26
SR** (n=68)	2 (2.9)	2	0.06	1	0.03	1	0.03
Nurses (n=173)	82(48.5)	103	1.19	65	0.75	38	0.44
LT (n=31)	14 (45.2)	18	1.16	1	0.06	17	1.10

JR=Junior residents; SR=Senior residents; LT=Laboratory technicians; OEB-HR=High risk occupational exposure to blood; OEB-PR=Potentially risky occupational exposure to blood (vide text)

*Occurrence rate per person year

**Includes HCWs with equivalent designations and experience in private healthcare setups (vide text)

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Table 2.Occurrence* of OEB among HCWs Based on Duration of Work Experience

Duration (years)	OEB-HR		OEB-PR		HBV Vaccination Coverage			Training On Universal Precautions
					Complete	Incomplete	Assessment of Post-Vaccinal anti-HBs Titer	
	No	OR*	No	OR*	No (%)	No (%)	No (%)	No (%)
<1 (n=87)	59	1.24	30	0.69	17 (19.5)	10 (1.1)	6(6.9)	38 (43.7)
≥1 to <5 (n=149)	28	0.38	25	0.34	45 (30.2)	12 (8.1)	13 (8.7)	101 (67.8)
≥5 (n= 180)	14	0.16	18	0.20	132 (73.3)	20 (11.1)	18 (10)	176 (97.8)
Trend χ^2; P	χ^2=31.50 P=0.0001		χ^2=2.98 P=0.22		χ^2=11.12 P=0.003	χ^2=4.00 P=0.14	χ^2=5.89 P=0.05	χ^2=90.91 P=0.000

*Occurrence rate per person year

Table 3.Distribution of OEB-HRs (n=101) according to Types of Exposures among HCWs

Type of Exposure	Mode of Exposure		No (%)
OEB-HR	Percutaneous	Hollow bore needle/cannula	52 (51.5)
		Solid bore needle	35 (34.7)
		Sharp	8 (7.9)
	Mucocutaneous	Superficial	6 (5.9)
		Deep (penetrating)	0 (0)

Table 4.Activities and Circumstances Involved in OEB among the HCWs

Activity	Proportions in Various Categories of OEB		Circumstance	Proportions in Various Categories of OEB	
	OEB-HR (n=101)	OEB-PR (n=73)		OEB-HR (n=101)	OEB-PR (n=73)
	No (%)	No (%)		No (%)	No (%)
Recapping the needle	29 (28.7)	1 (1.4)	Unexpected patient movement*	13 (12.9)	10 (13.7)
Manipulation of needle/sharp in patient	49 (48.5)	44 (60.3)	Inadequate visibility*	8 (7.9)	4 (5.5)
			Unattended device *	4 (3.9)	5 (6.8)
Cleaning the device	17 (16.8)	15 (20.5)	Collision with HCW*	1 (0.9)	4 (5.5)
Disposal of waste	6 (5.9)	13 (17.8)	Lack of concentration due to fatigue*	30 (29.7)	19 (26.0)
			Self-admitted fault	45 (44.6)	31 (42.5)

*Indicates circumstances considered by HCW responsible for OEB despite adherence to standard precautions

Baseline serostatus of 69 cases reporting to authorities revealed none to be seropositive for HIV, 2 for HBV (HbsAg) and 1 for HCV all with OEB-HR category of exposures. In majority of the reported OEBs (50 out of 69 reported OEB-HRs and 15 out of 23 reported OEB-PRs) the source blood or the source individual (in absence of blood samples) could be tested to detect seropositivity for common blood-borne pathogens, viz., HIV, HBV and HCV that revealed none to be seropositive for HIV, 3 for HBV (2 in OEB-HR and 1 in OEB-PR types of exposures) and 1 for HCV (in OEB-HR type of exposure). Follow up testing of the exposed HCWs, seronegative at baseline with OEB-HR (n=66) or OEB-PR (n=23) categories of exposures from sources either seropositive or of unknown serostatus for HIV, HBV or HCV revealed no seroconversion for HIV or HCV although seroconversion could be recorded for HBV (HBsAg) in 2 HCWs from private setups, one nurse with OEB-HR category and one LT with OEB-PR category of exposures. In both these instances, the serostatus of the source was unknown. On the other hand, none of the control HCWs, seronegative at baseline for HIV, HBV or HCV showed any seroconversion over the 6-month followup in absence of any history of OEB of either category during the followup.

Discussion

The present study on assessment of OEB among HCWs differed from many others on several aspects. Firstly, the study was based on a relatively shorter recall period, i.e., 6 months to measure occurrence of OEB as

opposed to many studies where such assessments were based on recall period ranging from one year to lifetime.[11-14] Shorter recall period has been considered to minimize recall bias specially in case of minor exposures.[15,16] Secondly, exposure of apparently intact skin to minute volume, e.g., few drops of blood has been given due consideration as potentially risky exposure, i.e., OEB-PR in the study keeping in mind possible transmission of HBV. HBV has been demonstrated to survive in environmental conditions for a longer time with transmission potential as high as 6-30% compared to about 0.3% in case of HIV.[9] It has also been demonstrated that at the peak of viremia, HBV concentration in blood may be as high as 10^9 Tissue culture infectious dose (TCID) as opposed to about 10^4 in case of HIV.[17] Thus HBV infection may occur in HCWs on exposure to blood with apparently intact skin or mucosa that may have invisible scratches or abrasions. Thirdly, the study included HCWs from private sector as well that is likely to work with limited resources including manpower.[5]

In the present study, the recorded incidence of high-risk category of OEB, i.e., 0.49 per person year was found to be higher compared to some reports from India.[12,18] However, a report from Turkey by Azap et al. mentioned overall exposure rate of 0.85 per person year among HCWs employed in the university hospital.[15] There could be several plausible reasons for such high incidence encountered in the present study, viz., inclusion of HCWs from private sector, inclusion of only the HCWs posted in wards and shorter recall period thereby minimizing under reporting due to recall bias.[15,16]

The nurses have been reported to have maximum occupational exposure to blood globally.[19] Studies from India have mostly reported nurses as the category of HCW encountering most frequent OEBs with occurrence rates as high as 100%.[12,14] Reports on correlation of working experience with degree of OEB from India have been variable. While a study from Karnataka, southern India, by Holla et al. indicated increase in occurrence of needle stick injuries (NSIs) with longer duration of working experience,[20] study by Aggarwal et al. from Delhi showed an inverse relationship[21] and study by Jayanth et al. from Vellore, southern India, found no relationship.[22]

Despite increased OEB among HCWs with shorter duration of tenure compared to those with longer duration, there was decreased coverage of HBV vaccine in the relatively inexperienced group of HCWs. This could be due to increasing awareness as well as increasing opportunity of participation in HBV vaccination coverage for HCWs with longer work experience initiated by health administrative authorities.[5] In developing countries, 40-65% of HBV infections in HCWs were attributable to percutaneous occupational exposure while in developed countries the corresponding figure was less than 10% largely because of immunization coverage.[23] Several in-depth studies from India and abroad have pointed out increasing experience in healthcare profession and accessibility to vaccine to be the two most important factors positively correlated to compliance to HBV vaccine.[16,24] The observation of as high as 43.7% of HCWs remaining untrained during first year of employment points out the need for more frequent training programs on standard precautions in India. There is paucity of data from India to evaluate efficacy of training in the area of standard precautions on incidence of OEB,[25] there are numerous reports from other countries documenting efficacy of such trainings on reduction in magnitude of OEB.[26,27]

The type of activity and the circumstances involved in OEB-HR incidents among HCWs reflect the nature of OEB-HR-prone activities carried out by HCWs, while recapping continues to be an avoidable risk among HCWs in India which is in accordance with the reports from India and abroad.[14,17] However, seroconversion in one LT with OEB-PR category of exposure and significantly higher rate of OEB-PR category of exposures in the same group of HCW merits due concern to expand coverage of HBV vaccination even for the HCWs not routinely exposed to percutaneous exposures. It was noteworthy that in more than half of the OEBs in either category, the exposures could be attributed to circumstances unrelated to biosafety measures, fatigue being the major attribute. Effect of work hours on errors in healthcare has been a long-recognized problem that has been an issue of repeated review by the health administrators in both developing and developed countries.[13,28,29]

Further, post-exposure seroconversion for HBV in two HCWs in private setup and significantly higher occurrence rate of OEBs in private setup compared to government setup tends to point out greater magnitude of problem related to blood-borne infections in the former setup although admittedly, due to limitation in sample size, it was not possible for us to make a comparative analysis of various characteristics between the two categories of setups.

The present study points out the continuing need for mandatory training in the field of safety precautions and HBV vaccination coverage among HCWs, for the fresh recruits, and rationalizing the workload.

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Conflict of Interest: None

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