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Original Article

A study of needle-stick injury incidence amongst healthcare workers and its root cause analysis in a tertiary care teaching hospital

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Abstract

Background: Needle-stick injury (NSI) incidence is a major occupational hazard amongst healthcare workers (HCWs).

Methods: In this retrospective study conducted amongst HCWs from October 2018 to October 2019, we aimed to know the incidence of NSI and its root cause. At the time of self-reporting of NSI, details were collected regarding mode of injury, viral markers of source and HCWs and vaccination status of HCWs. Exposed HCWs were followed up till 6 months for seroconversion.

Results: A total of 47 NSIs were reported during the study period. The incidence rate per annum was 0.13. The NSI incidence was high in intensive care units (ICUs) (47%) and was commonly due to recapping needles (36.2%). Amongst 12 NSIs, sources were positive for viral markers (6 for hepatitis B virus [HBV], 5 for human immunodeficiency virus [HIV] and 1 for hepatitis C virus). Amongst four completely vaccinated HCWs exposed to HBV-positive sources, two had anti-HBV antibody titres <10 mlu/ml. No seroconversion was seen in any of the exposed HCWs during follow-up.

Conclusions: The annual incidence of NSI in our hospital was 0.13 and was high in ICUs. This prompted the institution of training sessions for HCWs to reduce the NSIs.

Keywords: Antibody titre, healthcare workers, hepatitis B virus, human immunodeficiency virus, needle-stick injury, post-exposure prophylaxis

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INTRODUCTION

Needle-stick injury (NSI) is defined as 'introduction into the body of healthcare providers during the routine performance of their duties, of blood and other potentially hazardous material by a hollow bore needle or sharp instruments, e.g., needles, lancets and contaminated broken glass.[1] The risk of transmission of human immunodeficiency virus (HIV) following a hollow needle injury is approximately 0.2%–0.5%, for hepatitis C virus (HCV) 3%–10% and 40% for hepatitis B virus (HBV).[2] Healthcare workers (HCWs) who are at risk of NSIs include doctors, nurses, laboratory technicians, sanitary workers and biomedical waste (BMW) handlers.[3,4]

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The present study was conducted to know the prevalence of NSIs and its root cause analysis.

MATERIAL AND METHODS

A retrospective study was conducted amongst HCWs from October 2018 to October 2019 in a tertiary care teaching hospital. The data were collected from the Hospital Infection Prevention and Control (HIPC) Committee Office after obtaining institutional Ethics Committee (IEC) clearance (IEC No. 1055, dated) and analysed for the study. The data collection includes the details of questionnaire filled by the exposed HCWs at the time of self-reporting of injury which includes demographics of HCWs, category of work done by the HCWs, type of injury, site of injury, mode of injury, time of injury, ward at which the NSI occurred, severity of injury, use of personal protective equipment (PPE) at the time of injury or splashes, details of source viral markers, hepatitis B vaccination status of HCWs, anti-HBV antibody titres of vaccinated HCWs, immediate post-exposure measures taken like washing the site of injury and details of immediate post-exposure prophylaxis (PEP) taken in case of exposure with source who is known seropositive for HIV and HBV.

Our HIPC committee conducts an active PEP programme with an integrated approach to prevention including awareness raising, teaching, training, protective equipment such as heavy-duty gloves, banning of recapping, needle cutter at every ward and intensive care units (ICUs), sharps containers, coloured-coded waste bins, vaccination as well as round-the-clock sharps and splashes reporting and blood testing facility based on the guidelines of the National AIDS Control Organization of India (NACO).[5] Regular classes as a part of study curriculum are conducted separately for each group of HCWs via didactic/interactive lectures, audio–visual aids and hands-on practice, especially amongst newly inducted staff at least once a year in the form of induction training and also orientation programme being conducted to all internees every year. The standard pro forma for tests as prescribed in the NACO guidelines for each occupational exposure was followed. Hospital infection control nurses, clinical microbiology faculty and residents and trained technical staff were actively involved in follow-up and counselling of each exposed HCWs in our PEP programme. After obtaining informed written consent, details regarding blood sample collection of HCWs and of source if identified were collected for HIV, HCV and HBV viral markers. Screening for HIV 1 and 2 was done as per NACO guidelines.[5]

Besides, hepatitis B surface antigen and antibodies against HCV were done immediately by rapid tests (HBV and HCV by Meril Diagnostics Pvt. Ltd., India.) followed by using enzyme-linked immunosorbent assay (ELISA) kits (Meril Diagnostics Pvt. Ltd., India). All these tests were performed in duplicate and confirmed by ELISA, irrespective of the results of the preliminary screening. HCWs were also tested for hepatitis B surface antibody (anti-HBs) titres by anti-HBs kit supplied by Medical and Biological Services, India. Subjects with anti-HBs titre ≥10 mIU/mL were considered as responders to vaccination and <10 mIU/mL as non-responders after receiving two complete series of vaccination (0, 1 and 6 months).[6]

HCWs that got exposed to HIV-seropositive patients were immediately referred to the medicine department and then further followed up with a nearby antiretroviral therapy centre as per the advice of the physician. For seroconversion, all HCWs under investigation were counselled and advised for repeat testing after 6 weeks, 3 months and finally after 6 months. The serum samples of patients from whom the HCWs got exposed, if known, were also tested for HIV, HBV and HCV with viral load, if screening tests were positive. The outcome of such exposed HCWs and seroconversion if any was noted.

Statistical analysis

All the data collected were compiled into a computer-based spreadsheet for analysis. All categorical variables are represented as percentages. Statistical analysis was done using the Statistical Package for the Social Sciences statistical software (version 20) (IBM Corp., NY, USA).

RESULTS

In our study, the annual incidence of NSI was calculated to be 0.13. A total of 47 NSIs were reported from October 2018 to October 2019. Females (n = 45, 93.6%) were more commonly exposed than males (n = 2, 6.4%). Hollow bore needles (n = 40) were commonly involved in NSIs followed by suture needles (n = 3), splashes-related incidents and scalpel-related injuries (n = 2 each) among all reported NSIs. Nurses (38.3%) were found to have the highest exposure rate followed by sanitary workers (21.3%) and doctors (17%) (Figure 1). The incidence of NSIs was higher in ICUs (47%). Majority of the NSIs occurred during morning hours (62%). In our study, the most common site of NSIs being fingers (74.4%). Recapping of needles (36.2%) was the most common activity leading to NSIs in HCWs followed by improper handling of BMW (27.6%) (Table 1). Out of 47 self-reported NSIs, sources were negative in 24 incidences, and in 11 NSIs, sources were unknown. In 12 incidences amongst

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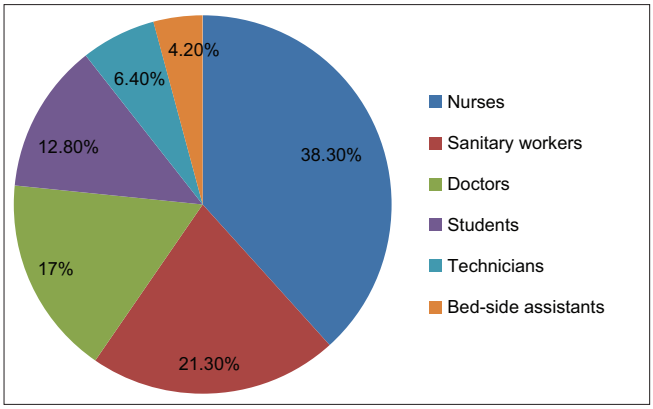

Figure 1: Categories of healthcare workers exposed to needle-stick injuries

Table 1: Mode of injury in reported NSIs (*n*=47)

Mode of injury	NSIs (%)
Recapping	36.2
BMW disposal	27.6
Removing intravenous needle	8.5
Intravenous catheter insertion	8.5
While checking random blood sugar	6.4
Suturing	4.2
Splashes	4.2
While doing fine-needle aspiration cytology	2.1
While assisting tracheostomy	2.1

NSIs=Needle-stick injuries; BMW=Biomedical waste

47 NSIs, the sources were found to be seropositive which include 6 (50%) for HBV, 5 (42%) for HIV and 1 (8%) for HCV (Figure 2). A significant number of HCWs (n = 26, 55.3%) were completely vaccinated and 23 (88.5%) amongst them had protective antibody titres >10 mIU/ml according to the Centers for Disease Control and Prevention (CDC).[7] Three (11.5%) amongst 26 completely vaccinated HCWs had hepatitis B surface antibody titres <10 mIU/ml. Amongst 47 NSIs, 12 (25.5%) were not vaccinated. Amongst 47 NSIs, 9 (19.14%) were incompletely vaccinated (Figure 3). In view of nine incompletely vaccinated, 3 were shown titres <10 mIU/ml and 6 had titres >10 mIU/ml. All the five exposed HCWs to HIV-seropositive cases were given PEP and follow-up

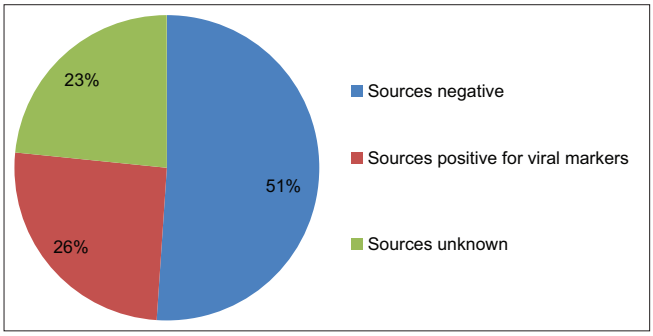

Figure 2: Status of sources in various needle-stick injuries reported

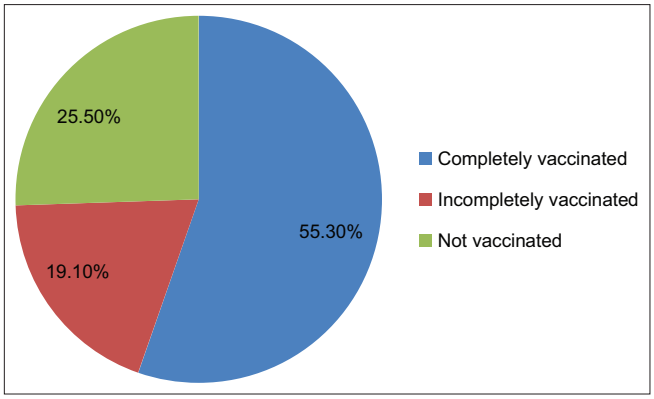

Figure 3: Vaccination status amongst exposed healthcare workers

was done for 6 months. No seroconversion was reported in any of the exposed HCWs after 6 months.

DISCUSSION

According to CDC, every year, more than 3 million HCWs are exposed to blood and body fluids via sharps and splash injuries in the United States alone.[8] NSIs may pose risk to the HCWs as they were associated with transmission of blood-borne pathogens including HBV, HCV and HIV. Occupational injuries with needles and sharps are commonly seen amongst HCWs leading to considerable morbidity. Wearing gloves is known to be an important line of defence, but several of the HCWs have not been wearing them at the time of their injury, higher proportions amongst the nurses and the technicians.

The four main strategies to prevent NSIs are education, regular repeated trainings, safe needle use and effective communication. Both education and trainings could raise HCWs' awareness and knowledge regarding safe procedures, NSI prevention and management. Safe needle use, along with the use of technology for sharp devices, would help HCWs too, to prevent NSI incidents. Last, effective communication along with adequate supervision from clinical instructors would prevent underreported incidents as well as help HCWs to feel safer and confident to perform procedures, which later can also prevent them from injuries.[9]

The present study was aimed to know the incidence of NSI amongst the HCWs and its root cause analysis in a tertiary care teaching hospital. A total of 47 self-reported NSIs were recorded in HIPC Committee Office between October 2018 and October 2019. The annual incidence of NSI observed in our study was 0.13. There was a female preponderance (n = 45, 93.6%) in our study, which is in line other studies *et al*.[7,10] Nurses (n = 18, 38.3%) constitute the larger part of reported NSIs in our

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study followed by sanitary workers (n = 10, 21.3%) and doctors (n = 8, 17%) (Figure 1). The higher incidence of NSIs was reported in nurses in our study, which was in concordance with the data published in several reports from India.[7,10-13] The higher incidence of NSIs amongst nurses can be attributed to the fact that nurses administer medication and intravenous fluids as ordered by doctors and they were the main healthcare group encountering with injections and sharp objects. The proportion of nurses, particularly females, was also usually high amongst HCWs, and there is also shortage of nurses in relation to patients as evidenced by low nurse-to-patient ratio. This leads to increased work pressure amongst nurses that lead to impairment in safe injection practices in turn leading to increased incidence of NSIs amongst nurses. Most of the injuries had occurred in interns and nurses who had newly joined. This could have been due to lack of experience, handling the heavy workload of patients under pressure situations and lack of knowledge regarding injection safety guidelines despite completion of induction training. Hence, there is a need for HIPC committee to conduct regular ongoing PEP programme for all the HCWs to prevent NSI-related complications. Moreover, majority of the NSIs occurred in ICUs (n = 22, 46.8%) followed by nephrology department (n = 11, 23.4%) where dialysis sessions were conducted on a regular continuous basis and also most of the NSIs occurred in our study during morning hours (n = 29, 62%) which was statistically significant ($P < 0.05$). This explains the increased workload in ICUs and hectic morning duty hours as majority of the procedures were conducted on an emergency basis. There would be pressure for immediate patient care, which leads to increased incidence of NSIs in these situations. This addresses the need for establishing better work environment in terms of staff numbers and resource adequacy, retaining more experienced nurses, periodic training on proper and safe work procedures to avoid NSIs and measures to be taken to minimise physical and emotional exhaustion at work. Furthermore, the incidence of NSIs is also more in females (n = 45, 93.6%) which is in line with a study[14] conducted in Iran which necessitates targeted approach to this group in prevention programmes. The second highest incidence of NSI following nurses was observed in sanitary workers (n = 10, 21.3%) due to improper handling of BMW.

Lack of knowledge regarding the consequences of NSIs and unsafe handling of BMW lead to increased incidence of NSIs amongst sanitary workers. The most common activity leading to NSI was recapping of needles (n = 17, 36.17%) followed by improper disposal of BMW (n = 13, 27.6%) (Table 1). Recapping of needle (n = 17, 36.2%) as a major activity in our study is in agreement with other studies.[15-17] In nine out of ten NSIs occurred in sanitary workers, they were not vaccinated against HBV which is of great concern as they are non-vaccinated groups who are at greater risk of exposure to blood and blood products and associated needle-stick and sharp injuries. The probability of having a NSI is inversely related to the years of experience.[11,18] This was endorsed in our study as five amongst eight doctors exposed to NSI are aged <25 years and were newly joined interns and junior residents. This may be due to lack of experience, unable to handle the heavy work pressure and lack of knowledge regarding safe injection practices. Poor compliance of sanitary workers for immediate action following exposure can be explained by lack of knowledge regarding blood-borne pathogens and perception of low risk of infection following NSI amongst HCWs. Amongst 47 NSIs that had occurred in our study sources traced to be positive for viral markers in 12 incidences (5 for HIV [42%], 1 for HCV [8%] and 6 for HBV [50%]). In 11 incidences, sources were not known. The exposed HCWs after consultation with physician were advised to take PEP prophylaxis and the final decision to take PEP was left to individual discretion. All unknown sources were undergone follow-up testing also.

All the HCWs exposed to known HIV-positive sources were given PEP and were followed up for seroconversion for 6 months. All exposed HCWs were enquired regarding vaccination status against HBV; amongst 47 HCWs exposed to NSI, 26 (55.3%) were completely vaccinated and 9 (19.1%) were incompletely (partially) vaccinated and 11 out of 47 (23.4%) were not vaccinated (Figure 3). The percentage of not vaccinated HCWs was greater amongst sanitary workers (9 out of 10) which are of great concern. Special attention should be directed against sanitary workers to prevent NSIs by conducting regular training sessions regarding vaccination, proper disposal of BMW and educating those regarding measures to be taken to prevent NSI and need for immediate first aid and PEP following exposure. Twenty six HCWs who had taken complete course of vaccination in the past had protective antibody tires >10 mIU/ml.[6] Three (11.5%) amongst them have hepatitis B surface antibody titres <10 mIU/ml. They are advised to take full series (0, 1 and 6 months) of revaccination following exposure and their titres are checked 1 month after completion of second vaccination series and are advised accordingly. Occurrence of suboptimal titres following complete course of vaccination is of great concern which necessitates frequent checking of anti-HBV titres amongst HCWs. The exposed HCWs to seropositive sources (HIV, HBV and HCV) were followed up for seroconversion by repeat testing at 6 weeks,

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3 months and 6 months. In our study, no seroconversion is reported in any of the exposed HCWs during follow-up testing. Our SVIMS administration has taken a decision to make the HBV vaccine available to all HCWs from 2014 onwards and beneficial effect of that evidence-based administrative decision was reflected in our study.

Root cause analysis, it showed that a higher incidence of NSI was occurred amongst nurses and sanitary workers and in ICUs, particularly during morning hours. The most common activity leading to NSI was recapping needles followed by breach in disposal of BMW.

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Conflicts of interest

Ragiineni Jayaprada is an Associate Editor of Journal of Clinical and Scientific Research. The other authors are faculty members/research scholars of Sri Venkateswara Institute of Medical sciences, Tirupati, of which Journal of Clinical and Scientific Research is the official Publication. The article was subject to the journal's standard procedures, with peer review handled independently of these faculty and their research groups.

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