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REGULAR ARTICLE

Sharps injuries in the operating room

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Abstract
Objectives We aimed to identify who sustains needlestick and sharps injuries, under what circumstances and what actions are taken to minimize the risk and in response to intraoperative NSSIs.
Methods The cross-sectional study was conducted in 2013 on 215 operation room personnel in 14 hospitals of the Hormozgan province, Iran.
Results Two hundred and fifty appropriate responders completed the questionnaire (86 %). Anaesthesia 59 (27.4 %) and operation room technicians 55 (25.6 %) sustained the greatest numbers of NSSIs over the past year. Awareness of local protocols was significantly worse in the residents group. The commonest reasons for noncompliance with NSSIs local protocols were not sure of the local protocols 44 (20.4 %) and prolonged operation so unable to leave operation table 37 (17.3 %).
Conclusions A revision of the local protocol to reduce the time it takes to complete may improve compliance. Education is of paramount importance in making health care workers aware of this issue. The application of safety devices led to a reduction in NSSIs and reduces the risk of blood borne infection as well.

Keywords Needlestick injuries · Healthcare personnel · Blood borne infection · Safety device · Occupational exposure

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Introduction

Sharps injuries are common within surgical practices and carry the risk of transmission of blood borne viruses [1]. The risk of infection for health care personnel depends on the prevalence of disease in the patient population and the nature and frequency of exposures. Surgeons and surgical trainees are at special risk due to the nature and frequency of the procedures they perform [2–4]. Although most surgeons are now adequately vaccinated against hepatitis B, there is no vaccine for the human immunodeficiency virus (HIV) or hepatitis C. Blood borne viruses (BBVs) represents a global pandemic [5]. Occupational blood exposure is an even more important problem in developing countries than in developed ones. High-risk behaviors, such as lack of compliance with universal precautions, two-handed needle recapping, improper needle disposal, inadequate injection practices, and lacking hepatitis B vaccination,

were significantly more frequent in developing countries [6, 7].

The published literature indicates that healthcare professionals, in particular surgeons, continue to demonstrate poor compliance with universal precautions [8]. However, data on the specifics of which personnel are at greater risk and what practices change the risk in this environment are almost nonexistent. Therefore, NSSIs to ORs personnel continue to occur. Surgeons can protect themselves by using protective equipment such as double gloves or goggles or by altering the operating practice. Reporting of injuries to occupational health departments can reduce rates of injury by identifying risk prone behaviors and practices. An accurate risk assessment can be performed and postexposure prophylaxis provided if necessary [9]. Despite the benefits of reporting such injuries and clear guidance for health care facilities on essential safe injection, infusion, and needlestick injuries from the Centers for Disease Control and Prevention of the ministry of health of Iran, it has been suggested that many OR personnel do not observe the guidance. We aimed to identify who sustains such injuries, under what circumstances and what actions are taken to minimize the risk in response to intraoperative needlestick and sharps injuries.

Materials and methods

The cross-sectional study was conducted in September 2013 on 215 of ORs personnel in 14 hospitals, including 12 government and 2 private hospitals in Hormozgan province, Iran. Except 2 military hospitals, which we did not have permission, as well as one private hospital on Kish Island all hospitals in Hormozgan province, with active operation room included in this study. Those 14 hospitals with 1435 beds admitted 446 inpatients daily, with a procedure of 217 surgeries per day.

Stratified sampling was used to choose 250 respondents representing a variety of healthcare professionals and cadres of OR personnel, including surgeons, assistance surgeons, specialist physicians, residents, OR nurses, technical operation room, anesthesia technicians, and other OR personnel (including housekeeping and administration staff). We obtained ethical approval from Hormozgan University of Medical Science for data collection on sharps injuries in operating room of Hormozgan hospitals. This study was funded by the Deputy for Research and information technology of Hormozgan University of Medical Sciences (Grant no. 9122). Two hundred and fifty questionnaires were distributed and 215 (86 %) were returned. Study participants included OR personnel working in operation room of the hospitals. A total of 215 OR personnel that agreed to be interviewed (86 % response rate) included surgeons ($n = 10$), assistance surgeons ($n = 2$), specialist physicians ($n = 6$), residents ($n = 9$), OR nurses ($n = 52$), operation room technicians ($n = 64$) anesthesia technicians ($n = 63$), and other workers ($n = 9$); those staff were interviewed and filled questionnaires. The questionnaire included 23 questions based on Adams et al. [10] and prior studies with the format of either multiple choice questions or free text. The questions revolved around:

- educational and occupational conditions of the personnel;
- dominate hand use of the operation room staff;
- vaccination of personnel;
- reason for use and rare use of double gloves;
- circumstances surrounding NSSIS;
- occurrence of NSSIS injuries in the past 12 months and within their tasks;
- time of occurrence NSSIS;
- reporting NSSIS;
- reason for noncompliance with NSSIS protocols;
- use of strict no-touch technique.

The answers about NSSIs among ORs personnel were categorized into positive and negative responses and were used to perform a statistical analysis. Two experts reviewed the content validity of the questionnaire before it was pretested in a sample of 25 healthcare workers. To evaluate the questionnaire's reliability, 10 % of the participants were retested 2 weeks later. The reliability of the questionnaire was confirmed by Cronbach's alpha calculation ($\alpha = 0.86$). The collected data were analyzed using SPSS v. 12 (SPSS, Chicago, IL, USA) and χ^2 test, with $P < 0.05$ considered statistically significant. The percentages and their 95 % confidence intervals are presented.

Results

The results of the survey were tabulated and percentile analysis was carried out. Two hundred and fifty questionnaires were administered, of which 215 were returned with a response rate of 86 %. Respondents comprised 10 (4.6 %) surgeons, 2 (0.9 %) assistance surgeons, 6 (2.8 %) specialist physicians, 9 (4.2 %) residents, 52 (24.2 %) OR nurses, 64 (29.8 %) operation room technicians, 63 (29.3 %) anesthesia technicians, and 9 (4.2 %) other workers (including housekeeping and administration staff). The educational status of operation room personnel interviewed was as: 12 staff (5.6 %) with diploma degrees, 96 (44.7 %) associate degrees, 80(37.2 %) bachelors, 2(0.09 %) masters and 25(11.6 %) with Ph.D. and doctorate degrees. Majority of the 215 OR personnel were females (62.3 %). One hundred and eighty-five (90.1 %) of

Table 1 Socio-demographic characters of respondents

Variable	No. (%)
Gender	
Male	81 (37.7)
Female	134 (62.3)
Age group (years)	
20 or less	1 (0.05)
20–29	98 (45.6)
30–39	87 (40.5)
40–49	27 (12.6)
50 or more	2 (0.09)
Educational level	
Diploma/degree	12 (5.6)
Associate diploma	96 (44.7)
Bachelor degree	80 (37.2)
Master degree	2 (0.09)
Ph.D. and Dr.	25 (11.6)
Years of services (years)	
<10	142 (66.0)
10–20	55 (25.6)
20–30	18 (8.4)

the personnel were between 20 and 39 years old. One hundred and forty-two (66.0 %) of the personnel had 10 years and insufficient working experience (Table 1). Right hand was the dominate use of the majority of 181 (84.2 %) of the respondents.

A total of 192 (89.3 %) reported that they had had a needlestick and sharps injuries at some stage in their career. One hundred and fifty-one (70.2 %) had experienced between 1 and 5 injuries, 36 (16.7 %) between 5 and 10, 5 (2.3 %) greater than 10 injuries. One hundred and sixty-one (74.9 %) nurses and operation room technicians sustained the greatest number of NSSIs, followed by 23 (10.7 %) surgeon, physicians and residents over the past years. Other personnel accounted for 8 (3.7 %) of the NSSIs (Table 2).

Majority of the 190 (88.4 %) OR personnel were staff of governmental hospitals. The top three categories of injury based on the injury occurred include suturing 68 (31.7 %), injection/aspirating 37 (17.2 %) and passing/receiving instruments 34 (15.7 %). Seventy-nine (36.7 %) of NSSIs occurred in the morning time during work time (Table 3).

One hundred and forty-nine (69.2 %) had reported their injuries to the head of department, health occupation or infection control committee of hospitals. One hundred and forty-eight (68.8 %) of them were aware of local NSSIs protocols. Their two top reasons for noncompliance with NSSIs local protocols included uncertainty of the local protocol 44 (20.4 %) and prolonged operation/inability to leave operation table 37 (17.3 %). Of the 105 responders, who reported the use of double gloves some, or most of the time at operation room, 13 (12.4 %) the infection risk reduction for the patient and 52 (49.5 %) infection risk reduction for themselves and 36 (34.3 %) cited both reasons for that. No infection risk reduction for themselves 17 (30.0 %), expensive price of gloves12 (21.0 %) and reduced sensation 12 (21.0 %), were the commonest reasons for rare use of double gloves (Table 4).

Discussion

Needlestick and sharps injuries of HCWs are important occupational hazards leading to infections with blood borne pathogens, such as HBV, HCV, or HIV [11–13]. Accidental NSSIs were most frequent in surgery. Those are about six times more common in members of surgical team rather than medical [14]. It is important to improve the knowledge about the prevalence and reasons for such injuries to find ways to prevent them.

Our study revealed (89 %) annual rates of NSSIs in operating room staff. However, the recent studies revealed the annual rates of NSSIs, ranging from 22 to 59 % [15–17]. Our study showed the high rates of NSSIs in governmental hospitals 190 (88.4 %) and 79 (36.7 %) in the morning shifts of Saturday to Thursday (7.00 AM–14.00 PM). The results showed that there were significant differences in both the incidence of needlestick and sharps injuries and time of the NSSIs (shift work) ($\chi^2 = 34.666$, degrees of freedom (df) = 12, $P = 0.001$) in the past year. This may be attributed to busy schedule at the time and the pressure among staff to complete tasks. In addition, more invasive procedures are performed in morning; especially, in governmental hospitals which are a similar finding to studies carried out elsewhere [18–21].

Table 2 Number of incidents NSSIs among operating room staff in the past year

Job category	No. of NSSIs (%)					
	1–2 (%)	3–5 (%)	5–10 (%)	>10 (%)	None (%)	Total (%)
Surgeons/physicians/residents	11 (5.1)	8 (3.7)	3 (1.4)	1 (0.5)	4 (1.9)	27 (12.6)
ORs nurses/technicians	79 (36.7)	46 (21.4)	33 (1.4)	3 (1.4)	18 (8.4)	179 (83.2)
Other	6 (2.8)	1 (0.5)	–	1 (0.5)	1 (0.5)	9 (4.2)
Total	96 (44.6)	55 (25.6)	36 (16.7)	5 (2.3)	23 (10.8)	215 (100)

Table 3 Characteristics of the NSSIs among ORs personnel

	No. (% total)
Operating room NSSIs by kind of hospital	
Government	190 (88.4)
Private	25 (11.6)
The circumstances surrounding NSSIs	
Performing an anastomosis	3 (1.4)
Suturing at depth	68 (31.7)
Injection/aspirating	37 (17.2)
Taking a needle off a syringe	11 (5.1)
Repositioning/removing a needle holders	13 (6.0)
Passing/receiving instruments	34 (15.7)
Other/unknown/not ans.	42 (19.6)
During clean-up	3 (1.4)
Improper disposal	4 (1.9)
Operating room NSSIs by time of the injury	
Saturday to Thursday (7.00 AM–14.00 PM)	79 (36.7)
Saturday to Thursday (14.00 PM–20.00 PM)	28 (13.0)
Friday	5 (2.3)
Do not remember/N/A	103 (47.9)

Table 4 Behaviour associated with the most recent NSSIs

	No. (%)
Reporting injury	($n = 215$)
Head of department	85 (39.5)
Head of health occupation	3 (1.4)
Head of infection control committee	58 (26.9)
All of them	3 (1.4)
No body	53 (24.7)
Other/do not remember	13 (6.1)
Awareness about local NSSIs protocol	($n = 215$)
Yes	148 (68.8)
No	66 (30.7)
The reasons given for noncompliance with NSSIs protocol	($n = 215$)
Not sure of the local protocol	44 (20.4)
Protocols take too long	28 (13.0)
Perceived low risk patient	16 (7.4)
Did not want to tell anyone about injury	4 (1.9)
Prolong operation/unable to leave operation table	37 (17.3)
Other/N/A	86 (40.0)
Vaccination against hepatitis	($n = 215$)
Yes	150 (69.0)
No	11 (5.1)
Not sure	54 (25.1)
Have training course in NSSIs provisional and prevention	($n = 215$)
Yes	123 (57.2)
No	92 (42.8)
The reason for using double gloves	($n = 105$)
Infection risk reduction for self	52 (49.5)
Infection risk reduction for patient	13 (12.4)
Infection risk reduction for self and patient	36 (34.3)
Other	4 (3.8)
The reason for rarely use of double gloves	($n = 57$)
Numbness sensation	12 (21.0)
Hand tingling	2 (3.5)
Expensive	12 (21.0)
No reduction of infection risk for self	17 (30.0)
No reduction of infection risk for patient	6 (10.5)
Other	8 (14.0)

In our study group, the percentages of NSSIs were highest in operation room nurses and technicians 161 (74.9 %). Those results echoed Rampal et al. [22, 23] and other studies. However, Luthi et al. [24] reported that physicians are exposed to the highest risk within all occupational groups. There are, indeed, significant associations between the gender of nurses and technicians and NSSIs incidences (at least 5 injuries) ($\chi^2 = 8.934$, $df = 2$, $P < 0.05$) in the past year. Almost at least five NSSIs occurred among females under 40 years [(90 (56.6 %)]. This could be due to the high percentage of working women in this study operating room nurses and technicians. This occupational group had the highest risk percentage of injuries in this study.

In Iran, reporting NSSIs is not considered compulsory. Poor reporting of sharps-related injuries reveals a failure to appreciate the potential consequences of such injuries. Also, most of the nurses and technicians (74.9 %) in this study reported that they had experienced NSSIs more than once in the past year. There are, indeed, significant associations between the levels of educational attainment of nurses and technicians and NSSIs incidences (at least 5 injuries) ($\chi^2 = 21.159$, $df = 8$, $P < 0.05$) and incidences of 5–9 needlestick and sharps injuries in the past year ($\chi^2 = 23.294$, $df = 2$, $P < 0.05$). Almost total NSSIs incidences injuries among nurses and technicians occurred in nurses and technicians with associated diploma degree [64 (42.4 %) at least 5 injuries] and [20 (55.6 %) at least 9 injuries] that is an issue involving their inadequate knowledge about universal precautions. It can be explained by the fact that nurses and technicians administer most of the injections and are responsible for vein contact punctures, intravenous fluid administration and other procedures that require the use of needles. The other reason that may account for the increased vulnerability of injury among nurses is the greater amount of time nurses spent on direct patient [25]. Nonreporting rates of NSSIs among personnel of operation room were 53 (24.7 %) of respondents; however, this rates were (16.7 %) among surgeons and

specialist physicians. Several studies have demonstrated that there is significant underreporting of sharps injuries among healthcare workers. One study reported that as many as 70 % of surgeons never or rarely exposed percutaneously [26]. The data of Wicker et al. studies [27] and a Japanese teaching hospital also showed a poor reporting rate [28]. Nonreporting rates between 45 and 75 % have been published recently [29–32]. Factors contributing to low reporting rates include: healthcare workers' perception of risk, occupation [30], length of service [31], lack of time, and poor follow-up care [32]. A number of studies indicate the potential to reduce the number of injuries in operation room, based on introduction of changes within the work environment and substitution of safety devices for predefined surgical procedures. The use of blunt suture needles in fascia and muscle closure [33–37] and designated neutral zones (hands-free technique) [38–40] are two strategies that have demonstrated their effectiveness in randomized clinical trials. Researchers, who conducted a multicenter surveillance study of occupational exposures and percutaneous injuries reported that 59 % of suture needle injuries were caused by needles used to suture fascia or muscle. The majority of (31.7 %) of participants in this study reported that suture needle injuries were caused by needles used to suture facia or muscle. It is estimated that the use of blunt suture needles alone could have reduced suture needle in juries by as much as 30 % [33].

Hands-free technique (HFT) has been proposed as a method to reduce health care workers, who are exposed to blood during operations [34]. Wright and colleagues [15] reviewed 249 glove tears and 70 sharp injuries and reported that only 6 % of injuries occurred during instrument passage. The use of HFT is recommended by several leading professional organizations and by many hospitals as a safety measure to reduce sharps injuries during operations. Despite this recommendation, its use is not widespread (42 % in the Stringer study). In this study 34 (15.7 %) of injuries occurred during instruments passage and sixty-five (30.2 %) of operation room personnel expressed the rarely use of HFT during their operations. In addition, the specific work practices that increase or decrease risk are too numerous to identify, control, and analyze adequately. Therefore, those aspects were assumed to be dependent on the surgical specialty. Our study showed a significant difference across specific work practices of sharps injuries which might have been avoidable: breast operations ($\chi^2 = 9.450$, $df = 5$, $P < 0.05$), Cardiothoracic operations ($\chi^2 = 22.417$, $df = 10$, $P < 0.05$), hepatobilliary operation ($\chi^2 = 20.\ 881$, $df = 10$, $P < 0.05$).

The result of this study showed that although majority of ORs personnel (68.8 %) stated that they knew local NSSIs protocol, however, there are gaps in the knowledge and practice. This finding echoed of Rampal et al. [23] study. The first commonest reason for noncompliance with NSSIs protocol was (20.4 %) not sure of the local protocol. The second reason was (17.3 %) the prolonged operation and inability to leave operation table due to the length of time taken to follow it. This result is in contrast to Adams et al. [10] study. Although further study would be required to prove it, a quicker-to-follow streamlined update of the current protocol, in conjunction with a campaign highlighting the importance to the individual adhering to it, may improve the reporting rate. Of the 57 responders, who rarely used double gloves, no reduction in self-infection risk 17 (30.0 %), numbness sensation and expensive 12 (21.0) were cited as being the reasons for occurrence. There is a widespread perception that double gloving reduces hand sensitivity and dexterity, but this issue has not been widely examined. However, there is a large body of literature on the use of double gloves during operations after an appropriate period of adaptation [34]. Each institution should have a set protocol for handling sharps and avoiding blood contamination, which is applicable to the operating room environment and which is generally built around the "Universal Precautions" recommended by the CDC. Timely reporting of occupational exposures to an employee health service is required to ensure appropriate counseling, facilitate prophylaxis or early treatment, and establish legal prerequisites for workers' compensation. Given that safer sharps devices or devices with a built-in safety feature are not yet widely available in Iran; strengthening education and training systems are thus essential.

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