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NEEDLE STICK INJURIES AMONG HEALTHCARE PROFESSIONALS.OVERVIEW OF PREVENTION AND MANAGEMENT.

1) AHMED HASAN MOHAMED ALOMRI
NURSE KING FAHAD GENERAL HOSPITAL, JEDDAH, SAUDI ARABIA
2) WAIL ABDULLAH SALEM ALSUBHI
NURSE KING FAHAD GENERAL HOSPITAL, JEDDAH, SAUDI ARABIA
3) BASMAH MOHAMMED HASAN ALJEHANI
NURSE KING FAHAD GENERAL HOSPITAL, JEDDAH, SAUDI ARABIA
4) MARYAM MOHAMMAD HASSAN RAJEH
NURSE KING FAHAD GENERAL HOSPITAL, JEDDAH, SAUDI ARABIA
5) GHADAH HAMED MUTLAQ ALREFAI
NURSE KING FAHAD GENERAL HOSPITAL,
JEDDAH, SAUDI ARABIA
6) YAHIA SALEEM ALAMRI
HEALTH AFFAIRS JEDDAH HEALTH ADMINISTRATION SAUDI ARABIA
7) HAMAD WASLALLAH WASEL ALMARAMHI
O R TECHNICIAN KING FAHAD GENERAL HOSPITAL JEDDAH, SAUDI ARABIA
8) KHALED TARIQ ABDULLAH AL-GHAMDI
NURSE KING FAHAD GENERAL HOSPITAL JEDDAH, SAUDI ARABIA
9) AMAL HASSAN ALHARBI
X RAY TECHNICIAN KING ABDULLAH MEDICAL CITY JEDDAH, SAUDI ARABIA
10) NAIF AHMED ALHARBI
NURSE KING FAHAD GENERAL HOSPITAL, JEDDAH, SAUDI ARABIA
11) ABDULKARIM QASIM KHAISHAN ALSHAIKH
NURSE WADI FARA GENERAL HOSPITAL, SAUDI ARABIA
12) MOHAMMED HAMOUD SALEH ALMAYMONI
ERADAH COMPLEX AND MENTAL HEALTH- ERADAH SERVICE,
JEDDAH, SAUDI ARABIA
13) KHADIJAH SALEEM ALROWAILI
MEDICAL LABORATORY TECHNICIAN MATERNITY AND CHILDREN HOSPITAL,
HAFAR ALBATIN, SAUDI ARABIA

Abstract

Over 20 million dedicated health care providers (HCP) expose themselves to biological, chemical, and mechanical hazards daily. The World Health Organization estimates that approximately three million health care providers are exposed to blood and body fluid due to needle stick or sharps injuries annually. Blood and body fluid exposures have resulted in 57 documented cases of HIV

seroconversion among healthcare personnel through 2001. Two thousand workers a year become infected with hepatitis C, and 400 contract hepatitis B. There are more than 20 additional types of infectious agents documented to be transmitted through needle sticks. More than 80% of needle stick injuries are preventable with the use of safe needles.
devices. Legislation has been developed in many countries to protect HCPs by encouraging employers to use best practices to prevent these exposures. Many different protocols for post-exposure management of needle stick injuries or blood and body fluid exposure have been proposed. The effectiveness of a protocol depends on the early initiation of post-exposure management. HIV prophylaxis has the smallest window of time for treatment and has to be initiated as soon as possible, preferably in the first few hours. Hepatitis B immunoglobulin (HBIg) could be given within the first seven days. Healthcare institutions should develop policies and procedures to reduce needle stick injuries by proactively instituting these recommendations, vaccinating all HCP for Hepatitis B (HBV), and incorporating improved engineering controls into a comprehensive needle stick injury prevention program. In this review, we present the historical background, nature, and size of the problem, followed by a review of the state of the art of prevention, clinical management, and corporate responsibilities.
Key words: needle stick injury, blood and body fluid exposure, prevention, post-exposure prophylaxis

Introduction

A needle stick injury is a nightmare that threatens large numbers of health care professionals (HCP) who are exposed to blood and body fluid worldwide. The cost is huge to both employers and to the nation and is immeasurable at personal and social levels. In this review, we will present the historical background followed by a discussion of the nature and size of the problem, including a discussion of prevention, corporate responsibilities, and legal issues. Post-exposure management in general and as it relates to hepatitis and HIV infections will be discussed with a short comment on its relevance to practice in the developing world.

Background

Since the mid-1840s, when the first needle was used, this essential part of healthcare provision has been a source of occupational injury for healthcare providers (HCPs) (1). Disposable syringes, which became available in the early 1960s, reduced the burden slightly as the need to sterilize and reuse the same syringe was no longer required. In 1978, a medical technician at the University of Wisconsin Hospital in Madison, WI, seroconverted to hepatitis B after occupational exposure to hepatitis B from an accidental needle stick injury. This sentinel event led Dr. Dennis Maki and Ms. Rita McCormick,RN, CIC, to perform groundbreaking research that brought the hazards of needle stick injuries to the attention of the medical community. This research created awareness among healthcare providers regarding blood-borne diseases from contaminated needles and sharps. In their 1981 report, Maki and McCormick found that the most important cause of needle stick injuries was recapping attempts and warned HCPs not to recap needles. Despite the

knowledge and awareness of the problem in the medical community, HBV and other bloodborne pathogens are frequently spread by accidental needle stick injuries. It was not until the deadly specter of HIV/AIDS came in the early 1980s that attention was focused on blood and body fluid exposure and the need for needle safety devices (1).

Nature and Size of the Problem Worldwide Threat to HCPs

There are 20 million healthcare providers (HCP) dedicating their lives to improving the health of more than 6.7 billion individuals around the globe (2). Healthcare providers are exposed to biological, chemical, and mechanical challenges every day, in addition to the emotional and mental stress they face. These HCPs live under fear of contracting infectious diseases through exposure to contaminated blood and body fluid (BBF). Needle stick injury (NSI) and blood and body fluid have been the reasons for 57 documented cases of HIV seroconversion among healthcare personnel through

2001. Two thousand workers a year become infected with hepatitis C (HCV) and 400 with HBV. More than 20 additional types of infectious agents are documented to have been transmitted through needle sticks, including tuberculosis, syphilis, malaria, herpes, diphtheria, gonorrhea, typhus, and Rocky Mountain spotted fever (3). The principal safety concern for health care providers is needle stick injury and becoming exposed to blood and body fluid, resulting in seroconversion to HBV, HCV, or HIV. According to the World Health Organization (WHO), approximately three million individuals are injured annually due to needlestick or sharps injuries. HCPs may encounter needle stick injuries during common work days (Table 1). The US alone has had one million needle stick injuries of this type. The estimated number of similar injuries in the UK is 100,000 (1). Due to these exposures, approximately 1,000 HCPs are estimated to suffer from serious infections annually (4). The US Department of Labor and Occupational Health, Safety, and Administration (OSHA) indicates that in the US, one out of every seven healthcare workers accidentally suffers from a needle stick injury annually. This can be extrapolated to state that in a span of 30 working years, every healthcare worker has the possibility of suffering from four needle stick injuries. Exposure to blood and body fluids is not limited to physicians and nurses, though they are the groups that suffer from most of the exposures. Exposures are also seen in laboratory technicians, paramedics, nursing assistants, cleaning and housekeeping staff, and even family members.

Needle Stick Injury and the Law

The US Congress, in its 106th session, made changes to the blood-borne pathogen standards in effect under the Occupational Health and Safety Act of 1970. The Needle Stick Safety and Prevention Act was developed to prevent occupational exposure to blood-borne pathogens. In 1991, the Occupational Safety and Health Administration (OSHA) issued a standard regulating occupational exposure to blood-borne pathogens (5). The Food and Drug Administration (FDA) issued an alert to utilize needleless IV systems wherever possible. These legislative and regulatory

changes were a clear indication that blood and body fluid exposure was recognized as a major issue, and this subsequently led to the development of safer needle designs. The first safe needle designs were patented in the 1970s. The FDA has approved more than 250 devices for marketing as safety devices since that time (4).

The European Union Directive 2000/54/EC of the European Parliament and the Council of September 18, 2000, stressed the protection of workers from risks related to exposure to biological agents at work (6) and dealt with the use of safe methods to prevent healthcare workers from exposure to blood, body fluids, NSI, and other biological contaminants. It mandated all members to comply with the minimum requirements designed to guarantee an effective and improved standard of safety and health with regard to the protection of healthcare workers from the risks related to exposure to biological agents at work. Essentially, the goal was to ensure the safety and health of workers. After this directive, member countries have initiated changes in their legislation. Austria's government has started a safety platform. Belgium, France, and Germany have proposed law changes, and Spain has instituted an initiative to address the protection of healthcare workers from exposure to needle stick injuries and blood and body fluids (7). The United Kingdom's National Health Services, in their recent guide for "healthy work places," have addressed these issues too.

Table 1: Common causes of needle stick injuries

Causes	**Estimated %**
Disposing of needles	35
Administrating injections	20
Drawing blood	18
Recapping needles	15
Handling trash and dirty linens	12

Prevention

More than 80% of needle stick injuries are preventable with the use of safe needle devices (4). Primary prevention is the replacement of the risk with a less hazardous substitute. In the case of blood and body fluid, it would require the replacement of needles and other sharps. This is not always possible but should be implemented where applicable with needle-free connectors, blunt needle cannulas, and adhesive strips to close wounds. Needles and other sharps would always be present in one form or another in the healthcare facility. Secondary prevention methods add active or passive safety features, such as shielding in the case of needles and other sharps.

According to the CDC, one-quarter of the injuries happen when the protective device is not activated (8). Proactive approaches should include immunization for HBV,awareness campaigns, and training of HCPs regarding the grave consequences of letting blood and body fluid exposures go unreported.

Effective Post-Exposure Management

There are many different protocols for post-exposure management of needle stick injuries to blood and body fluids. The Centre for Disease Control (CDC), the World Health Organization (WHO), and other organizations as well as institutions such as academic hospitals have their own protocols.

General Principles

Initiation of postexposure management to blood and body fluids by needle stick or sharps injury depends on timely reporting of the incident. HIV prophylaxis has the smallest window of time. The treatment has to be started as soon as possible, within the first few hours. After 72 hours, most protocols recommend not initiating HIV prophylaxis. HBV immunoglobulin (HBIg) could be given within the first seven days and has been shown to be 75% effective in preventing seroconversion. Perceived severity of communicable infections, the perceived efficacy of reporting injuries, and overall motivation to maintain health were the best predictors of reporting compliance. Non-compliant personnel, when surveyed, emphasized the negative aspects of reporting occupational injuries, mainly that it "takes a lot of time."

The solution to non-compliance with reporting occupational injuries is to invest in training and education designed to sensitize healthcare providers to the importance of reporting and its effect on strategic planning to safeguard their health (9). Physicians are least likely to report a needle stick injury compared to other healthcare providers. It is estimated that approximately only one out of three needle sticks are reported. In the NIOSH study, it was estimated that over 2,100 health care professionals will incur a needle-stick-related injury at the time of publication in 1999 (10).

Several protocols for post-exposure management exist in the literature. These are exemplified by the algorithm followed at the Sheikh Khalifa Medical City, Abu Dhabi, UAE (Figure 1). According to this protocol, when there is a blood and body fluid exposure, the following routine is followed by both the source (patient) and staff (individual exposed). Each is assessed for their immune status for HBV, HCV, and HIV. If the source is negative for HBV, HCV, or HIV, no further follow-up is mandated. If the source is positive for HBV and the staff has antibody titers for HBV below 10 IU post-exposure, prophylaxis (PEP) is started immediately. Both HBV immune globulin (HBIG) and the HBV vaccine are given immediately. The second dose of the HBIG and HBV vaccines is given four weeks later, followed by the third dose at six months from the initial dose. In case the source is positive for HCV, the staff member would be followed to assess if they require treatment according to the protocol, which is HCV PCR six weeks after the exposure, with follow-up blood work for HCV antibodies and LFTs at three and six months. The Advisory Committee on Immunization Practices (ACIP) in 1994 reviewed the available data regarding the prevention of HCV infection with immunoglobulin (IG) as a post-exposure prophylactic treatment for HCV exposure. ACIP concluded that they would not support IG or interferon as PEP for HCV (26). Staff members exposed to blood and body fluid infected with HIV are immediately started on the two-drug regimen if the exposure was superficial and blood did not come into contact with the source's blood. In the case of deep prick or cut injuries during surgery, the three-drug regimen is started. Blood tests are requested for follow-up according to the protocol.

Specific clinical problems

Hepatitis B

Occupational transmission of HBV in HCPs is well recognized (12). Blood contains the highest titer of HBV in all body fluids. HBV surface antigen (HBsAg) was also found to be present in breast milk, bile, cerebrospinal fluid, feces, nasopharyngeal washings, saliva, semen, sweat, and synovial fluid (13). The risk of HBV infection is primarily associated with the amount of contact with blood and the presence of hepatitis E antigen (HBe Ag) status at the source. Studies show that if the source is positive for both hepatitis B surface antigen (HBsAg) and hepatitis E surface antigen (HBe Ag), the risk of developing clinical hepatitis is 22–31%. Serological evidence of HBV infection was 37–62%. Whereas if the exposure was to blood from a source that was only HBsAg positive, the risk of developing clinical hepatitis was 1–2%, and the risk of the risk of developing serological evidence of HBV infection was 23–37% (14). Recent studies have shown that the emergence of HBeAg-minus HBV in wild-type HBV carriers is associated with an exacerbation of liver disease. It also showed the presence of antibodies against HBeAg (anti-HBe) in serum in 50% of the cases. week, an extremely important factor in transmission (17). Therefore, it's possible to get an HBV infection by direct or indirect blood or body fluid exposure that inoculates HBV into cutaneous scratches, abrasions, burns, or other lesions or mucosal surfaces (18).

Due to the high risk of HBV infection among HCPs, routine pre-exposure vaccines for healthcare providers against HBV and universal precautions have been recommended since the 1980s (19). Compliance with this recommendation increased after the Occupational Safety and Health Administration (OSHA) (20) issued a standard regulating occupational exposure to bloodborne pathogens (5). Since June 2002, 22 US states have enacted this regulation as some form of legislation to prevent blood and body fluid exposure.

In cases of individuals who were not vaccinated pre-majority anti-HBe-positive patients, HBeAg-minus HBV was the predominant virus. HBeAg-minus HBV was shown to be associated with a course of hepatitis, which leads to flare-ups of liver cell necrosis interspersed with periods of asymptomatic HBV carriage. This evidence supports the hypothesis that the genetic heterogeneity of HBV significantly influences the infectivity and outcome of chronic HBV (15). Bonino and colleagues showed that the ratio between wild-type HBV virus and HBV mutant, unable to secrete antigen (HBeAg minus HBV), appeared to be an effective determinant in the outcome of chronic HBV and its infectivity. Their study showed that quantitative analysis of HBeAg minus HBV in the blood is a useful tool to monitor infectivity in chronic HBV patients (16). Hepatitis B virus has been demonstrated to survive dried blood at room temperature on environmental surfaces for at least one exposure to contaminated body fluid. The efficacy of post-exposure prophylaxis (PEP) has been studied. Both HBV immune globulin (HBIG) and/or HBV vaccine have been found to be effective. Regimens involving either a multiple dose of HBIG alone or the HBV vaccine series alone are reported to be 70–75% effective in preventing HBV infection. HBIG, if initiated in the

first week of exposure to HBsAg-positive blood, provides 75% protection from HBV infection (21).

Hepatitis C

Hepatitis C virus (HCV) is not efficiently transmitted through occupational exposure to blood and body fluids. Occupational exposure to blood and body fluid of a HCV-positive patient on average has an incidence of 1.8% (range: 0-7%) seroconversion for HCP (22). One study indicated that transmission for HCV occurred only from hollow-bore needles when compared with other sharps (23). There is limited data on the survival of HCV in the environment. The Advisory Committee on Immunization Practices (ACIP) in 1994 reviewed the available data regarding the prevention of HCV infection with immunoglobulin (IG) as a prophylactic treatment for HCV post-exposure. The ACIP concluded that they did not support IG or interferon as PEP for HCV (24). Their conclusion was based on the fact that no protective antibody response has been identified following HCV infection in experimental studies in chimpanzees with IG. From that research, anti-HCV IG failed to prevent transmission of infection after exposure (8). The FDA has not approved antiviral medications such as interferon for post-exposure prophylaxis of HCV infection.

In the absence of an effective post-exposure prophylactic treatment for occupational exposure to HCV, recommendations for post-exposure management are based on interventions to achieve early identification of the disease. Studies have shown that if serum ALT increases considerably (500–1000 IU/L), early therapy in the acute phase can be beneficial. There have been no studies to evaluate the efficacy of early therapy for HCV RNA-positive patients with normal ALT levels (8). Treatment initiated early in the chronic phase of HCV infection (within 6 months after the onset of the infection) might be as effective as treatment started during the acute phase (25).

HIV Infection

HCPs are at risk of occupational transmission of HIV after exposure to blood and body fluids infected with HIV. Studies show the risk of HIV transmission after percutaneous exposure to HIV-infected blood is estimated to be approximately 0.3% (range: 0.2–0.3%), whereas the risk of transmission after mucous membrane exposure is approximately 0.09% (range: 0.006–0.5%). (26). The risk of HIV transmission after exposure to other body fluids and tissues has been quantified but is probably much lower than that for blood (27). Occupational exposure to HIV-infected blood should be evaluated *within hours*, not days. If the source is determined to be HIV positive, the occurrence should be investigated as to what type of sharp caused the infection, the amount of blood involved, the exact method of contact with the HCP, and at what stage of infection is the source. These details will help in deciding which post-exposure prophylactic drug regimen should be used. Less severe exposure qualifies for a two-drug regimen, whereas severe exposure requires a three-drug regimen for a four-week duration (28). The optimal duration for post-exposure prophylaxis is unclear, but according to the CDC, the hospital guideline for prophylaxis treatment is continued for four weeks. The basic two-drug regimen includes Zidovudine 300mg plus Lamivudine 150mg (Combivir®); 1 tablet PO BID (with meals) for four (4) weeks as the primary

or basic regimen. The expanded regimen consists of Combivir (as above) plus Lopinavir/RRitonavir 200/50 mg; 2 tablets PO BID (with meals) for four (4) weeks as the expanded regimen (28, 26). It is recommended not to start with abacavir and nevirapine as prophylactic treatment, and efavirenz should be avoided even in treatment for pregnant patients (29).

Personal and Economic Cost of Needle Stick Injury The Developing World Perspective

A single needle stick injury can cost anywhere from a few hundred thousand to a million dollars. More important than the economic factors of blood and body fluid exposure is the psychological trauma to the individual as well as the co-workers and family members. This includes delayed childbearing, altered sexual practices, and the side effects of post-exposure prophylactic treatment. These challenges are further complicated if a potential chronic disability is developed, leading to loss of employment, denial of compensation claims,and even liver disease requiring a liver transplant (Table 3).

The American Hospital Association reported that one case of serious occupational exposure to infection by bloodborne pathogens can add up to $1 million or more in expenditures for testing, follow-up, lost time, and disability payments. Whereas the cost of follow-up for a high-risk exposure per needle stick injury without infection is generally in the range of $3,000. Therefore, the total cost of simply testing without subsequent seroconversion in the US approaches $2.4 billion (8).

At Sheikh Khalifa Medical City, the cost ranges from 1300- 3500 AED (US$ 400- 1000) for follow-up of one incident of blood or body fluid injury without seroconversion. Millions of dollars invested in follow-up and treatment after exposure to blood and body fluids can be saved with proper planning and funding to purchase safe needles and equipment. Safe needle devices cost only 28 cents more than standard devices. Still, the unitization of these devices, even in hospitals in the US, remains less than 15% (4).

The challenges of needle stick injuries in the developing world are even more complicated. The World Health Organization (WHO) estimated that the global burden from occupational exposure to blood and body fluid results in 40% of known cases of HBV and HCV and 2.5% of HIV. The WHO stated that while 90% of infections among HCPs are attributed to occupational exposure in the developing world, 90% of the reporting of occupational exposure to BBF is from the developed world (30). This highlights the importance of sensitization and advocacy for both reporting and post-exposure follow-up in the developing world. However, at the present time, there is limited research data published from the Middle East as an example, despite the predictable high risk of bloodborne transmission in clinical practice. Out of the total of 2710 hits in Medline in response to the search term “needle stick injuries," only 46 reports came from this region. 24 came from Turkey and Iran, 10 from Saudi Arabia, 4 from Egypt, and 3 from Jordan. 2 from Morroco, one each from Libya, Lebanon, Palestine, and Syria. No reports were available from the UAE, Iraq, Tunisia, Algeria, Yemen, Qatar, and Bahrain.

Conclusion

Millions of health care providers are exposed to blood and body fluids due to needle stick or sharps injuries annually. Blood and body fluid exposures have resulted in many cases of HIV, HCV, and HBV. Many different protocols for post-exposure management of needle stick injuries or blood and body fluid exposure have been proposed. The key element for the effectiveness of a protocol depends on the early initiation of post-exposure management. Healthcare institutions should strive to develop policies and procedures to reduce needle stick injuries by working proactively to vaccinate all HCP for HBV and incorporating improved engineering controls into a comprehensive needle stick injury prevention program.

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