RISK FACTORS AND PREVENTION OF INFECTION IN AUTOPSY ROOM - A REVIEW

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ABSTRACT

Forensic medicine personnel who come in direct contact with the body fluids, soft tissues of the dead and skeletal material in various stages of decomposition ,are at continuous risk of acquiring various kinds of infections including blood-borne viral and other bacterial infections. However, limited data are available regarding these risks to persons who are usually exposed to large number of traumatized bodies in India, a country that has an existing and growing HIV epidemic and high hepatitis virus seroprevalence. In the pre-antibiotic and pre-vaccine eras, an occupational infection was a serious threat for a forensic medicine and general health care person, but many such fears were allayed with the advent of antibiotics, vaccines and infectious disease eradication and elimination programmes. Safety is an issue not only relevant to the team performing the autopsy, but also has direct implications regarding the protection of the environment. Prevention strategies include immunization, exposure avoidance by the use of universal precautions.

KEY WORDS: Autopsy Room, Risk, Prevention.

INTRODUCTION

The postmortem examination room has always been a potential source for infection, long before the concept of bacteria had been developed. The forensic medicine experts, forensic pathologists, forensic anthropologists and other persons engaged directly or indirectly in postmortem work are at greater risk of exposure to blood-borne viruses and other infections including human immunodeficiency virus, hepatitis B, hepatitis C, hepatitis D and G viruses, non-A, non-B hepatitis (NANB), tuberculosis, Creutzfeldt Jakob Disease, herpes, hantavirus pulmonary syndrome, smallpox, human T-cell lymphotropic virus type I and infections from other pathogenic organisms (Brown et al., 1984; Rosenberg et al., 1986; Gerbert 1988; Ratzan and Schneiderman 1988; Geller 1990; Douceron et al., 1993a; Templeton et al., 1995; Fink 1996; Ajmani 1997; Galloway and Snodgrass 1998; Riddle and Sherrard 2000; Sagoe-Moses et al., 2001). Scientific investigation has confirmed that with the cessation of life, certain bacteria are released which, if allowed to go unchecked, can be a health hazard. Moreover, with death, there is neither the reticulo-endothelial system nor the blood -brain barrier to restrict the translocation of micro- organisms within the dead human remains (Rossa and Hockett 1995; Ajmani 1997). So these bacteria and microorganisms pose serious threat to forensic medicine persons working in the mortuary. Autopsy room Infections are acquired by one or more of the following routes:

(a) A wound resulting from a blood or body fluid contaminated object or needle-stick injury.

(b) Splash of blood or other body fluid onto an open wound or area of dermatitis.

(c) Contact of blood or other body fluids with mucous membranes of the eyes, nose or mouth.

(d) Inhalation and ingestion of aerosolized particles.

Dead bodies in various conditions often brought for postmortem examination are of unknown background, the risks of infection from these bodies are also unknown. The transmission of these deadly diseases via blood or any other means, their capacity to represent a source of infection without necessarily being any indication of their presence, their prevalence in individuals such as drug abusers, prostitutes etc., who are liable to meet violent unexplained deaths and the existence of social and ethical pressures which restrict the availability of information, all combine to create significant risk for forensic medicine expert and postmortem examination room worker (Harris 1993). Dead-bodies are often brought for postmortem examination prior to completion of testing, which may reveal advanced infections and deadly diseases or syndromes. Forensic medicine personnel often work on dead-bodies with various stages of decomposition. **In** decomposed skeletal remains, detailed dissection of

the tissue is often essential in order to link morphological feature of the skeleton to functional differences in locomotion, manipulation or posture and investigate the interaction between soft and hard tissues (Galloway and Snodgrass, 1998). Whatever, the stage of human remains, the potential for exposure to pathogens in the tissue or body fluids must be acknowledged.

Hepatitis:

Worldwide, viral hepatitis is one of the most frequently reported diseases; it is the major health problem especially in developing countries such as India. Viral hepatitis represents a disease entity caused by at least five unrelated viruses whose primary tissue tropism is the hepatocyte. These viruses are highly infectious, transmitted through a variety of modes. The main transmission route of hepatitis B, C, D and G are through sexual intercourse, intravenous drug abuse, blood to blood contact, body piercing, needle pricking, human bites etc. (Galloway and Snodgrass 1998; Plessis et al 1999; Pretty et al 1999; Ganju and Goel 2000; Lamba and Murphy 2000; Riddle and Sherrard 2000). While the hepatitis A and E are transmitted through faecal material (Lemon, 1994; Bradley, 1994).

Hepatitis B virus is the most transmissible of the blood-borne viruses and at present is the only blood-borne virus in which transmission is preventable by vaccination (Riddle and Sherrard 2000).

Infection with hepatitis B virus can produce a chronic infection that places the individual at risk of death from chronic liver disease or primary hepatocellular carcinoma. Damage induced by the virus increases susceptibility to other liver ailments, which can prove fatal. The long incubation period of 6 to 24 weeks often masks the association between the event of infection and the onset of symptoms (Robinson, 1994; Galloway and Snodgrass, 1998). Increased risk of hepatitis B virus infection has been found among health care workers especially those having frequent contact with blood and/ or exposure to needles or sharp instruments (Hadler et al., 1985). In India, in health care workers, the prevalence rate increases with duration in the profession reaching 30% for those who have worked for 20 or more years as compared to 5% among persons of comparable age in the general population (Thyagarajan et al., 1996; Ganju and Goel, 2000). Ganju and Goel, 2000, reported that hepatitis B was found to be positive in 8.8% in the technicians who are in direct contact with blood during profession. Riddle and Sherrard 2000, showed that in the period 1985-1988, there were 16 cases of occupationally acquired hepatitis B among the UK health care workers, but with the increase in awareness level of vaccination, the comparatively recent period showed decline in the occupationally acquired hepatitis B virus. Surveillance of forensic medicine personnel or health care workers suffering sharp injuries suggests that the overall chance of acquiring infection by this route is about 5%, although if the contaminating blood contains 'e' antigen (HBeAg), the risk of infection may be as high as 30% (CDC, 1998a). Li et al., 1993 and Plessis et al., 1999, reported frequency of hepatitis B prevalence at about 23% and 8% respectively in forensic autopsy cases. This virus is about 100 times more transmissible than HIV and reflects both higher values of infectious particles in the blood with hepatitis B virus as well as ability to be transmitted by aerosol due to the smaller size of the viral particle (Galloway and Snodgrass, 1998). Hepatitis C virus infection is responsible for the majority of cases of parenterally transmitted Non-A, Non-B hepatitis and is known to produce a persistent infection that is often associated with

chronic liver disease (Margolis, 1997). The transmission of hepatitis C virus is associated with direct percutaneous exposure to blood such as through transfusion of blood or blood products; transplantation of organs from infectious donors and sharing of contaminated needles among injection drug users (Margolis, 1997). Persons associated with postmortem examination and other health care workers experiencing needle stick injuries are at countable risk of acquiring hepatitis C infection. Surveillance data from the CDC Sentinel Countries study show that 3% of the reported cases of acute hepatitis C are associated with the needle stick injuries (Kiyosawa et al., 1994). The incubation period for acute hepatitis C following accidental needle stick has been reported to average 6- 7 weeks but may range from 2 to 26 weeks (Tsude et al., 1992). Hepatitis D virus is found in the patients with hepatitis B virus and can cause chronic liver disease. In addition to blood, hepatitis D I virus is also found in serum-derived fluids such as wound exudates; however its presence in other body fluids i.e. semen, saliva and faeces has not been studied. Hepatitis G virus infection can be found in both symptomatic and asymptomatic acute viral hepatitis, but its exact role in human liver disease is not yet clearly understood (Alter et al., 1997; Borse et al., 1999; Kapoor et al., 2000). Hepatitis G is transfusion associated and I presumably contractible through inadvertent content during autopsy although no casual relationship between infection and actual hepatitis has been shown (Galloway and Snodgrass, 1998). Human immunodeficiency virus (HIV): The first reports of Acquired Immune Deficiency Syndrome (AIDS) were published in 1981 in literature. These reports described a cell immunodeficiency with no identifiable cause. This deficiency caused the development of a variety of opportunistic infections and malignancies, many of which are extremely rare. Later, cause of the syndrome was found to be a retrovirus (HTLV-III), which is now known as the human immunodeficiency virus (Barr, 1992; Pretty et al., 1999). In a brief time, AIDS cases were recognized among hemophiliacs, transfusion recipients and injection drug users from diverse geographic locales around the world (Blattner et al., 1997). Soon after the first AIDS case was registered in Tamil Naidu state of India in January 1986, a National AIDS committee was constituted. The nature and magnitude of the danger posed by AIDS to the world can be gauged by the fact that according to the latest reports, it is killing six persons every minute worldwide; the figure is said to be rising every hour. The latest data of UNAIDS reveal that while over 0.4 million people are infected with AIDS today, 0.28 million people have already succumbed to the disease. There is an estimated 14,000 new infections everyday in the world. As on December 31st 2001, India had 3.86 million AIDS patients (Jaisingh, The Tribune, 2002).

Body fluids responsible for transmitting the HIV include blood, semen, vaginal secretions, breast milk, and cerebrospinal, peritoneal, amniotic, pericardial and synovial fluids. Other fluids such as saliva, tears, and urine are not implicated in the transmission of HIV unless they contain sufficient and visible blood (Williams et al., 1996). The greatest concern remains the dead body of undiagnosed patient. The HIV is of low infectivity compared with other blood-borne viruses such as hepatitis B and C. Deep injury, visible blood on the device causing the injury, injury with a needle used in a vessel, and injury with hollow-bore needle (compared to a solid needle) all increase the likelihood of a larger inoculums of blood entering the recipient. Other factors such as penetration of a needle through a latex glove (which may have wiping effect) also alter the risk of transmission (Riddle and Sherrard, 2000). The first case of occupationally transmitted HIV infection was reported in the medical literature in 1984 (Anonymous, 1984). In a surveillance conducted by CDC, at least 54 health care workers in the USA have had HIV infection developed after occupational exposure (CDC, 1998b). Postmortem samples have reported HIV positive individuals of about 6% by Li et al., 1993 and about 15% by Plessis et al., 1999. The risk for infection among medical and laboratory personnel including mortuary workers is considered as low but resembles the rates for single contact heterosexual transmission (Weiss et al., 1985; Padian et al., 1988; Padian et al., 1990). Infection risk due to needle prick is estimated at 0.3% to 0.5% (Marcus, 1988). HIV does not survive for long periods with drying; postponement of autopsies in known AIDS cases does not eliminate risk of contamination by HIV. According to Douceron et al., 1993b, viable HIV was isolated from blood obtained 16.5 days after death.

Tuberculosis:

Tuberculosis still remains the major killer in the developing countries like India. It is estimated that 99% of the deaths and 95% of all the cases occur in the developing world (Sharma and Ahluwalia, 2000). Out of 300 million people infected with Mycobacterium tuberculosis in India, 12 million are supposed to be of active tuberculosis (Bhatia, 2000). Tuberculosis is transmitted by airborne droplets nuclei of 1 to 5JlM usually from the sputum positive case. The groups at higher risk include autopsy workers and persons involved in histopathological preparations from fresh material. In a study, medical students washed their hands in a sink contaminated with M. tuberculosis; the infection was most probably caused by inhalation of an aerosol created as the water was run into the sink (Morris, 1946; Harris, 1993). According to another study, the postmortem room workers were infected during the autopsy procedure; the infection was most probably contracted by the aerosol particles generated by an oscillating saw (Templeton et al., 1995). The forensic medicine personnel in India must consider themselves highly vulnerable since there is high frequency of tuberculosis. The increased frequency of the tuberculosis cases may be attributed to the secondary effect of the epidemic of AIDS.

Rabies:

Concerns about the possible transmission of rabies to forensic personnel are not all surprising. Being a public health problem, data from the WHO indicate that about 30,000 people die of rabies in India which accounts for about 81 % of global report of 37,000 deaths annually (Sudarshan et al., 1999). The virus has been detected in human tracheal secretions, saliva, nasal swabs and human tissue (Warrel and Warrel, 1988). For example, an autopsy on a patient having unknown meningoencephalitis was conducted in New York, and was later found to have died of rabies when routine histopathological slides of brain tissue were reviewed approximately 2-3 weeks after death. Then after diagnosis, the post exposure prophylaxis was administered to 55 persons including 5 members of the autopsy team (Stratton and Decker, 1996).

Other dangerous infections:

Smallpox -a colossus of death no longer strides the earth but lies imprisoned under heavy guard in Moscow and Atlanta awaiting the visit of the executioner (Decker and Schaffner, 1996). Smallpox claimed its last victim, a photographer; the infection occurred in her office by an air wafted from a slipshod laboratory (Hawkes, 1979) and in 1980, World Health Organization declared this disease eradicated. Scientists have shown the retrieval of the virus after few months of infection; there is highly unlikely that smallpox will be readily transmitted from dead tissue, however, there is a little concern for forensic anthropologists involved in excavations or exhumations of smallpox victims with permafrost. Plague is an ancient disease existing in a 'nest' a reservoir of animals (rats or squirrels etc.), which perpetuates the bacillus, Yersinia pestis. Humans, however, are an accidental host and have no role in the maintenance or propagation of the disease in nature except in pneumonic spread, person-to-person (Simmons and Gelfand, 1996). Plague is perpetuated in the natural animal reservoirs of urban and Sylva tic rodents by fleabites or by the ingestion of the infected animal tissues. Pneumonic plague is highly contagious by airborne transmission. The incubation period is 2-7 days following the bite of an infected flea. In 1993, the plague had claimed more than a million lives while the deadly plague, which swept the world in the 14th century, had wiped off half of India's population. The outbreak of pneumonic plague in Surat, India in late 1994 served a reminder that the disease remains dangerous (Sethi, The Tribune, 2002). In February 2002 plague again struck the Himachal Pradesh state in India and claimed 5 lives. Hence, forensic personnel should be alerted to the possibility of plague in order to avoid skin contact and erosolization of particles. Hantavirus pulmonary syndrome (HPS) -a severe form of respiratory distress and non-cardiogenic pulmonary edema (CDC, 1993; Hughes et aI, 1993; Hjell et aI, 1994; Fink, 1996). Humans probably become infected after inhaling aerosolized droplets of urine or particulates contaminated with rodent excreta as the infected rodents shed the virus in their saliva, urine or faeces (Fink, 1996). Exposure to infected rodents, their nests and excreta while examining human remains may place forensic expert at risk to this respiratory disease as postmortem rodent activity is commonly encountered on bones and soft- tissues of the dead and rodents are usually found nesting in a skeleton or a corpse (Haglund et al., 1988; Haglund, 1992; Patel, 1994). Other viral and bacterial infections are also potential hazards during postmortem examination and scene recovery due

to presence of endemic conditions, within local populations and colleagues, contaminated water or insect and animal reservoirs. A wide range of diseases are represented within this group with a variety of transmission modes, latency periods and virulence and includes viral haemorrhagic fever, malaria, rubella, Ebola and Marburg viruses, Lassa fever, human granulocytic enlichosis and human T-lymphotropic virus type I, rickettsiae, mycoplasms, salmonellae, shigella, diphtheria, pertussis, Strepto(;OCCUS pyogenes (Group A Streptococcus), pneumococcus, meningococcus, anthrax (Anthrax bacillus), Haemophilus influenzae, brucellois, legionellosis etc. (Decker and Schaffner, 1996; Galloway and Snodgrass, 1998; Times News Network, 2001).

Universal Precautions:

Standard universal precautions must be applied to all the cases regardless of the knowledge of status of infection. Universal precautions are meant to apply to blood, semen and vaginal secretions as well as to cerebrospinal, synovial, pleural, peritoneal, pericardial and amniotic fluids and they do not apply to faeces, nasal secretions, sputum, sweat, tears, urine and vomitus unless they contain visible blood (Ajmani, 1997). Entry to postmortem examination room should be restricted except for the experts and workers who are trained in handling the infected material. The experienced persons should conduct the examination because it has been shown that the risk of accidental exposure is greatest among the inexperienced. This has been confirmed by a study wherein a laceration injury occurred in 1 of every 11 autopsies conducted by pathology residents. In contrast, one such injury occurred for every 53 autopsies performed by staff pathologists (0' Brian, 1991; Stratton and Decker, 1996). Immunosuppressed or immunodeficient individuals and individuals who have uncovered wounds, weeping skin lesions or dermatitis should not perform the examination. The autopsy room should be of a size sufficient to accommodate the workload without overcrowding and the design of the room and equipment should be such as to permit free movement and easy and thorough cleaning and disinfection of autopsy tables, dissecting surfaces, floors, walls etc. (Harris, 1993) and creating an atmosphere in which work is done more safely. Appropriate proper clothing i.e. gloves, masks, eyewear, headwear, shoe covers, an impervious or full-covered gown should be worn by the mortuary staff while conducting postmortem examination. Gloves should be checked for leakage as a study reports about 8.3% failure rates during postmortem examination (Western and Locker, 1992). The use of gloves protects from blood and other body fluid skin contamination and reduces the volume of material transferred to skin in case of needle-stick. Glove perforation happens commonly, double gloving in the mortuary is recommended to minimize the risks of cutaneous blood contacts. Although not much reliable, a case is reported wherein a pathologist sustained a deep scalpel injury with profuse bleeding while performing an autopsy in spite of wearing double gloves (Johnson et al., 1997). Hand washing is required after contamination with blood or other body fluids and immediately after gloves are removed. Contamination with blood or other body fluids must not be transferred from gloved hands to surfaces which may subsequently be touched by ungloved hands e.g. door handles, telephone receiver, table, chair, books etc. Sharp instruments should be handled with great care and there should be no hand-to-hand passing and minimized use of sharp instruments while performing postmortem examination. After using scalpels, disposable syringes, needles and other sharps should be placed in puncture resistant containers for disposal; these containers should be placed as close as practical to the area where sharps are being used. In case of tuberculosis, where inhalation is the principal route of infection, The Health Services Advisory Committee (1991) recommends that 10% formalin should be introduced into the lungs after appropriate microbiological specimens have been taken and before the lungs are examined (Harris, 1993). The procedures like bone cutting or chiseling should be avoided with oscillating/rotating saw which are most likely to cause splashes of blood and aerosolization of infected particles in case of tuberculosis. Although light surgical style facial masks may also be used in the mortuary, these are not an adequate substitute for a respirator when working with potentially infectious material. For example, in case of tuberculosis infection, surgical masks have proven insufficient and properly fitted respirators with high efficiency fitters are required by OSHA (Suruda et al., 1994; Galloway and Snodgrass, 1998). In case of plague and hantaviruses, the guideline centers around two critical issues (Fink, 1996): (a) avoiding aerosol droplets or particulates of rodent excreta and direct inoculation from infected tissues and (b) decontamination with a disinfecting product recommended by the CDC i.e. Lysol, a 10% solution containing chlorine bleach, or

some other biphenyl compounds (CDC, 1993). Thus, the use of High Efficiency Particulate Air-filter (HEPA) respirators, latex gloves, and disinfectants are recommended as universal precautions against hantaviruses and plague exposures (Butler and Peters, 1994; Mills et al., 1995).

Vaccination:

Hepatitis B virus is almost totally preventable by adequate vaccination and appropriate booster injections. According to recommendation from U.K., every health care worker should be vaccinated and antibody level measured every 5 years (Riddell and Sherrard, 2000). Immunoglobulin for the prevention of hepatitis A virus may be considered for mortuary setting wherein faecal-oral transmission is likely. This provides protection of infection with hepatitis A for a period of two years. Another safe and highly effective inactivated (killed) HA V vaccine is available. Antibodies induced by the vaccine are not detectable until two weeks after administration, but reach much higher level than obtained with immunoglobulin. Ideally, two doses of vaccine, two weeks to one month apart should be given. A booster dose given 6-12 months later is recommended. Such a schedule is expected to provide at least 10 years protection (WHO, 2001).

Tuberculin test should be performed and a radiograph should be taken if a worker subsequently develops symptoms such as prolonged unexplained cough, fever or weight loss (Harris, 1993). For plague, a formalin-killed vaccine is available for occupationally exposed personnel but it is not routinely indicated for health care workers in United States (Simmons and Gelfand, 1996). Vaccines against other deadly diseases like tetanus, diphtheria, pertussis, measles, mumps, rubella, rabies etc. should also be administered to forensic medicine personnel.

What to do if an injury occurs:

In case of needle stick injury, remove glove, wash the hand or other part under running tap water but it should be warm enough to encourage bleeding. Consider anti-HIV and HBV drug prophylaxis if the injury is with a needle contaminated macroscopically with deceased blood and the exposed individual should also have a blood test for serological status of HBV and HIV. Factors, which increase the risk, are deep injury, visible blood on the injury device, procedure involving a device being placed directly in a blood vessel (e.g. a hollow bore needle). Exposed mucous membranes should be flushed with water with at least 15 minutes. For example, eye exposure should be treated by emergency eyewash for 15 minutes or rinsed with saline eyewash solution. Information should be given to the supervisor immediately.

Disinfectants or sterilizing agents:

For the sake of safety, the instruments or items, which are used in postmortem examination, should be placed in a plastic container with 0.5 sodium hypochlorite solutions. Later they may be cleaned and should be autoclaved before being used again. Instruments, which can be autoclaved, should be sterilized in 1 % gluteraldehyde for at least 10 minutes. Alluminium and stainless steel are damaged hypochlorite; and instruments made of these instruments should be "- decontaminated with 2% aqueous gluteraldehyde solution (Geller, 1990). The 10% formalin solution is found effective against all kinds of viruses and is recommended for the disinfections of instruments, tables and other surfaces after the postmortem examination of HIV and viral hepatitis infected person. However, it should be taken into consideration that the formalin is highly irritant to the eyes. 1-2% soluble phenolics are recommended against bacterial pathogens including M. tuberculosis. In a case of Creutzfeldt Jakob disease, prolonged soaking on sodium hydroxide solution is recommended (Geller, 1990).

Conclusion:

High prevalence of various infectious diseases in the population poses a great risk to forensic Medici with cadavers. Periodic training and education in safe postmortem procedures, prevention of sharp's injuries and other kinds of exposures should be imparted to the forensic personnel regularly. They should be aware of the potential transmission of these infections and the use of preventive measures. Non-availability of the vaccination for some of these deadly infections alerts that avoidance to such an exposure is the only prevention by the use of universal precautions while at work. The: expenditures associated with the post-exposure treatment of the occupationally infected individual, institutional insurance premiums and workers compensation benefits should be covered by the appropriate health authority.

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