Health hazard free mortuary - a formidable task for the Indian hospitals

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Abstract:

Medicolegal autopsy is a compulsory requirement in all the unnatural deaths as well as deaths under suspicious circumstances but the prevailing conditions in majority of the mortuaries are a potential health hazard for those working there. An autopsy may subject the doctor (autopsy surgeon) and other staff involved, to a wide variety of infectious agents such as HIV, Hepatitis B, Hepatitis C, Mycobacterium tuberculosis, etc. Other health hazards include toxicity resulting from chemicals like formalin, phosphine gas and organophosphates, etc. Proper assessment, personal protective equipment, appropriate autopsy procedures and infrastructural modifications can substantially reduce these risks.

Introduction:

Throughout the world, the frequency of consent autopsies has substantially declined over the previous decades, from approximately 50% of all hospital deaths in 1950 to less than 10% in 1995[1]. One of the main reasons for this decrease is the increased risk of occupational exposure of pathologists to dangerous pathogens[2]. However, medicolegal autopsies being a basic legal requirement to ascertain the cause and manner of unnatural deaths, have registered an overall increase throughout the country.[3-5] Furthermore, these cases on many occasions are brought dead to the hospital and as such their medical history is not known. Even in cases of deadly poisoning, the relatives put forward a fictitious history of gastroenteritis or so without realizing the potential health hazards to which the medical team assigned the job of ascertaining the cause of death are exposed. Practically, it is almost impossible to know the medical status (whether or not HIV/HBV/Tuberculosis, etc, present) of each and every deceased person in any hospital.

Autopsy transmitted infections may occur after direct cutaneous inoculation, or contact with droplets and aerosols. Streptococcal sepsis, tuberculosis, blastomycosis, AIDS, hepatitis B and C, rabies, tularemia, diphtheria, erysipeloid fever and certain viral hemorrhagic fevers are some of the serious infections that can be transmitted in this manner. Many of these have proved to be fatal.[6 - 13]

It has long been recognized that the dissectors, observers and other persons in close proximity to an autopsy are at a high risk of contracting infectious diseases from the bodies. Studies in British clinical laboratories between 1970 and 1989 established that the highest rate of laboratory- acquired infections was in autopsy workers[14]. Many studies have confirmed that with the cessation of life, certain pathogenic bacteria are released, which if left unchecked, may prove hazardous to the personnel dealing with them. Moreover, with death, the natural barriers in the body, like the Blood Brain Barrier, etc, are lost and the pathogens translocate themselves unrestricted within the dead body[6]. The risk of acquiring infections, from these bodies, is hence very high to the persons involved in their autopsy. It is therefore prudent to consider all the dead bodies to be potential carriers of infection and follow the “Standard Precautions”, when dealing with them.

Material and Methodology:

Material for the study comprised of 2835 cases of unnatural deaths and/or death under suspicious circumstances reporting to Government Medical College & Hospital Chandigarh, for medicolegal autopsy during the period 1994 to 2003. Data on the relevant factors was collected from various sources viz. case papers or hospital records, the inquest papers and the information furnished by the relatives. The samples from various organs viz. Lungs, Liver, Spleen and Kidneys were subjected to histopathological examination and a portion of spleen was subjected to microbiological examination to ascertain the organism responsible for septicemia. The test samples of body tissues and fluids such as Liver, Spleen, Kidneys, Stomach & Small Intestine with their contents, Lungs, Heart, Brain, Muscles (as and when required), Blood etc. were properly preserved and forwarded to the Forensic Science Laboratory/Chemical Examiner for chemical analysis to determine the allegedly consumed poison.

Observations:

Of the 2835 autopsies conducted during the study period, vehicular accidents comprised the maximum (36%), followed by poisoning (21%) and burns (18%). Vehicular accidents registered a steady decline from 59% to 29%, while poisoning cases increased from 13% to 31%. Deaths due to burns also registered an increase from 11% in 1994 to 25% in 2001 followed by a decline to 16% during 2002 and 2003. Putrefied bodies constituted 2% of the total autopsies. **(Table 1)**

87% of the deaths due to poisoning, 52% due to burns, 46% due to disease and 8% due to vehicular accidents respectively, were potentially hazardous to the personnel associated with performing the autopsies. **(Table 2)**

Of the total 1015 hazardous cases, maximum were due to poisoning by various agrochemicals (51%), followed by septicemia due to infected burns and trauma cases (32%). Out of a total 8% cases of tuberculosis diagnosed at autopsy, 65% were established before death whereas in the remaining 35% cases, it was an incidental finding in deaths due to vehicular accidents or burns or other causes. 0.4% and 0.5% autopsies were established HIV positive and Hepatitis B cases respectively. 3% cases belonged to the category of 'others' that included liver abscess, lung abscess, bronchopneumonia, etc. **(Table 3)**.

Klebsiella was the most common organism responsible for causing septicemia (33%), followed by Pseudomonas (29%) and Staphylococcus (13%). Salmonella accounted for only 1-% cases. **(Table 4)**

Out of total 595 cases of deaths due to poisoning, aluminium phosphide and zinc phosphide accounted for 65% cases; Organo phosphorus and organo chloro compounds for 22% whereas alcohol, benzodiazepines and other drugs claimed 8%. No poison detected was reported by the chemical examiner in 5% cases despite the history, clinical features and poison specific treatment of the patient in the hospital. **(Figure 1)**

Discussion:

Since long, it has been recognized that among physicians, pathologists are a high risk group for occupationally acquired hepatitis B (HBV) virus because of their exposure to blood.[15] It has been reported that resident doctors working in Pathology sustained a percutaneous injury with a blood exposure in 1 in 11 autopsies and experienced pathologists in 1 in 55 autopsies[16]. Scalpel blades made majority of these cuts. However, many other objects such as broken glass, needle fragments, bone pieces, and fragmented projectiles can injure the autopsy personnel[17]. Weston J et al[18] have documented that approximately 8% surgical gloves get punctured during autopsy and about 1/3rd of these remain undetected by the pathologist, thus causing any pre existing hand injuries to be bathed in infectious blood for a prolonged period of time. The prevalence of HBV, HCV and HIV infection is higher in forensic autopsy population as the cases dealt by them constitute a higher percentage of drug addicts, particularly the intravenous users.[19] However, as low as 0.4% HIV cases and 0.5% Hepatitis B cases observed in the present study could be attributed to the lack of mandatory testing for such cases on the part of hospitals and social stigma attached to it preventing the voluntary testing. Performing autopsies on persons who have died of viral hemorrhagic fever (VHF) poses even greater risk. Many pathologists and their assistants have died of autopsy transmitted Ebola, Marburg and Lassa hemorrhagic fevers[20].

Infectious aerosols are composed of air borne particles aproximatley1-5mm in diameter, which can remain suspended in air for long periods of time. When inhaled, they cross the upper respiratory passages and reach the pulmonary alveoli [21].Aerosols are generated by aspirators, oscillating saws and water hoses, when applied to the dead bodies. Even compressing and dissecting the lungs can give rise to infectious aerosols.[22] One of the most common organisms to be transmitted through this route is Mycobacterium tuberculosis. Others reported organisms include rabies, plague, meningococcemia, Q fever, anthrax, Klebsiella, staphylococcus, Pseudomonas, etc. In the present study, klebsiella, staphylococcus and pseudomonas accounted for 75% cases of septicemia.

Autopsy is an exceptionally efficient method of transmitting tuberculosis from the dead body to those present in the autopsy room. The risk for infection does not vary with the distance from the autopsy table. Exposures as brief as 10 minutes in the autopsy room

have resulted in transmission[23]. Autopsy exposure is far more infectious than exposure during life.[24] It is not unusual for tuberculosis to remain undetected until a patient dies. In a study of hospitals in Dundee, Scotland, 50%of autopsied active tuberculosis cases were unrecognized before autopsy[25]. In a country like India, where tuberculosis is still the most fatal respiratory disease affecting the lower socioeconomic group and where unidentified vagabonds constitute an appreciable percentage of the autopsy population, the percentage of unrecognized tuberculosis cases is substantially high, as compared to the more developed countries. In the present study, however, only 35% of the tuberculosis cases were found undiagnosed during life. Instances of tuberculosis outbreak caused by multi-drug resistant M. tuberculosis have increased in the recent past [26]. Embalming itself has been shown to produce active tuberculosis aerosols. Embalmed bodies have yielded active M. tuberculosis for as long as 60 hours after fixation.[27]

Formaldehyde is the most common toxic agent to affect the autopsy personnel. It is highly volatile and causes irritation of the eyes, mucous membranes and skin[28]. According to the Occupational Safety and Health Adminstration,[29] exposures to this chemical of 0.75 PPM for 8 hrs and of 2 PPM for 15 min is the safe limit. The odour threshold for formaldehyde is between 0.1 to 1 PPM. Therefore the ability to smell the substance generally means that the person is exposed to a concentration, which exceeds the occupational standard. Long-term exposure to the substance has also been associated with an increased risk for all cancers, particularly the cancer of lung[30].

Forensic Pathologists and the technicians may be exposed to cyanide when performing autopsies on persons who have died after ingesting this substance[31]. The risk is maximum when the stomach is exposed, as the cyanide salts are converted to highly volatile hydrocyanic gas in the acidic environment of the stomach[32]. Similar risk exists in cases of deaths due to Aluminum phosphide and Zinc phosphide ingestion as fatal phosphine (hydrogen phosphide) gas is released in the stomach. Phosphine has been reported to cause symptoms at concentrations of approximately 2 ppm[33]. In the present study, agrochemicals like aluminium phosphide, zinc phosphide, organophosphorus and organochloro compounds were reported to have been detected in 87% cases of deaths due to poisoning. Organo-phosphates (e.g., Malathion and Parathion) fumes may cause toxicity on inhalation, while opening the stomach[34]. Certain nerve gas agents are organo-phosphorus compounds (Tabun, Sarin). These can penetrate heavy rubber gloves and aprons and be absorbed through the skin. Hence bodies contaminated with these agents require to be thoroughly washed with water or 5% hypochlorite solution before the autopsy. [35]

Autopsy workers may also be exposed to radioactive materials in a body from therapeutic or diagnostic procedures. Cases of pathologists receiving excessive radiation after autopsying such bodies have been reported[36]. The extent of radiation exposure is dependent on the dose administered to the patient, type of radiation emitted, the radio nucleotide used, the exposure time and the protection gear worn by the autopsy personnel. Rubber gloves reduce b-radiation very much, but not the d-radiation from the isotopes[37].

Autopsy precautions:

Although the agent-specific degrees of risk have been clearly established for bio-medical and microbiologic laboratories, the same standards have not been well laid down for the autopsy room. However the safety standards developed for the various clinical and investigative laboratories can be broadly applied to the mortuaries[38].

Proper personnel protection involves personal protective equipment, engineering, work practices, etc. The protective gear used and the procedures followed so as to protect the health care workers were formerly termed Body Substance Isolation Procedures or Universal Precautions. Recently, these precautions were combined into Standard Precautions, which were developed to reduce the transmission of all pathogens from moist body substances[39]. Autopsy workers need to be protected from blood borne and aerosol- transmissible pathogens. To protect the eyes, skin, and mucous membranes, all persons in the autopsy room should wear a surgical gown with full sleeves, surgical cap, and some type of goggles and shoe covers. Persons dissecting and those assisting should wear double gloves. Surgical gloves may mitigate the risk from splashed body fluids and will prevent the persons involved in dissection from contacting their face and nose with soiled hands. They however do not protect them from inhaling airborne contaminants[40]. In such cases, particularly when there is a risk of pathogens like M. tuberculosis, wearing of N-95 respirators should be made mandatory[41]. These mask like respirators are designed to filter about 95% of particles that are 1mm in diameter. Their use should be considered for all autopsies because it is frequently impossible to determine the risk for an aerosolized pathogen before an autopsy.

Any paper waste, sponges, waste tissue, soiled clothes, and similar materials should be treated as standard hospital “red bag” waste and incinerated[42]. Afterwards, the table surface should be cleaned with appropriate liquid chemical.

Vaccination is currently recommended for all health care workers who are regularly exposed to blood and other body fluids and can significantly decrease the risk of occupational exposure to the pathogens[43]. Autopsy personnel should have a baseline tuberculin skin test at the time of employment. Periodic re-testing of workers with negative skin test results should be undertaken at regular intervals.

Entry to postmortem examination room should be restricted except for the experts and workers who are trained in handling the

infected material. If possible, the autopsy rooms should be separated from the administrative part of the mortuary. Separation prevents the employees and other persons not participating in the postmortem examination from being exposed to various pathogens. Exhausts should be suitably located and directed to the outside of the mortuary.

Immunosuppressed or immunodeficient individuals and individuals who have uncovered wounds, weeping skin lesions or dermatitis should not perform the autopsy.

All exposed personnel should have access to appropriate health – care facilities at the earliest.

The morbid anxiety about occupationally acquired HIV-infection in the forensic practice has made mortuary workers unduly overcautious without any scientific justification, as there exists no evidence to-date that HIV infection is readily acquired in the mortuary. However, a scalpel blade injury during autopsy and seroconversion thereafter, has been reported thus demanding that all such autopsies should be carried out with total precautions against infective risks. It has also been advocated that pre-autopsy testing for HIV and other infective agents should be mandatory. However, a blood test before autopsy tends to be governed by ethical considerations, mortuary ethos, laboratory facilities and budgetary constraints. Furthermore a screening test for HIV antibody may be insensitive in somebody affected shortly before death that has not seroconverted.

Conclusion

Taking utmost precautions while dissecting the bodies can decrease the risk of autopsy-transmitted infections. Personnel performing dissections must be careful with sharp instruments like scalpels, needles, etc. They must also be aware of the possibility of encountering other sharp objects like broken glass, splintered bone fragments, and projectile pieces. They should thoroughly and immediately wash any skin surfaces that are contaminated with blood or other potentially infectious body fluids to prevent infecting themselves. After the autopsy is complete and the gloves are removed, it is essential to thoroughly wash the hands as un-apparent defects may appear in the gloves during use and may lead to contamination. Since it is almost impossible to know the status of each and every deceased person due to practical, financial, ethical and legal reasons, therefore, it is preferable to improve our work culture and follow standard work-precautions. It should be realized that occupational hazards are a global challenge and they can not be overcome anywhere unless they are dealt with everywhere.

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Table 1: Annual distribution of autopsies

Year	Burns		Poisoning		Vehicular Accidents		Disease Process		Putrefied Bodies		Others		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1994	27	11.49	30	12.76	139	59.15	14	05.96	03	01.28	22	09.36	235	08.29
1995	31	14.22	34	15.60	108	49.54	22	10.09	05	02.29	18	08.26	218	07.69
1996	38	16.89	42	18.67	101	44.89	19	08.44	02	00.89	23	10.22	225	07.94
1997	44	16.54	49	18.42	106	39.85	25	09.40	06	02.26	36	13.53	266	09.38
1998	52	18.18	53	18.53	96	33.57	19	06.64	04	01.40	62	21.68	286	10.09
1999	68	22.44	58	19.14	102	33.66	22	07.26	07	02.31	46	15.18	303	10.69
2000	77	21.88	67	19.03	113	32.10	27	07.67	06	01.70	62	17.61	352	12.42
2001	81	24.77	86	26.30	83	25.38	19	05.81	09	02.75	49	14.99	327	11.53
2002	55	16.27	89	26.33	98	28.99	21	06.21	07	02.07	68	20.12	338	11.92
2003	46	16.14	87	30.53	82	28.77	23	08.07	05	01.75	42	14.74	285	10.05
Total	**519**	**18.31**	**595**	**20.99**	**1028**	**36.26**	**211**	**07.44**	**54**	**01.90**	**428**	**15.10**	**2835**	**100.00**

*Others include deaths due to Hanging, Drowning, Assault, Fall from height etc.

Table 2: Annual distribution of hazardous cases

Year	Burns			Vehicular Accidents			Disease Process			Poisoning			Total		
	Total No.	Hazardous		Total No.	Hazardous		Total No.	Hazardous		Total No.	Hazardous		Total No.	Hazardous	
		No.	%		No	%		No.	%		No.	%		No.	%
1994	27	13	48.15	139	11	07.91	14	08	57.14	30	26	86.67	210	58	27.62
1995	31	16	51.61	108	09	08.33	22	10	45.45	34	27	85.29	195	64	32.82
1996	38	20	52.63	101	11	10.89	19	07	36.84	42	36	85.71	200	74	37.00
1997	44	25	56.82	106	08	07.55	25	14	56.00	49	42	85.71	224	89	39.73
1998	52	25	48.08	96	07	07.29	19	09	47.37	53	46	86.79	220	87	39.55
1999	68	40	58.82	102	07	06.86	22	09	40.91	58	49	84.48	250	105	42.00
2000	77	35	45.45	113	09	07.97	27	12	44.44	67	57	85.08	284	113	39.79

2001	81	45	55.56	83	06	07.23	19	07	36.84	86	73	84.88	269	131	48.70
2002	55	23	41.82	98	07	07.14	21	10	47.61	89	82	92.13	263	122	46.39
2003	46	25	54.35	82	08	09.76	23	11	47.83	87	76	87.36	238	120	50.42
Total	**519**	**267**	**51.45**	**1028**	**83**	**08.07**	**211**	**97**	**45.97**	**595**	**514**	**86.72**	**2358**	**963**	**40.93**

Table 3: Pattern of hazardous cases

Year	Hazardous	Poisoning		Putrefied		Infected									
						Septicemia		Tuberculosis		HIV +ive		Hepatitis B		Others	
	No.	No.	%	No	%	No.	%	No.	%	No.	%	No.	%	No.	%
1994	61	26	42.62	03	04.92	27	44.26	04	06.56	00	00.00	00	00.00	01	01.64
1995	67	27	40.30	05	07.46	26	38.81	06	08.96	00	00.00	00	00.00	03	04.68
1996	76	36	47.17	02	02.63	28	36.84	05	06.58	00	00.00	02	02.63	03	03.95
1997	95	42	44.21	06	06.32	33	34.74	10	10.53	00	00.00	00	00.00	04	04.21
1998	91	46	50.55	04	04.40	29	31.87	08	08.79	00	00.00	01	01.10	03	03.30
1999	112	49	43.75	07	06.25	45	40.18	10	08.93	00	00.00	00	00.00	01	00.89
2000	119	57	47.90	06	05.04	43	36.13	09	07.56	00	00.00	00	00.00	04	03.36
2001	140	73	52.14	09	06.43	37	26.43	12	08.57	01	00.71	01	00.71	07	05.00
2002	129	82	63.57	07	05.43	23	17.83	09	06.98	02	01.51	01	00.78	05	03.38
2003	125	76	60.80	05	04.00	32	25.60	10	08.00	01	00.80	00	00.00	01	00.80
Total	**1015**	**514**	**50.64**	**54**	**05.32**	**323**	**31.82**	**83**	**08.18**	**04**	**00.39**	**05**	**00.49**	**32**	**03.15**

*Others include Liver abscess, Lung abscess, Pneumonia, etc.

Table 4: Frequency of Organisms isolated from Spleen on Microbiological Examination.

Organism	Cases	
	Number	Percentage
Klebsiella Species	106	32.82
Pseudomonas Aeuroginosa	95	29.41
Coagulase +ve Staphylococcus	42	13.00
Klebsiella Pneumoniae	27	08.36
Proteus Mirabilis	25	07.74
E. Coli	16	04.95
B Haemolytic Streptococcus	09	02.79
Salmonella	03	00.93
Total	**323**	**100.00**