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ORIGINAL ARTICLE

Seroprevalence of human immunodeficiency virus, hepatitis B virus, and hepatitis C virus among the forensic autopsy cases in South India

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Abstract

A dead body is handled by health workers and relatives during shifting, transporting, and autopsy. Cadavers are known as potential sources of infections like human immunodeficiency virus (HIV), hepatitis B virus (HBV), hepatitis C virus (HCV), tuberculosis, Ebola, H1N1, and prion diseases. The objective of our study was to estimate the seroprevalence of HIV, HBV, and HCV in forensic autopsies. We included 421 cases in this study, which were autopsied during 2015-2017. It was conducted in a tertiary hospital in South India (Pondicherry). We took the blood sample for testing HIV, HBV, and HCV. The prevalence of HIV/ HBV/ HCV was 2.9% (95% CI: 1.6% - 5%, n=12). The seroprevalence of HIV, HBV, and HCV was 0.7% (95% CI: 0.2% - 2.1%, n=3), 1.9% (95% CI: 0.9% - 3.7%, n=8) and 0.2% (95% CI: 0.03% - 1.6%, n=1), respectively. Cases with tattoos/multiple injection marks/scar of previous surgery had 4.3 times higher odds (95% CI: 1.2 – 14.7, p-value- 0.02) of having HIV/HBV/HCV compared to those without it. We found a low seroprevalence of HBV, and HCV in forensic autopsies except for HIV, which was a little higher compared to the general population. These findings can be used to come up with specific guidelines to deal with cases more carefully to avoid the risk of infections.

Keywords

HIV; HBV; HCV; Virus; Infection; Autopsy; Seroprevalence

Introduction

Mortuaries, dissecting rooms, and forensic laboratories are high-risk areas as they are the potential sources of various infections. The forensic surgeon or pathologist and the staffs are at higher risk of exposure to various viruses such as human immunodeficiency virus (HIV), hepatitis B virus (HBV), hepatitis C virus (HCV), tuberculosis, Ebola, H1N1, and prion diseases.[1,2,3] Exposure to a large amount of blood and body fluids due to the unique characteristics of autopsy practice raises the concern as occupationally acquired infection.[4] The agents of great concern are HIV, HBV, and HCV as they are chronic infections and they have similar concerning epidemiology, pathogenesis, clinical presentation and, the mode of transmission. The estimated risk of transmission of HIV, HBV, and HCV following percutaneous exposure is 0.3%, 20%, and 2% respectively.[5]

The use of sharp instruments during evisceration, slicing of organs, and exposure to the sharp edges of bones can puncture the gloves of forensic surgeons leading to skin contamination.[–6]

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Many infectious agents may be transmitted to the autopsy surgeon and staff from body fluids, contaminated instruments, and tissues during an autopsy. Relatives of deceased and police personnel may be exposed to infectious material during identification, inquest, and transportation and handling of the body. The preservation of biological material for chemical, histopathological, and microbiological examination also carries the risk of transmission of infectious organisms.[–7]

It has been observed in developing countries like India that autopsy surgeons often perform autopsies on the dead bodies of unknown background. These cases have unknown risks of communicable diseases to autopsy surgeon and the health staff. The less availability of testing facilities for such viral markers among the general population makes it challenging to deal with it. A minimal data is available for India regarding HIV, HBV, and HCV seroprevalence among forensic autopsies; a region that has an existing and growing HIV epidemic and high HBV seroprevalence. In India, very few people infected with these infections had been tested and knew their status. The objective of our study was to estimate the seroprevalence of HIV, HBV, and HCV in forensic autopsies in a tertiary health care hospital of South India.

Material and Methods

It is a hospital-based cross-sectional study conducted in a tertiary hospital of South India (Pondicherry). The data was collected for randomly selected 435 autopsies conducted

between September 2015 to July 2017. We have considered 421 cases and excluded 14 cases as the blood samples were haemolysed. The data regarding the socio-demographic factors and medical history was collected from the medical records and relatives/police. We deidentified the cases by giving them an identity code and collected data in a proforma. Three blood samples of 2 ml each in plain tubes were collected by cardiac puncture from the right ventricle at the time of autopsy using a needle and syringe. The labeled samples were sent to the Department of Microbiology for conducting the serological tests. The serum was separated by centrifugation at 3000 rpm for 10 minutes and tested for Hepatitis B antigen (HBsAg) and anti-Hepatitis C virus antibodies (anti-HCV) by ELISA. Three different assays based on different principles or antigenic composition were performed for HIV testing (Strategy III) as per the National Aids Control Organization guidelines for testing.[8] COMBIAIDS-RS Advantage-ST immunodot test was tested as the first HIV testing kit, followed by SD BIOLINE HIV-1/2 3.0 as second kit and HIV TRIDOT as the third HIV test.

All data were entered in MS Excel and analyzed by using SPSS 19.0. The prevalence of HIV/HBV/HCV was reported with the 95% confidence interval. We used bivariable and multivariable logistic regression to assess the factors associated with the HIV/HBV/HCV among forensic autopsy cases. All the factors which came potentially significant (p-value <0.2) in the bivariable analysis were considered for the multivariable logistic regression model. The informed consent was obtained from the next of kin, relatives, and concerned Police in unidentified cases.

Table 1: Age wise distribution of seroprevalence of HIV, HBV, and HCV in the forensic autopsies.

Age group	HIV Status		HBV Status		HCV Status		Seroprevalence of HIV, HBV and HCV		Total
	Negative	Positive	Negative	Positive	Negative	Positive	Negative	Positive	
1-14 years	13(100.0%)	0(0.0%)	13(100.0%)	0(0.0%)	13 (100.0%)	0(0.0%)	13(100.0%)	0(0.0%)	13
15-49 years	269(98.9%)	3(1.1%)	267(98.2%)	5(1.8%)	272(100.0%)	0(0.0%)	264(97.1%)	8(2.9%)	272
50 years above	136(100.0%)	0(0.0%)	133(97.8%)	3(2.2%)	135(99.3%)	1(0.7%)	132(97.1%)	4(2.9%)	136
Total	418(99.3%)	3(0.7%)	413(98.1%)	8(1.9%)	420(99.8%)	1(0.2%)	409(97.1%)	12(2.9%)	421

Table 2: Factors associated with HIV/HBV/HCV in the forensic autopsies.

Variables (n=421)	No. of cases with HIV/ HBV/HCV	Bivariable analysis		Multivariable analysis	
		cOR (CI)	p-value	aOR (CI)	p-value
Sex					
Male (n= 296)	11 (91.7%)	4.8 (0.6 – 37.5)	**0.136**	1.9 (0.1 – 26.4)	0.643
Female (n = 125)	1 (8.3%)	1		1	
Age in years					
< 25 (n=86)	2 (16.7%)	1		Not included	
26 – 50 (n=218)	7(58.3%)	1.4 (0.3 – 6.8)	0.683		
≥ 51 (n=117)	3 (25%)	1.1 (0.2 – 6.8)	0.914		
Residence (n=414)					
Urban (n= 43)	1(8.3%)	1		Not included	
Rural (n=371)	10 (83.4%)	1.2 (0.1 – 9.3)	0.887		
Marital Status (n=414)					
Married (n=342)	8 (66.7%)	1		Not included	
Unmarried (n=72)	3 (25%)	1.8 (0.5 – 7)	0.387		
Education (n=414)					
No formal education (n=70)	4 (33.3%)	1		1	
Educated (n=344)	29 (58.4%)	0.3 (0.1 – 1.2)	**0.095**	0.3 (0.1 – 1.3)	0.105
Occupation (n=414)	10 (83.4%)	1		1	
Earning (n=278)	1(8.3%)	0.2 (0.02 – 1.6)	**0.125**	0.3 (0.2 – 4.7)	0.416
Not earning (n=136)					
Presence of tattoos, multiple injection marks, scar of previous surgery					
Absent (n=351)	7 (58.3%)	1	**0.027**	1	
Present (n=70)	5 (41.7%)	3.8 (1.2 – 12.3)		4.3 (1.2 – 14.7)	**0.021**

Table 3: Comparison of seroprevalence of HIV, HBV and HCV in the forensic autopsies

Seroprevalence	HIV(%)	HBV(%)	HCV(%)
Our study (South India)	**0.7**	**1.9**	**0.2**
Okudaira et al.[9] (Japan)	-	2.8	0.6
Gharehdaghi et al.[10] (Iran)	2.6	3.84	9.05
Watkin et al.[11] (USA)	0.25	0.76	1.272
Li et al.[12] (USA)	5.6	23.2	19.1
Cattaneo et al.[13] (Italy)	16.3	-	28.7
du Plessis et al.[14] (South Africa)	11.0	8.0	1.0
Morris et al.[15] (South Africa)	26.2	-	-
Lazerk et al.[16] (North France)	-	-	16.9
Christensen et al.[17] (Denmark)	4	35	51
Yadav et al.[18] (North/West India)	2.39	6.94	1.67
Mehta et al.[19] (North India)	0.6	-	-
Bansal et al.[20] (North India)	5	-	-
Sanaei-Zadeh et al.[21] (Iran)	0.0	4.6	4.0
Eriksen et al.[22] (Denmark)	3	36	57
Kato et al.[23] (Japan)	-	-	16.6
Tofigi et al.[24] (Iran)	6.25	27.5	-
Bakri et al.[25] (Jordan)	0.0	2.1	2.1

Results

We included 421 cases out of 435 cases after excluding 14 haemolysed autopsy blood samples. Of these, 296 were males (70.3%), and 125 were females (29.7). Most of the individuals were of the age 26-50 years (n = 218, 51.8%) followed by older than 51 years (n = 117, 27.8%) and lastly individuals aged less than 25 years (n = 86, 20.4%). 81.2% of the cases were married (n = 342), while 72 cases were unmarried (17.1%) and 7 belonged to unknown status (1.7%). Majority of the cases worked as agricultural labourers (n = 144, 34.2%), followed by homemakers (n = 85, 20.2%), non-agricultural labourers (n = 57, 13.5%), self-employed (n = 46, 10.9%), student (n = 42, 10%), driver (n = 26, 6.2%), and unemployed (n = 9, 2.1%). 216 individuals had completed their secondary education (51.3%), 95 had completed their primary education (22.6%), 70 had no formal education (16.6%), 33 had completed higher secondary education (7.8%) and 7 individuals were of unknown status. Out of the 421 cases, 70 individuals had tattoos, while 351 did not have any.

The mean age of the cases was 41.6 years (SD-17.5) and ranged from 2 years to 85 years. There was the presence of tattoos, multiple injection marks, and scar of previous surgery in 70 (16.6%) of the cases. The common cause of death of selected 421 cases was an accident (281, 66.8%), suicide (113, 26.8%), homicide (2, 1.7%), and natural death (20, 4.8%). Out of these cases, 193 (45.8%) cases were road traffic accident deaths. The number of cases where the time since death is less than 24 hours was 342 (81.2%), between one to two days was 68 (14.3%), between 3 days to one week was 7 (1.7%), whereas only 4 cases (1.0%) were having time since death more than one week.

The seroprevalence of HIV, HBV, and HCV in the age group of 15-49 years was 1.1%, 1.8% and zero respectively. Seroprevalence of HIV, HBV, and HCV in more than 50 years was zero, 2.2%, and 0.7% respectively. Seroprevalence of combined three viruses was 2.9 % in 15-49 years group. The association between age and status of three serological markers was not significant (P>0.05) (Table 1).

The total number of positive cases was found to be 12 (2.85%) for at least one viral marker. The seroprevalence of HIV/ HBV/ HCV was 2.9% (95% CI: 1.6% - 5%, n=12). The seroprevalence of HIV, HBV, and HCV was 0.7% (95% CI: 0.2% - 2.1%, n=3), 1.9% (95% CI: 0.9% - 3.7%, n=8) and 0.2% (95% CI: 0.03% - 1.6%, n=1), respectively. Not a single case was found to be positive for two or more viruses (HIV/HBV/HCV). Out of the 421 cases, 7 cases were unidentified and one among them was positive for HBV. In the bivariable analysis, sex, education, occupation and tattoos, multiple injection marks, a scar of previous surgery were potentially significant. In multivariable analysis, cases with tattoos/multiple injection marks/scar of previous surgery had 4.3 times higher odds (95% CI: 1.2 – 14.7) of having HIV/HBV/HCV compared to those without it (Table 2).

The seropositive cases were eight (2.8%) among accident deaths, three (2.7%) in the suicidal deaths, one (5.6%) among the natural death, and no positive case seen in the homicidal deaths. All the cases tested positive for HIV and HCV, and seven out of eight cases tested for HBV were having time since death less than 24 hours, while one positive case of HBV was more than one week.

Discussion

Some studies sample size was more as compared to our study (421 samples) like 1044 cases in Okudira et al..[9], 1039 cases in Gharehdaghi et al..[10], and 785 body donation cases in Watkins et al..[11]. Other studies have comparable samples like 173 cases in Sanaei-Zadeh et al..[2], 414 cases in Li et al..[12], 397 cases in Cattaneo et al..[13], 263 cases in du Plessis[14], 195 samples in Morris et al.[15], 77 cases in Lazrek et al.[16], 299 cases in Christensen et al.[17], 418 cases in Yadav et al.[18], 328 cases in Mehta et al.[19], and 200 cases in Bansal et al.[20].

In our study, most of the cases were male (70.3%) and our findings were similar to 83.2% male in Sanaei-Zadeh et al.[2], 82.6% male in Cattaneo et al.[13], 79.1% male in du Plessis et al.[14], 74.6% male in Okudira et al.[9], 73% male in Lazrek et al.[16], 78% in Christensen et al.[17], and 80% male in Gharehdaghi et al.[10]. In our study the age range of cases were 2 to 85 years as

compared to age range of cases 2 to 78 the years in study of Sanaei-Zadeh[2], all cases in 16-50 years in the study of Cattaneo et al.[13], 3 months to 79 years (average age, 36 years) in the study of du Plessis[14], 1 month to 89 years in Lazrek et al.[16] The median age was 38 years in Christensen et al.[17]. In our study, 51.8% of cases were in 21-50 years of age similar to 70.4% cases in 20-49 years in the study of Sanaei-Zadeh[2]. But, the most frequent age group was more than 60 years (258, 24.9%) in Gharehdaghi et al.[10] Most commonly married cases 342 (81.2%) were included in our study similar to 61.8% married cases were included in Gharehdaghi et al.[10] The most common occupation was an agricultural laborer (34.2%) in our study as compared to self-employed (31.4%) in Gharehdaghi et al.[10] The majority cases had education up to secondary school (51.3%) in our study as compared to education lower than primary school (41.3%) in another study.[10] Tattoos, multiple injection marks, scar of previous surgery were observed in 70 (16.6%) cases in this study compared to drug abuse (18.1%), sign of nonmedical injection mark (8.7%), and tattoos (12.7%) in Gharehdaghi et al.[10]

The most common cause of death was an accident (66.8%) in our study similar to a head injury (54.91%) in Sanaei-Zadeh et al.[21], trauma 319 (30.7%) in Gharehdaghi et al.[10] But, suicide (35%) was a common cause of death in Lazrek et al.[16] Maximum samples (342, 81.2%) were collected within 24 hours of death in our study. Sample carried out within 1 to 38 days of death as per Cattaneo et al.[13] The median time since death of sample collection was four days in Eriksen et al..[22] The peripheral blood collected from the cadavers where the time since death varied from six hours to three days.[19] The time since death was less than 24 hours in 74.3% cases in Gharehdaghi et al.[10]

The total number of positive cases was found to be 12 (2.85%) for at least one viral marker (HIV, HBV, and HCV). Eighteen (2.3%) cases were positive for these three infections and it was similar to our findings.[11] But, Gharehdaghi et al. observed that 161 samples (15.49%) were positive for at least one of the infections (HBV, HCV, and HIV).[10] A high HIV seroprevalence among autopsy cases was reported in Li et al..[12] (USA) and du Plessis et al..[14] (South Africa) was 5.6% and 11% respectively. The differences were due to the selection of the study population. Our cases were representing the general population. Studies from West and South India showed a seroprevalence of HIV 2.39% and 0.6%.[18,19] A study conducted in Iran and Jordan did not show any HIV positive cases among the autopsies (Table 3).[21,25]

An estimated adult (15-49 years) HIV prevalence was of 0.22% [0.16-0.30] in India (2017). In India, around 21.40 lakh people living with HIV (PLHIV) and 97% of the total PLHIV belonged to the 15+ year age group. Females constituted 42% of estimated PLHIV (15+ years). In 2017, 87580 people were newly infected with HIV and 69110 PLHIV died from AIDS-related causes in the same year. Tamil Nadu had 1.42 lakh PLHIV. While Tamil Nadu (0.22%, 0.14-0.31) had point prevalence like the national average.[26] Our study showed a low seroprevalence of HIV in forensic autopsies when compared to the previous studies, but found to be higher than that of the general population.

The HBV seroprevalence among the autopsy cases in the USA (23.2%) and South Africa (8%) was high. A study reported a seroprevalence of 6.94% in West India.[12,14,18] Okudaira et al. and Bakri et al. reported HBV seroprevalence in forensic autopsies as 2.8% and 2.1% in Japan and Jordan respectively (Table 3).[9,25] Globally in 2015, viral hepatitis caused 1.34 million deaths. About 257 million people had chronic HBV infection. Seventy-one million people had chronic HCV infection with 1% prevalence. About 2.7 million had chronic HBV infection and 2.3 million had been infected with HCV among the 36.7 million PLHIV in 2015. Highest hepatitis B prevalence was observed in the WHO Western Pacific region (6.2%), WHO African region (6.1%) WHO South-East Asia region (2.0%). The highest HCV prevalence observed in the Eastern Mediterranean region (2.3%) followed by the European Region (1.5%).[27] The present study showed a low seroprevalence of HBV of 1.9% among the autopsy cases tested compared to the previous studies. There was no single case with a combination of HIV, HBV, and HCV. A high HCV seroprevalence was reported from various studies conducted in the USA (19.1%), Iran (4.04), Jordan (2.1%), and West India (1.67%) (Table 4).[12,18,21,25] The prevalence of anti-HCV positivity in India was reported around 1% and ranging from 0.09% in the rural population in Maharashtra to 7.89% in a tribal population of Arunachal Pradesh.[28] The seroprevalence of HCV in the present study is less compared to that of the previous studies and the general population as well.

Li et al.[12] observed a higher positive rate in the age between 30-39 years for both HBV and HCV. du Plessis et al..[14] found more HIV seroprevalence (11% to 19%) and HBV seroprevalence (8% to 9%) in the age group of 15-49 years. A maximum number of HIV cases were found in the age group of 31-40 years (n=4, 9.52%).[20] Morris et al.[15] also observed a rise in HIV seroprevalence from 26.2% to 30% among the 15-49 years age group. Since 15-49 years is the reproductive age group, the rise in seroprevalence found in various studies displays a concern regarding the spread of infection in the living, but our study showed the rise is not significant.

Similar to other studies the males outnumbered the females in the study population. Eleven male cases were positive for viral markers out of 12 cases tested positive. Li et al.[12] reported a similar seroprevalence of HIV among males (5.7%) and females (5.2%), but HCV infection in males (21.8%) was twice when compared to females (10.3%) and no significant difference was present among the male and female HBV seroprevalence. A study conducted in Italy showed males (82.6%) were more than, females (17.3%), and study in Iran

also reported more males (83.2%) than females (16.8%).[13,21] The high representation of male deaths that warrant a medicolegal investigation can be attributed to the presence of more seroprevalence in males.

The HIV seroprevalence is found comparatively high among the urban population when compared to the rural population. Urbanization, lower level of education, low income, and mobile occupation are associated with a high prevalence of HIV infection.[29] Laborers representing both agriculture as well as the non-agriculture sector have a fair representation in our study population. The seroprevalence of any one of the viral markers is 2.8% and 5.3% respectively.

It is a known fact that tattooing is associated with a high risk of HBV and HCV infection, especially if not done by professionals.[30,31] A study conducted in the USA showed significantly increased seroprevalence of HIV, HBV, and HCV among intravenous drug users (IDU). Among this 83.6% were infected with one of these viruses. HIV-1 was seen in 25.5% and both HBV and HCV were seen in 47.3%.[12] Similarly, the study in Italy also had a high number of drug-related deaths in their study population, where 81 out of 107 drug overdose cases had markers of infection.[13] Christensen et al..[17] (Denmark) assessed the seroprevalence of HIV, HBV, and HCV in postmortem blood samples of drug-related deaths had an anti-HIV prevalence of 4% (9/214), an anti-HBc prevalence of 35% (74/209), and anti-HCV prevalence of 51% (110/215). These results showed the overestimation of seroprevalence of HIV, HBV, and HCV among forensic autopsies due to the increased representation of high-risk groups such as drug-related deaths and IDU.

One of the limitations of our study could be the use of rapid test kits used for the diagnosis of HIV/HBV/HCV, as their sensitivity and specificity can affect the estimate of prevalence. Further studies at a larger scale might be required to generalize the findings. Further studies can be conducted to generate evidence with a larger sample size.

Conclusion

We found a low seroprevalence of HBV, and HCV in forensic autopsies except for HIV, which was a little higher compared to the general population. Cases with tattoos, multiple injection marks or scar of previous surgery have higher odds of having HIV/HBV/HCV. These findings can be used to come up with specific guidelines to deal with autopsy cases more carefully to avoid the risk of infections.

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