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Surveillance of Human Immunodeficiency Virus (HIV) Antibodies in Medicolegal Autopsies in Finland—Monitoring Early Changes in HIV-Seropositivity Among Risk Groups and Average Population

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ABSTRACT: In order to cooperate with voluntary screening programs aimed at the surveillance of the HIV epidemic in Finland, we have studied medicolegal autopsies for HIV antibodies since 1986 using an enzyme immunoassay on postmortem sera. The investigation covered 47.4% and 39.2%, respectively, of all deaths under the age of 65 years in the metropolitan areas of Helsinki and Turku—two cities on the densely populated southern coast of Finland from which most HIV infections have thus far been detected.

Nine HIV-positive cases (0.12%) were detected among the 7305 medicolegal autopsies tested in 1986 to 1990. This figure is higher than the prevalence of 0.01 to 0.03% in voluntary screening programs for the general population would suggest. Seven of our cases had previously tested positive, and two were previously unknown cases, indicating that people at high risk are clustered in the medicolegal autopsy series. Of the six cases in an early stage of infection, three committed suicide suggesting the importance of HIV-screening in suicide cases in tracing symptomless HIV carriers.

Five of the cases were detected in 1990, a year when the number of new HIV infections had more than doubled compared to the previous two years. This suggests that testing of medicolegal autopsies as surrogate tests for the population gives useful information even in low-prevalence areas like Finland. Such testing has none of the ethical problems of many other back-up surveys, and may be particularly sensitive to early changes in epidemiology.

KEYWORDS: pathology and biology, AIDS, HIV, epidemiology, homosexuality, narcotics addicts, autopsy

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The first AIDS cases in Finland were detected in Helsinki in 1983. The number of new HIV cases uncovered during the next few years reached a maximum in 1986. Surprisingly, despite increasing free testing through several communal, state, and voluntary screening programs, the number of new Finnish cases started to decrease in 1987 [1]. At the same time a decrease in new HIV infections was also observed among homosexuals in other cities in Europe [2–5].

Medicolegal autopsy series, when it includes sudden deaths and fatal traffic accidents, is considered to provide the most representative sample of the living population. Moreover, homosexuals and drug addicts with a high HIV-infection risk often commit suicide [6] or otherwise die violently and are thus subjected to medicolegal autopsy [7]. Single persons who have a higher risk of HIV infection due to a greater number of sexual contacts are also more prone to die unwitnessed or violently—an indication for medicolegal autopsy in Finland. Hence, we believed that HIV-testing in medicolegal autopsies would be a valuable method in searching for 'hidden' HIV carriers in Helsinki. We expected to discover a number of untested HIV-infected men with a history of homosexual behavior or use of intravenous narcotics, especially among suicide cases [8]. Our findings support the view that screening of medicolegal autopsies for HIV antibodies is a valuable tool for the surveillance of HIV-epidemic in a low-prevalence community.

Materials and Methods

This series covers 7973 medicolegal autopsies in the cities of Helsinki and in Turku and their environs. The population of Helsinki metropolitan area and the surrounding Uusimaan province is 1.2 million and the population of Turku metropolitan area is 270,000. There are 4.9 million inhabitants in Finland.

According to Finnish law, a medicolegal autopsy is performed in cases of sudden death due to diseases or to unknown cause; in cases with obvious disease-induced death but with no contact with a physician; in all unnatural deaths including accidents, poisonings, suicides, homicides, and obscure deaths as well as in cases with suspected occupational disease, and in cases of suspected medical malpractice. All deaths occurring in jail and mental hospitals or death of a conscript also are subject to medicolegal autopsy.

The overall medicolegal autopsy rate in 1988 in Finland was 17.5%, which translates into 8852 medicolegal autopsies of the total 49 090 deaths in Finland. However, in deaths under the age of 65 years it comprises 42.9% of all deaths in Finland. In violent and accidental deaths the autopsy rate is between 91 and 100%. The total number of medicolegal autopsies in Helsinki and Turku in 1988 was 3420, which corresponds to 39% of all medicolegal autopsies in Finland. In cases of natural disease-induced death under the age of 65 years, a medicolegal autopsy was performed for 29.3% and 21.5% in Helsinki and Turku, respectively. Under the age of 65 years the series covers practically all deaths caused by accidents, suicides and violence in both cities.

Single persons comprised 26% of all the medicolegal autopsies in Helsinki. They were more prone ($\chi^2 = 23.035$, $P < 0.001$) to die violently (308 violent deaths of 591 casualties) compared with married persons (318 violent deaths of 811 casualties). Thus, our medicolegal autopsy series is probably the most representative sample possible of the sexually active population under 64 years of age, which population also harbors the HIV virus.

The background of belonging to a risk group was surveyed in a series of 209 consecutive male suicide cases in Helsinki in 1986 to 1987 [8]. Although the police reports and available hospital records gave little information about sexual orientation, in seven (3.3%) of 209 male suicide cases there was some indication of a homosexual background. In four other cases (1.9%), use of intravenous narcotics was evident. These figures probably represent an underestimation.

Screening for HIV in Medicolegal Autopsies

Blood of the cadavers was drawn from the femoral vein through an incision. The sample was taken before autopsy, or, due to practical reasons or busy schedule, at autopsy. The samples were tested using an enzyme immunoassay at the HIV-laboratory of the National Public Health Institute of Helsinki or at the Department of Virology, University of Turku. Because it can be assumed that samples from bodies that had died a long time previously might have lost some of the antibodies, we tested the sensitivity of the enzyme immunoassay by testing serial dilutions from sera, vitreous humor, and gallbladder fluid as well as samples stored over long periods at room temperature. Positive results were confirmed by the Western blot method.

Helsinki—In the first phase of our screening program, September 1986 to September 1987, we tested sera for HIV-antibodies in all male cases ($n = 209$) of suspected suicide and unclear cause of death. In the second phase, October 1987 to November 1990, we have tested sera in all medicolegal autopsies ($n = 7071$). During the first phase, the commercial test manufactured by Organon was used. The second phase was started by using tests by Pasteur and Abbott but were replaced by Combi-1-2, Pharmacia, from January 1989. In Helsinki the autopsy series covers all death cases admitted to medicolegal autopsy from the Helsinki metropolitan area and the surrounding Uusimaa province (population 1.2 million).

Turku—Sera from medicolegal autopsies performed during September 1987 and April 1989 were screened for HIV antibodies using HIV Elisa Test System, Ortho. On three occasions Vironostika Anti-HIV Uni-Form, Organon, Or Wellcozyme HIV Recombinant, Wellcome, tests were used as trials, respectively, but were later abandoned due to the high proportion of falsely reacting sera. Since April, 1989, tests were done only in cases with a strong suspicion of HIV due to a known homosexual or drug addict background. In Turku the autopsy series comprises all death cases in the metropolitan area (population 270,000) examined at the Department of Forensic Medicine, University of Turku. The series covers 42% of the total number of medicolegal autopsies in the Turku and Pori province.

Results*HIV-Antibody Tests*

Helsinki—Sera for HIV-antibodies were tested in 6612 autopsies (90.8%) of the 7280 autopsies (Table 1). Eight (0.12%) of the sera proved to be HIV-positive (Table 2). Four individuals had died from infections associated with AIDS, three committed suicide, and one was murdered. Only two of the people (Cases 3 and 6) were not previously known to have HIV-infection. All others had tested positive when alive. Of the eight, four were homosexuals, one had acquired the infection through blood products, but in three cases the route of transmission remained unclear.

Turku—Of the 693 sera (80.3%) tested of the 863 autopsies, one case (0.14%) turned out to be positive (Table 1 and 2). In this case a decomposed body of a young man without known history of homosexuality or use of intravenous narcotics was found in his apartment. He was not previously known to have HIV-infection. The cause of death also remained unclear. Since 1989, performing an HIV test only in selected cases, no positive cases have been found thus far.

In four of the positive cases (Cases 1,2,4,8), the autopsy revealed opportunistic infections as a cause of death (Table 2). These cases were considered to be late (IV) stages

TABLE 1—*Screening for Human Immunodeficiency Virus (HIV) in postmortem sera in medicolegal necropsies in Helsinki and Turku.*

City	No.	Tested ^a	%	Positive ^b		False	
						Reactive ^b	%
Helsinki	7280	6612	90.8	8	0.12	175	2.6
Turku	863	693	80.3	1	0.14	17	2.4

^aEnzyme immunoassay (Combi-1-2, Pharmacia in Helsinki and HIV Elisa Test System, Ortho in Turku).

^bPositive results confirmed by Western blotting.

[9]. Five of the people (Cases 3,5,6,7,9) were only HIV positive and were considered to be early infections (Stage I to III). Of those with early infections, three committed suicide, one was murdered and in one case cause of death was unknown.

Reliability of Post-Mortem Enzyme Immunoassay

The results, considering fresh and stored postmortem samples from sera, vitreous humor and bile, showed that even after prolonged times, specific antibodies could be detected at dilutions comparable to fresh samples. This suggests that postmortem decomposition did not significantly affect the sensitivity of the testing system. Pharmacia's Combi-1-2 test and Ortho's HIV Elisa Test System proved to be good choices when screening postmortem sera or bile, whereas Wellcome's Wellcozyme-HIV recombinant test, which did not succeed with sera, was usable when studying postmortem vitreous humor or bile.

False positives, caused probably by decomposition or hemolysis of the blood samples, were detected in 2.6% of the cases tested with the Combi-1-2 and in 2.4% in cases tested with HIV Elisa Test System.

In the initial phase, six blood samples (0.09%) were not tested because of clotting, but later this problem was overcome by dissolving the clot in saline.

Discussion

The number of HIV-positive cases among the medicolegal autopsies, nine of 7.305 (0.12%) is rather high when compared to the prevalence suggested by other screening programs conducted in Finland. It is lower than among visitors to the AIDS information and support centers (0.5%) who are assumed to comprise people at risk groups. It is also lower than among outpatients attending the sexually transmitted disease clinic in Helsinki (0.17%) but significantly higher than among primary health care center visitors (0.03%) or other groups studied that should represent the general population. Screening of medicolegal autopsies is thus a sensitive indicator of early changes in the epidemiology of HIV. This may be due to the fact that hiding or abstaining from testing, which may cause serious errors in all kinds of voluntary surveillance problems, does not affect the representativeness of our sample.

As many as five of the positive cases were found in 1990, the year when other surveillance programs also detected many more new cases than in the previous years (about 100 for 1990). Three of the six cases with early stage of infection (Stage I to III) were detected in 1990. Three cases, detected in 1987 and in 1990, had not tested positive before.

The occurrence of three suicides in the nine HIV positives suggests that HIV positives are clustered in suicide cases. Moreover, all HIV-positive suicide cases were in the early stages of the infection. HIV screening in series of suicide victims seems thus to be useful

TABLE 2.—Cases with HIV antibodies in medicolegal autopsies in Helsinki and Turku.

No.	Year	Sex	Age	Stage of infection ^a	Transmission	Cause of death
<i>Helsinki</i>						
1	1987	M	29	IVC	homosexual	pneumonia
2	1987	F	50	II	blood products	lymphatic leukemia/opportunistic infections
3 ^b	1988	M	31	III	homosexual	homicide
4	1990	F	44	IVC	not known	opportunistic infections
5	1990	M	44	II	homosexual	suicide
6 ^b	1990	M	51	II	not known	suicide
7	1990	M	26	III	not known	suicide
8	1990	M	58	IVC	homosexual	opportunistic infections
<i>Turku</i>						
9 ^b	1987	M	39	II	not known	unknown

^aI = acute HIV infection; II = symptomless infection; III = lymphadenopathy syndrome (L-AS); IVC = secondary infections associated with AIDS (Centers for Disease Control, USA, 1986).

^bNot previously tested.

in tracking HIV-positive persons belonging to risk groups. Homosexuals have been found to have a high suicide risk compared to the rest of the population [10], and suicide attempts have been reported following positive HIV-test results, or the appearance of related symptoms, such as lymphadenopathy [6]. Homosexuals may even consciously attempt to contract AIDS as a means of committing "slow" suicide [11]. It is impossible to assess the number of homosexuals included in the suicide cases of the present autopsy series. Nevertheless, one third of the suicide cases concerned a single male, and of 209 male suicides in Helsinki, we could determine homosexual orientation in 7 cases (3.3%). Rich et al. [10] found 13 (6.4%) homosexuals among 202 male suicides in San Diego, which corroborates our data. There are very few deaths in Finland ascribed to overdose of narcotics. We found four cases (1.9%) with a narcotics background in a survey of 209 male suicides. None of these had used narcotics overdose as a means of suicide. However, during the period 1976 to 1984 one out of three deaths among addicts was a suicide [7]. Thus, the HIV positivity of narcotic addicts also can be monitored by screening suicides.

The value of the medicolegal sample as representative of the population depends on the legislation and the autopsy rate of the country. In all countries, however, medicolegal autopsies are suitable for screening early HIV seropositivity among high-risk subjects clustering in the series due to their often non-natural manner of death. In Finland, the medicolegal autopsy series covered 5512 (42.9%) of the total 12 850 deaths in age groups below 65 years in 1988. Of medicolegal autopsies, one half (51.6%) are performed in cases of natural death. Sudden death, mostly caused by cardiac diseases, is the most important cause in two-thirds of the natural death cases. The other half of the medicolegal autopsy series consists of violent deaths, including suicides and traffic accidents, which are considered to represent a random sample of the living population. However, alcohol-related deaths as well as deaths of heavy consumers of alcohol are overrepresented in any medicolegal autopsy series.

Technically, postmortem sera is appropriate for HIV testing at autopsy because the gamma globulin fraction of the serum protein is little affected by autolysis [12]. In our series, however, false positive test results occurred in 2.4 to 2.6% of the cases in these circumstances. We could detect HIV antibodies in putrefied cadavers as well as in HIV-positive samples of blood, vitreous humor and bile stored at room temperature for several weeks to months.

Finland has a very low prevalence of HIV-infections: in a population of 5 million, 398 HIV-positive cases had been discovered by the end of May 1991. Of the positive cases, 74 have developed AIDS or died of it. Homosexuals account for 61%, heterosexuals 24%, drug addicts 5%, blood products-victims 2.7%. Among 28 500 persons tested in 1989, representing the general adult population, the prevalence of HIV is only 0.02%, according to statistics reported by the Public Health Institute.

Several testing programs are now in progress on a voluntary basis in Finland. Tests are performed on blood donors, conscripts, hospital patients with infections or with venereal diseases, prisoners, clients in AIDS information and support centers, drug users at withdrawal clinics, as well as on patients in health centers and pregnant women [2,8,9]. This low prevalence and our previous report, covering medicolegal autopsies in Helsinki 1986 to 1988, with a prevalence of 0.09% [17] are in accordance with the low estimates from those screening programs. The seropositivity in other similar necropsy studies (Table 3) in the USA [13], France [14], South Africa [15], Sweden [4], and Canada [16] varies from 0.8% in Johannesburg to 18% in San Francisco, depending on the nature of the autopsy sample

In conclusion, we propose that postmortem testing of HIV-antibodies in medicolegal autopsies, if considered to represent a cross-section of the population and including most nonhospital death cases of the risk groups, can be useful in monitoring the surveillance of HIV-infection in the population. HIV testing in medicolegal autopsies is a convenient

TABLE 3—*Human Immunodeficiency Virus (HIV) seropositivity in various autopsy series.*

City	No. of tested	Positive	%	Reference
Helsinki	2256	2	0.09	Karhunen et al. 1989 [8]
Johannesburg	745	6	0.8	Schoub et al. 1989 [15]
Stockholm	4661	53	1.1	Rajs et al. 1989 [4]
Vancouver	207	4	1.9	Little and Ferris 1990 [16]
Bordeaux	114	5	4.6	Dupon et al. 1989 [14]
San Francisco	121	23	19.0	Coleman et al. 1986 [13]

and effective “back-up” for epidemiological studies and could be used instead of unlinked anonymous tests from hospital and other similar patient materials. It may be particularly sensitive to early changes in the spread of infection and could thus aid in foreseeing the extent of the epidemics beforehand.

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