Acute Hepatitis Delta Virus Infection in Italy: Incidence and Risk Factors after the Introduction of the Universal Anti–Hepatitis B Vaccination Campaign

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Background. Updates on the incidence of and risk factors for acute hepatitis delta virus infection in Italy, as well as in other countries, are lacking, and the impact of the mandatory anti–hepatitis B vaccination has not been evaluated.

Methods. We performed a case-control study within a population-based surveillance for acute viral hepatitis.

Results. During 1993–2004, 344 cases of acute hepatitis delta virus infection were reported. After a peak in 1993 (2.8 cases per 1 million population), the incidence decreased from 1.7 to 0.5 cases per 1 million population. Coinfections were prevalent. The decrease in incidence particularly affected young adults, and it paralleled the decrease in incidence of acute hepatitis B. In 1993, being an injection drug user (adjusted odds ratio [ORadj], 67.9; 95% confidence interval [CI], 18.1–254.5) or being a member of a household with a carrier of hepatitis B surface antigen (ORadj, 14.8; 95% CI, 3.0–72.9) were the only independent predictors of infection. During 1994–2004, being an injection drug user (ORadj, 36.8; 95% CI, 20.7–65.4), cohabitation with an injection drug user (ORadj, 4.2, 95% CI, 1.7–12.3), hospitalization (ORadj, 3.5; 95% CI, 1.9–6.6), receipt of dental therapy (ORadj, 2.3; 95% CI, 1.4–3.6), promiscuous sexual activity (ORadj, 2.2; 95% CI, 1.4–3.6), and receipt of beauty treatment (ORadj, 2.0; 95% CI, 1.3–3.2) were independently associated with infection.

Conclusions. Incidence of acute hepatitis delta infection is markedly decreasing in Italy. Undergoing invasive medical procedures, engaging in promiscuous sexual activity, and receiving beauty treatments are emerging, in addition to injection drug use, as important risk factors for infection. Further efforts are needed to increase vaccine coverage in high-risk groups and to implement the safety of invasive procedures performed both inside and outside health care facilities.

Hepatitis delta virus (HDV) is a defective RNA virus that requires the helper function of hepatitis B virus (HBV) for infection [1]. HDV infection can occur either simultaneously with HBV infection (coinfection) or in chronic carriers of the hepatitis B surface antigen (HBsAg) (superinfection). The presence of HDV in patients who have chronic HBV disease is associated with a more rapid progression to cirrhosis and with a higher risk of liver decompensation and hepatocellular carcinoma [2]. HDV prevalence is high in areas of sub-Saharan Africa, Eastern Europe, the Middle East, central Asia, the South Pacific islands, the Amazon Basin, and the Mediterranean Basin [3]. In Italy, the virus was endemic in the 1970s, when it was responsible for a substantial proportion of cases of juvenile cirrhosis [4]. In the past decades, HDV prevalence among HBsAg-positive patients has progressively decreased in southern Europe [5]: in Italy, prevalence decreased from 25% in 1983.
[4] to 8.3% in 1997 [6]; in Spain, prevalence decreased from 15.1% in 1979–1985 to 7.1% in 1986–1992 [7]; and in Greece, prevalence decreased from 21.5% in 1970–1974 to 16.5% in 1985–1989 [8]. However, updated data on the incidence of HDV infection in Italy, as well as in other countries, are lacking. Data from a national surveillance system for acute viral hepatitis (Sistema Epidemiologico Integrato dell'Epatite Virale Acuta [SEIEVA]) [9] have shown a decrease in the incidence of acute HDV infection in Italy, from 3.1 cases per 1 million population in 1987 to 1.2 cases per 1 million population in 1992; injection drug use, household contact with an HBsAg-positive individual, and promiscuous sexual activity were independent predictors of infection in that time period [10]. In 1991, a mandatory universal anti-HBV vaccination campaign of infants and 12-year-old adolescents was initiated in Italy. Taking into account the close bond between HBV and HDV infections, we aim to update the previous SEIEVA report [10] and to describe the epidemiology of acute HDV infection after the introduction of the anti-HBV vaccination campaign.

METHODS

Participants. SEIEVA is coordinated by the Italian National Institute of Health (Istituto Superiore di Sanità, Rome) and was established in 1985; since that time, the number of local health units (LHUs) throughout the country that voluntarily participate in the system has progressively increased. In the present study, SEIEVA data for the period 1993–2004 were analyzed; the percentage of the Italian population under surveillance has progressively increased. In the present study, SEIEVA data for the period 1993–2004 were analyzed; the percentage of the Italian population under surveillance was ~40% in 1993–1995, ~45% in 1996, ~55% in 1997–1999, and ~60% in 2000–2004.

Cases of acute viral hepatitis, whether the affected patients are admitted to the hospital or not, are reported to the surveillance system through the LHUs. Case definition of acute hepatitis is based on clinical, biochemical, and serological criteria. Clinical and biochemical criteria include the occurrence of an acute illness that is compatible with hepatitis together with an increase in serum alanine aminotransferase levels (>2.5 times the upper limit of normal). Serological criteria, used to distinguish the different types of acute viral hepatitis, are as follows: acute hepatitis A virus (HAV) infection is defined by IgM anti-HAV–positive serological test results, regardless of other viral markers; HBV infection is defined by IgM hepatitis B core antibody (anti-HBc)– and HBsAg–positive and IgM anti-HAV–negative serological test results; and hepatitis C virus (HCV) infection is defined by IgM anti-HAV and IgM anti-HBc–negative and anti-HCV–positive serological test results. Cases of acute hepatitis with HBsAg-positive, anti-HDV–positive, and IgM anti-HAV–negative serological test results are classified as HDV infection. If IgM anti-HBc is also present, the case is considered to be HBV-HDV coinfection. If IgM anti-HBc is absent, the case is considered to be HDV superinfection in a chronic HBsAg carrier. Assays to detect viral hepatitis markers are performed in different local laboratories using standardized methods.

The study was approved by the ethics committee of the Italian National Institute of Health; written informed consent was obtained from all participants.

Data collection. Patients who received a diagnosis of acute viral hepatitis were interviewed by either a public health inspector or a physician of the LHU using a standard, 2-page questionnaire. Information regarding sociodemographic characteristics, exposure to parenteral risk factors within the previous 6 months, and exposure to fecal-oral risk factors within the 6 weeks before disease onset were collected. The interviewer was blinded with respect to the type of viral hepatitis, to avoid bias in the identification of risk factors. The results of assays to detect hepatitis markers were recorded on the questionnaire after the interview; the completed questionnaires were forwarded to the coordinating center at the Italian National Institute of Health.

Incidence rates estimation. Incidence rates were estimated using the new reported cases for each type of hepatitis as the numerator and the population of LHUs participating in the surveillance system at various points in time as the denominator. No changes were made in the notification system during the study period. Most patients with symptomatic acute hepatitis are admitted to hospitals and virtually all cases of hepatitis in hospitalized patients are recorded by LHUs.

Case-control study. To estimate the association of cases of HDV infection with potential risk factors, cases of hepatitis A reported during the same time period as the SEIEVA study were used as controls. Cases reported in 1993 were analyzed separately, because an outbreak of HDV infection occurred in that year.

Statistical analysis. Differences in proportion between coinfections and superinfections were tested using the χ² test or Fisher’s exact test, when necessary. The difference between mean age was evaluated using the Student’s t test. A P value <.05 was considered to be statistically significant.

Crude ORs and associated 95% CIs for the factors under consideration were calculated in a univariate analysis. Multiple logistic regression was used to estimate the adjusted OR (ORadj) for all risk factors. Age, sex, area of residence, and educational level were also adjusted for during the analysis. All statistical analyses were conducted using STATA software, version 8.0 (Statacorp).

RESULTS

During the period 1993–2004, 9433 HBsAg-positive, IgM anti-HAV–negative cases of acute hepatitis were reported to SEIEVA. Overall, 46.2% of these case patients were tested for anti-HDV, although the percentage of patients tested for anti-HDV...
Figure 1. Incidence rates of acute hepatitis delta virus (HDV) infection. Data were collected by Sistema Epidemiologico Integrato dell’Epatite Virale Acuta (SEIEVA) during the period 1987–2004.

de-estimated by approximately two-thirds in the last 2 years of that period. The anti-HDV test was more frequently performed in injection drug users (IDUs; 53.9% of whom were tested; P <.001) and in individuals who engaged in promiscuous sexual activity (defined as ≥1 sexual partner in the previous year; 52.5% of whom were tested; P <.001), than in patients reporting other risk factors. Three hundred forty-four cases were classified as acute HDV infection, 218 (63.4%) of which were coinfections.

Figure 1 shows the yearly incidence rates of cases of acute HDV infection (per 1 million population) since 1987. In figures 2A and 2B, the age-specific yearly incidence rates of cases of acute HDV infection (per 1 million population) and cases of acute hepatitis B (per 100,000 population) are reported, respectively. In these figures, an overall decrease in incidence is evident; in particular, a decrease in incidence—for both HDV and HBV infections—occurred in the 15–24-year-old age group. Two peaks are evident in the acute HDV infection incidence curve. A first peak was observed in 1990; this excess of cases of infection was not linked to any specific geographical area or reported risk factor. A second peak (64 cases, corresponding to 2.8 cases per 1 million population) occurred in 1993: 56.3% of these cases were from northeastern Italy; 60.7% of these case patients were IDUs. From 1994 to 2004, 280 acute cases of HDV infection were reported, and the incidence rate decreased from 1.7 to 0.5 cases per 1 million population. Coinfections represented 69% of cases of HDV infection in 1993 and 62% in 1994–2004. The characteristics of the acute HDV infections that were reported to SEIEVA during the period 1987–1992 have been previously reported [9].

Table 1 describes demographic and clinical characteristics of cases of HDV infection reported in 1993–2004 and compares coinfections with superinfections. Most cases of HDV infection were observed in men ≥25 years of age who had a medium-high educational level and who resided in the northern central region of the country. Sociodemographic characteristics did not differ between patients with coinfections and patients with superinfections, except for geographical area: 38.9% of superinfected subjects versus 11.9% of coinfections were reported (see table 1) in the southern region of the country or in the islands. In addition, the clinical characteristics were similar, but HBV-HDV—coinfected individuals experienced jaundice more frequently than superinfected individuals. Almost one-half of the patients were anti-HCV positive, and 75% of these were IDUs. Two patients with HBV-HDV coinfection died: one was an HCV-positive IDU, and the other was a 65-year-old man with cancer.

As mentioned earlier, because an outbreak of HDV infection occurred in 1993 in northeastern Italy (mainly among IDUs), risk factors for HDV infection were evaluated separately for the year 1993 and the period 1994–2004. In 1993, being an IDU or a member of a household with a chronic carrier of HBsAg were the only independent predictors of infection (table 2).

In the period 1994–2004, in addition to injection drug use (which remained strongly associated with HDV infection), hospitalization, receipt of beauty treatments (i.e., tattooing, piercing, manicure/chirophy, and barber shop shaving) or dental therapy, having had ≥2 sexual partners in the past year, and cohabitation with an IDU emerged as other independent risk factors (table 3).
Table 1. Characteristics of patients with hepatitis delta virus (HDV) infection reported to Sistema Epidemiologico Integrato dell’Epatite Virale Acuta (SEIEVA) during the period 1993–2004.

| Characteristic                  | Patients with coinfections | Patients with superinfections | Total patients | P
|--------------------------------|----------------------------|-----------------------------|---------------|---
| Percentage of total patients   | 63.4                       | 36.6                       | 100           |   
| Sociodemographic characteristics|                            |                            |               |   
| Sex                            |                            |                            |               |   
| Male                           | 172 (78.9)                 | 103 (82.4)                 | 275 (80.2)    |  .434
| Female                         | 46 (21.1)                  | 22 (17.6)                  | 68 (19.8)     |   
| Age, years                     |                            |                            |               |   
| <14                            | 2 (0.9)                    | 6 (4.8)                    | 8 (2.3)       |  .069
| 15–24                          | 49 (22.5)                  | 29 (23.0)                  | 78 (22.7)     |   
| 25–34                          | 97 (44.5)                  | 61 (48.4)                  | 158 (45.9)    |   
| >35                            | 70 (32.1)                  | 30 (23.8)                  | 100 (29.1)    |   
| Years of schooling             |                            |                            |               |   
| ≤5                             | 29 (18.1)                  | 22 (24.2)                  | 51 (20.3)     |  .2
| 6–8                            | 78 (48.8)                  | 48 (52.7)                  | 126 (50.2)    |   
| >9                             | 53 (32.1)                  | 21 (23.1)                  | 74 (29.5)     |   
| Geographic area                |                            |                            |               |   
| North central Italy            | 192 (88.1)                 | 77 (61.1)                  | 269 (78.2)    | <.001
| Southern Italian islands       | 26 (11.9)                  | 49 (38.9)                  | 75 (21.8)     |   
| Clinical characteristicsd      |                            |                            |               |   
| Jaundice                       |                            |                            |               |   
| Yes                            | 197 (94.7)                 | 106 (88.3)                 | 303 (92.4)    |  .036
| No                             | 11 (5.3)                   | 14 (11.7)                  | 25 (7.6)      |   
| Hospitalization                |                            |                            |               |   
| Yes                            | 202 (95.3)                 | 119 (96.0)                 | 321 (95.4)    |  .769
| No                             | 10 (4.7)                   | 5 (4.0)                    | 15 (4.7)      |   
| Duration, mean days ± SD       | 20.9 ± 12.7                | 21.6 ± 13.9                | 21.2 ± 13.1   | .653
| Anti-HCV                       |                            |                            |               |   
| Positive                       | 91 (45.7)                  | 56 (49.1)                  | 147 (47.0)    |  .563
| Negative                       | 108 (54.3)                 | 58 (50.9)                  | 166 (53.0)    |   
| Death                          |                            |                            |               |   
| Yes                            | 2 (0.9)                    | 0                          | 2 (0.6)       |  .534
| No                             | 216 (99.1)                 | 126 (100.0)                | 342 (99.4)    |   

NOTE. Data are no. (%) of patients, unless otherwise indicated. HCV, hepatitis C virus.

a Defined as HDV infection that occurs simultaneously with hepatitis B virus infection.
b Defined as HDV infection in chronic carriers of the hepatitis B surface antigen.
c Comparison between patients with coinfections and patients with superinfections.
d Information on selected characteristics may be missing for some patients.

DISCUSSION

With the exception of 2 outbreaks that occurred in 1990 and 1993, the incidence of reported cases of acute HDV infection in Italy progressively decreased over time, reaching a nadir in 2004. This decrease closely paralleled the decrease in incidence of acute hepatitis B during that time, and it was already ongoing before the introduction of the universal vaccination program. In fact, many factors are thought to have contributed to the decreasing spread of HBV infection in Italy [11–13], and these factors probably also explain the similar trend exhibited by HDV infection: the social changes that occurred in the past decades (e.g., general improvement of hygienic standards and living conditions and a decrease in family size); the increasing use of disposable syringes; blood screening; the impact of the anti-AIDS campaign on risky behaviors related to sexual contact and to drug abuse; and the vaccination of high-risk groups since the 1980s. Most of these factors have probably affected the risk of acquiring HDV and HBV infections, especially among younger individuals. The universal vaccination campaign, which was initiated in 1991, further enhanced this trend by reducing the pool of susceptible children (at high risk for chronic HBV infection) while having the greatest impact in the
15–24-year-old age group in terms of the reduced number of acute symptomatic HBV and HDV infections. At present, Italy is a country of low HBV endemicity [13]. This translates to a lower incidence of HDV superinfections, which are at high risk to result in a chronic infection and to perpetuate HDV endemicity. This is supported by the finding that the proportion of the total number of cases of acute HDV infection that are HDV superinfections decreased from 50.6% in 1987–1992 [10] to 36.6% in 1993–2004; furthermore, this proportion is lower in northern regions (which have a lower HBV carrier prevalence) than in southern regions. Other epidemiologic data are consistent with our figures, which reveal a decreasing impact of HDV infection in Italy. At a general population level, in a recent survey conducted in a town in southern Italy, the prevalence of chronic carriers of HBSAg was 0.8%, none of whom were anti-HDV positive [14]. At the hospital level, multicenter surveys performed in 1983 [4], 1987 [15], 1992 [16], and 1997 [6] have shown that the proportion of HBSAg-positive patients who were anti-HDV positive was 25%, 23.4%, 14.4%, and 8.3%, respectively. Besides a reduced incidence of HDV infection, it is likely that an increased mortality associated with chronic HDV-HBV hepatitis [2] also contributed to the progressive decrease in the population of coinfected patients.

Injection drug use played an important role in the outbreak that occurred in 1993; similar outbreaks have been reported in other industrialized countries, as well [12, 17, 18]. In 1993, acute HDV infection was strongly associated, not only with injection drug use, but also with cohabitation with a chronic carrier of HBSAg. This condition increases either the risk of acquiring acute HDV-HBV coinfection or the probability of being chronically HBV infected. Thus, in periods of high HDV circulation, the risk of acquiring acute HDV coinfection or superinfection is increased for households of chronic carriers of HBSAg.

During the period 1994–2004, household contact with an IDU, promiscuous sexual activity, and receipt of beauty treatments and dentistry procedures (in addition to injection drug use) played a role in the transmission of HDV. Hospitalization was also an independent predictor of HDV infection, whereas surgery and blood transfusion were not. It is likely that, as has already been demonstrated for HBV and HCV infections [19], other invasive diagnostic and therapeutic procedures play a role in the transmission of HDV in hospitals. In addition, invasive procedures that are performed outside health care facilities, such as beauty treatments, have been shown in a previous SEIEVA report [20] to be risk factors for transmission of HBV and HCV. It is noteworthy that, in our previous analysis of the incidence of and risk factors for HDV infection during the period 1987–1992, only injection drug use, household contact with an HBSAg-positive carrier, and promiscuous sexual activity resulted in an independent association with HDV infection. Thus, an important change in the pattern of HDV transmission might have occurred in the past 2 decades: besides IDUs and people engaged in promiscuous sexual activity—who are still at high risk of infection—there is likely a decreasing impact from intrafamiliar HDV spread and an increasing impact from invasive procedures; the latter is probably because of the growing number of people who undergo invasive medical procedures and the recent great diffusion among the general population of fashionable beauty practices, such as piercing.

When interpreting the results of this study, some possible limitations should be discussed. First, the incidence rates of acute HDV infection reported in this study are probably far from the true incidence of infection. In fact, SEIEVA, as well
as other surveillance systems that are based on the voluntary reporting of cases of acute hepatitis, may lack sensitivity because of underreporting, the occurrence of subclinical infection, and the lack of HDV testing for all HBsAg-positive, IgM anti-HAV-negative individuals. However, because the system was unchanged during the study period, its low sensitivity may affect yearly incidence rates but not the incidence trend of infection over time. In fact, the decreasing trend of incidence of HDV infection parallels that of acute hepatitis B in the same time period, and it is in agreement with the results involving seroepidemiological studies of the general Italian population and hospitalized individuals [4, 6, 14–16]. Thus, data collected through a passive surveillance system provide valuable evidence of a change in secular trend over reasonably long time periods.

Finally, in the study period, a high proportion of Italians were hospitalized individuals [4, 6, 14–16]. Thus, data collected through a passive surveillance system provide valuable evidence of a change in secular trend over reasonably long time periods.

Second, the use of patients with hepatitis A as control subjects to estimate the strength of the association between HDV infection and various routes of exposure may raise some concern. HAV has different modes of transmission than HDV, although they can occasionally share the same risk factors, such as injection drug use or transfusion of blood or blood products. However, percutaneous transmission of HAV is considered to be a very rare event in the general population: of the patients with hepatitis A who participated as control subjects in this study, only a very low percentage reported blood transfusion or injection drug use as a risk factor (0.1% and 1.7%, respectively). However, an overinclusion of exposed persons in the control group would, at most, have led us to underestimate the related OR. Moreover, it should be considered that, in case-control studies, the comparability between case patients and control subjects is a crucial factor and is more important than representativeness. In fact, all individuals in this study who had acute hepatitis represented reported cases, originated from the same geographical area, were identified through the same surveillance system, and were interviewed by the same blinded interviewer; they were, thus, exposed to the same selective factors, if any. The possible confounding effect of some sociodemographic variables was likely removed through the means of multiple logistic regression analysis. Although patients with hepatitis A could not be considered to be absolutely the best control subjects, their inclusion, which also allowed us to save time and expenses, represents a valid and feasible choice in this study. Third, because HBsAg-positive, IgM anti-HAV-negative individuals who reported injection drug use or promiscuous sexual activity were tested more frequently for HDV than were other risk groups, the role of these risk factors in HDV spread was likely overemphasized in our study population. Conversely, we possibly underestimated the risk associated with the other exposures as a result of underreporting and the relatively low percentage of HBsAg-positive, IgM anti-HAV-negative individuals with hepatitis who were tested for HDV. This does not seem to greatly influence the incidence rate estimate, but it might affect the generalizability of our data concerning the relative role of the various risk factors.

The present study shows that, although acute HDV infection is decreasing in Italy, it still exists, and its incidence is probably underestimated. The lack of HDV testing in HBsAg-positive individuals represents a culpable negligence of the diagnostic procedure. Because both HDV superinfection and coinfection worsen the prognosis of HBV infection [2, 21, 22], and because nucleoside/nucleotide analogues are ineffective in chronic
Epidemiology of HDV Infection in Italy

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References

ERRATA

In an article published in the 1 February 2007 electronic issue of the journal (Mele A, Mariano A, Tosti ME, Stroffolini T, Pizzuti R, Gallo G, Ragni P, Zotti C, Lopalco P, Curale F, Balocchini E, Spada E, on behalf of the SEIEVA Collaborating Group. Acute delta hepatitis in Italy: incidence and risk factors after the introduction of the universal anti–hepatitis B vaccination campaign. Clin Infect Dis 2007;44:e17–24), an error appeared in figure 2B. The label for the vertical axis of the figure is incorrect; the label should read “No. of cases per 100,000 population” (not “No. of cases per million population”). The corrected figure appears below. The authors regret this error.

![Figure 2](https://example.com/figure2.png)

Figure 2. Yearly age-specific incidence rates of acute hepatitis delta virus (HDV) infection (A) and acute hepatitis B virus (HBV) infection (B). Data were collected by Sistema Epidemiologico Integrato dell’Epatite Virale Acuta (SEIEVA) during the period 1987–2004. Vertical dotted line, the beginning of the hepatitis B vaccination campaign.


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