



THE AGA KHAN UNIVERSITY

eCommons@AKU

---

Department of Medicine

Department of Medicine

---

February 2010

# Hepatitis D: Scenario in the Asia-Pacific region

Z Abbas

*Aga Khan University*

Wasim Jafri

*Aga Khan University*

Sajjad Raza

Follow this and additional works at: [https://ecommons.aku.edu/pakistan\\_fhs\\_mc\\_med\\_med](https://ecommons.aku.edu/pakistan_fhs_mc_med_med)



Part of the [Community Health Commons](#), and the [Virus Diseases Commons](#)

---

## Recommended Citation

Abbas, Z., Jafri, W., Raza, S. (2010). Hepatitis D: Scenario in the Asia-Pacific region. *World Journal of Gastroenterology*, 16(5), 554-562.

**Available at:** [https://ecommons.aku.edu/pakistan\\_fhs\\_mc\\_med\\_med/53](https://ecommons.aku.edu/pakistan_fhs_mc_med_med/53)

## Hepatitis D: Scenario in the Asia-Pacific region

Zaigham Abbas, Wasim Jafri, Sajjad Raza

Zaigham Abbas, Department of Hepatogastroenterology, Sindh Institute of Urology and Transplantation, Karachi 74200, Sindh, Pakistan

Wasim Jafri, Department of Medicine, The Aga Khan University Hospital, Karachi 74800, Pakistan

Sajjad Raza, Dow Medical College, Karachi 74200, Pakistan

Author contributions: Abbas Z conceived the topic; all authors did an independent search which was matched and divided different segments of the Asia-Pacific region for review; Abbas Z wrote the final draft; Jafri W and Raza S reviewed the final draft.

Correspondence to: Zaigham Abbas, FCPS, FRCP, Department of Hepatogastroenterology, Sindh Institute of Urology and Transplantation, Karachi 74200, Sindh, Pakistan. drzabbas@gmail.com  
Telephone: +92-21-35857172 Fax: +92-21-99215469

Received: June 24, 2009 Revised: September 13, 2009

Accepted: September 20, 2009

Published online: February 7, 2010

### Abstract

Hepatitis D virus (HDV) infection is present worldwide and affects all age groups. Around 18 million people are estimated to be infected with HDV. An important trend in HDV infection is global decline. HDV prevalence has decreased significantly in Europe since the 1970s and 1980s when it was first reported. The Asia-Pacific region now seems to be where HDV is a major health concern. There is a lack of available data from most of the countries from this region; hence, the true status of HDV cannot be determined. In South Asia, most of the countries have conditions that are favorable for the spread of hepatitis B and other related infections. Countries like Pakistan and Iran have shown an increase in HDV prevalence over a period of time. Other countries and region like China, Turkey, Australia, Japan, India and Taiwan, some of which had very high HDV prevalence in the past, have shown a decline in the incidence, but high prevalence persists in some. Intravenous drug abusers, homosexual men and women, prostitutes, and people on hemodialysis are the groups with very high HDV prevalence.

© 2010 Baishideng. All rights reserved.

**Key words:** Hepatitis D; Asia-Pacific region; Prevalence; Epidemiology

**Peer reviewer:** Raffaele Pezzilli, MD, Department of Internal Medicine and Gastroenterology, Sant'Orsola-Malpighi Hospital, Via Massarenti, 9, Bologna 40138, Italy

Abbas Z, Jafri W, Raza S. Hepatitis D: Scenario in the Asia-Pacific region. *World J Gastroenterol* 2010; 16(5): 554-562  
Available from: URL: <http://www.wjgnet.com/1007-9327/full/v16/i5/554.htm> DOI: <http://dx.doi.org/10.3748/wjg.v16.i5.554>

### INTRODUCTION

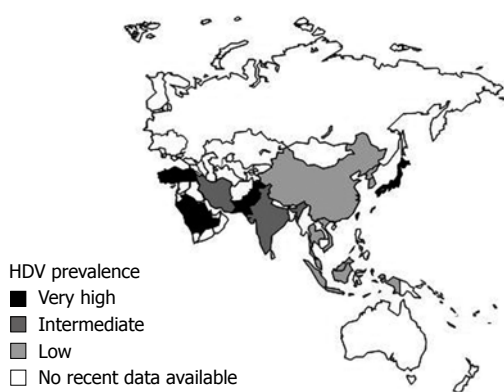
Hepatitis D virus (HDV) infection is present worldwide and affects all age groups. However, it does not have uniform distribution and its general pattern is parallel to that of hepatitis B virus (HBV). Its prevalence is highest in some parts of Africa, South America, Romania, Russia and the Mediterranean region included Southern Italy<sup>[1]</sup>. It is also noteworthy that approximately 5% of the global HBV carriers are co-infected with HDV. Out of approximately 350 million carriers of HBV worldwide, 18 million people are infected with HDV<sup>[2]</sup>.

Hepatitis D prevalence has declined significantly in Europe since the 1970s and 1980s when it was first reported. The new foci of infection now seem to be in the developing countries. The Asia-Pacific region seems to be where HDV exists with high prevalence rates in some of the countries<sup>[3]</sup>.

### HDV

HDV is also known as hepatitis delta virus, and is a defective RNA virus that requires HBV for its virion assembly and penetration into hepatocytes<sup>[4]</sup>. There are three genotypes of HDV, identified on the basis of analysis of HDV genomes from various parts of the world<sup>[5]</sup>. The most prevalent worldwide is genotype I, which is related to a broad spectrum of pathogenicity.

Hepatitis Delta-Scenario in the Asia-Pacific region

**Figure 1** Hepatitis D prevalence in the Asia-Pacific region.

The United States, Middle East and Europe are the places where genotype I is predominant, with some geographically based subtypes<sup>[6,7]</sup>. Genotype II is predominant in the Far East<sup>[5]</sup>. Genotype III is associated with severe forms of hepatitis and is predominant in Northern South America<sup>[8]</sup>.

## GLOBAL TREND OF DECLINE

An important trend in worldwide HDV infection is a global decline in the prevalence of hepatitis D infection, which is true for both acute and chronic forms of the disease<sup>[9]</sup>. This decreasing trend is the result of global HBV vaccination, increasing awareness, improved prevention strategies and socioeconomic conditions<sup>[10]</sup>. Italy, which was considered a traditionally prevalent area for HDV and where the virus was first reported, has shown a steady decline in the prevalence of this infection from 23% in 1987 to 14% in 1992 and 8.3% in 1997<sup>[11-13]</sup>. Figure 1 summarizes the prevalence of hepatitis D in the Asia-Pacific region, incorporating the recent data.

## HDV IN PAKISTAN

In South Asia, most of the countries offer conditions that are favorable for the spread of hepatitis B and other related infections. These conditions mainly include lack of defensive strategies and approaches for these infections, extreme and persistent poverty, densely populated areas, and deteriorating public health and educational infrastructure. According to a study conducted from January 1994 to April 2001, the prevalence of HDV infection in Pakistani hepatitis B surface antigen (HBsAg)-positive individuals was 16.6%. A large belt with high prevalence exists in the middle of the country, which comprises rural areas<sup>[10]</sup>. The predominant genotype of HDV is genotype I and that of HBV is genotype D<sup>[5]</sup>.

A recently conducted study shows a very high HDV prevalence of 58.6% in HBsAg-positive patients who visited liver clinics in Karachi and Jacobabad. The study showed a higher prevalence compared to that in a previous study by Mumtaz *et al.*<sup>[10]</sup>. The prevalence

in these patients coming from districts of Sindh and Balochistan Provinces was 67% in Jacobabad, 65.4% in Jafferabad, 60% in Naseerabad, 69.2% in Kashmore, 65.2% in Quetta and 36.6% in Karachi<sup>[14]</sup>.

The high prevalence could be due to the frequent use of therapeutic injections and drips, contaminated needles, surgical and dental equipment, reusing traditional razors by barbers, use of injectable drugs, and sexual transmission<sup>[10]</sup>. There is higher seroprevalence of HDV in younger male subjects who are positive for HBsAg.

## HDV IN INDIA

In India, the trend is much different from that in Pakistan and HDV infection does not seem to be very common. It is suggested that the infection is switching towards low prevalence in this country<sup>[15]</sup>. A number of studies have been done in India to estimate the prevalence of HDV infection but there is lack of a national survey.

In Northern India, the prevalence of hepatitis D in HBsAg-positive individuals from New Delhi was reported to be 8.1% in 1996<sup>[16]</sup> and 10.6% in 2005<sup>[15]</sup>, which was lower than in Chandigarh in Northern India, where the infection was reported endemic in 1995 and showed a prevalence of 14.2%<sup>[17]</sup>. In Central India, a study in Indore showed higher prevalence of 5.7% in patients with chronic liver disease, 1.9% in those with acute viral hepatitis, 15% in those with hepatic failure, and 2.3% in those with chronic renal failure<sup>[18]</sup>. In Kolkata, the prevalence was found to be 3.3% in 1998<sup>[19]</sup>.

In Mumbai, according to a study done in 1992, the HDV prevalence was 37.46% in HBsAg-positive patients. There was a higher HDV prevalence of 63% in patients with fulminant hepatitis<sup>[20]</sup>. However, another study from this city showed a prevalence of 16% in patients with acute viral hepatitis, 17% in asymptomatic HBsAg carriers, and 19% in patients with chronic liver disease. Among the high-risk population, HDV prevalence was 20% in chronic renal failure patients, 29% in medical professionals, and 38% in recipients of multiple transfusions<sup>[21]</sup>. Delta infection in Ludhiana was reported to be 33% in children with a high prevalence of HDV<sup>[22]</sup>. Another study from Ludhiana in the same year showed a prevalence of 10% in HBsAg-positive patients<sup>[23]</sup>. In Southern India, low HDV prevalence in patients undergoing hemodialysis was reported in a study published in 1991<sup>[24]</sup>. However, there is high prevalence of HDV in the resident tribes of Nicobar and Andaman islands<sup>[25]</sup>.

## HDV IN IRAN

HDV is a major public health issue in Iran<sup>[26]</sup>. Studies from different areas of the country show varied prevalence rates. Although overall HBV, and therefore, HDV prevalence might have decreased in Iran, studies have indicated an increase in HDV occurrence in HBsAg-positive patients. Anti-HDV prevalence in asymptomatic HBV carriers from Southern Iran was 14% in 1989<sup>[27]</sup>. A recently published study reported a prevalence of 9.7%

in chronic HBV patients from Shiraz, which represented a decrease in prevalence from 1989<sup>[28]</sup>. In Midwest Iran, a low prevalence of 2.4% in 1989 was reported in HBsAg carriers<sup>[26]</sup>. A study conducted during 1986-1988 has estimated the prevalence of hepatitis D in various high-risk groups. The prevalence of anti-delta was found to be 2.5% (3/120) in asymptomatic chronic carriers of HBsAg, 33.33% (2/6) in hemophilic patients, 44.5% (16/36) in HBsAg-positive hemodialysis patients. Five out of eight patients with hepatocellular carcinoma (HCC) were also positive for anti-HDV<sup>[29]</sup>. In 2000, 1.3% of blood donors positive for HBsAg and 25.2% of HBsAg-positive hemodialysis patients were found to be anti-HDV positive<sup>[30]</sup>.

In Tehran, HDV prevalence was found to be 5.7% in chronic HBV patients in 2004<sup>[31]</sup>. In Golestan Province, Northeastern Iran, a recent study has shown an anti-HDV prevalence of 5.8% in HBsAg carriers<sup>[32]</sup>. Another study also has shown an HDV prevalence of 5.8% (8/139) in this part of Iran. These studies suggest an increase in HDV prevalence over the past decade<sup>[33]</sup>.

In Babol, Northern Iran, HDV prevalence was 2% in chronic hepatitis B patients in 2002<sup>[34]</sup>. However in Kerman, Southern Iran, HDV prevalence was found to be 20.7% in chronic hepatitis B patients<sup>[35]</sup>. In Tabriz, Northwestern Iran in 2000, HDV prevalence was observed to be 6.15% in chronic HBV patients<sup>[36]</sup>. A recently published study (2008) has shown a high HDV prevalence of 31.57% in HIV/HBV co-infected individuals in Kermanshah, Western Iran<sup>[37]</sup>.

## HDV IN AFGHANISTAN

Not enough data are available from Afghanistan to estimate recent prevalence of HDV. A study was conducted between 1976 and 1984 in which sera were collected from 362 persons in various epidemiological groups with chronic and acute HBV infection. Some sera were also collected from drug addicts and hemophiliacs with antibodies for hepatitis B. It was seen that hepatitis D was common in drug addicts, hemophiliacs, hemodialysis patients and prisoners. However, HDV was uncommon in homosexual men, people with sporadic hepatitis B, and in people from other endemic areas for hepatitis B. HDV prevalence was 18% in patients with chronic liver disease, 2% in asymptomatic carriers of hepatitis B, and 5% in acute hepatitis B patients. No infection was observed in institutionalized mentally retarded persons and health-care workers. During the 9 years of the study, no change was seen in HDV frequency<sup>[38]</sup>.

## HDV IN MAINLAND CHINA

In mainland China, HDV infection is not very prevalent but it does exist. The results of a study done in Sichuan Province in 1987 have suggested a low prevalence of 0.8% in HBsAg-positive patients, although the prevalence rate of HBV was high<sup>[39]</sup>. In 1989, the prevalence of anti-

HDV was 4.3% in Tibet, Inner Mongolia, and Xinjiang, whereas no HDV infection was observed in Henan, Fujian, Liaoning, Heilongjiang, Guangxi, Sichuan, Beijing and Shanghai<sup>[40]</sup>. In 1990, 2346 liver samples were tested from 17 different areas of China for the intrahepatic hepatitis D antigen (HDAg). The observed detection rate was 9.47%<sup>[41]</sup>.

In the area of Guangzhou, the prevalence of HDAg in 1990 was 13.3% in adults and 13.6% in children, which showed an insignificant difference in prevalence between the two age groups<sup>[42]</sup>. In the area of Shijiazhuang, the prevalence of HDV infection was observed to be 12.92% in 1990 and the study suggested Shijiazhuang as a high-HDV-prevalence area<sup>[43]</sup>.

In the province of Henan, a study conducted between 1991 and 1993 showed that 3.5% of the HBsAg-positive blood samples were anti-HDV positive. The investigators did not observe any significant difference of HDV prevalence with sex. However, noteworthy differences were observed in different age groups, particularly in those aged > 60 years<sup>[44]</sup>. In Shandong province, 7.72% of the HBsAg-positive patients were found to be anti-HDV positive in 1998. The prevalence rates were 13.15% in patients with hepatitis B and only 3.16% in HBsAg carriers<sup>[45]</sup>. A 2006 study conducted in Wuhan City has shown a low prevalence of HDV infection of 2.22% in intravenous drug users. However, the HBV and HCV prevalence rates were much higher in this population<sup>[46]</sup>.

## HDV IN HONG KONG, CHINA

In Hong Kong, hepatitis D has high prevalence rates among intravenous drug abusers (IVDAs). These findings were reported by a study that tested the sera of a large number of patients with acute or chronic HBV infection for anti-HDV between January 1988 and December 1990. HDV was detected in 13 out of 14 IVDAs, which corresponds to a prevalence of 93% in this group, whereas the prevalence was only 0.15% in 664 non-IVDAs<sup>[47]</sup>.

## HDV IN TAIWAN, CHINA

Taiwan is considered to be endemic for hepatitis B, but as a result of effective immunization, HBV prevalence has decreased markedly. Hepatitis D prevalence in Taiwan was very high in the 1990s and before, but the prevalence has decreased greatly since then and new cases of HDV infection are now encountered rarely<sup>[48]</sup>.

In 2003, the HDV prevalence in HBsAg carriers was 15.3% (56/366)<sup>[49]</sup>. A study published in 1997 identified 77 patients with acute HDV superinfection among 527 consecutive HBsAg carriers over the past 12 years. From June 1983 to May 1995, the prevalence decreased considerably by each 3-year period (23.7, 15.5, 13.1 and 4.2%, respectively). This change in the endemicity might have occurred due to the effective preventive measures taken against sexually transmitted diseases (STDs) and promiscuity and encouragement to use disposable

needles<sup>[50]</sup>. In 1990, a high HDV superinfection prevalence of 24.7% (21/85) was observed in HBsAg carriers from Southern Taiwan<sup>[51]</sup>.

Prostitutes are considered a high-risk group for hepatitis B and D. In 1993, the HDV prevalence in adult licensed prostitutes was 55%, 36% in adult unlicensed prostitutes, and 16% in teenage unlicensed prostitutes. Important factors identified for this high HDV prevalence were use of unsterilized needles for tattooing and ear piercing, and frequent sexual contact with multiple partners, which resulted in genital ulcers<sup>[52]</sup>. From 1986 to 1989, a two fold increase in HDV prevalence was observed in prostitutes. However there was no change in the HDV prevalence in IVDAs and the general population<sup>[53]</sup>. In 1992, the HDV prevalence in HBsAg carriers was 9.6% in STD patients, 33.1% in prostitutes, 2.2% in blood donors from the general population, and 68.1% in drug abusers<sup>[53]</sup>.

In 2002, HDV prevalence in IVDAs was 39%. From 1986 to 1997, a decreasing rate of 4.7% every year was observed in this high-risk group<sup>[54]</sup>. In 1990, 91% (119/131) of the HbsAg-positive IVDAs were found to be positive for anti-HDV, which showed an extremely high HDV prevalence in this high-risk group<sup>[55]</sup>. In 1989, 78.5% of the HbsAg-positive parenteral drug abusers tested positive for anti-HDV in Southern Taiwan<sup>[56]</sup>. In 1988, a study showed a high HDV prevalence of 85% in 151 IVDAs/HBsAg carriers, and in 1986, the results of a study showed that HDAg was detected in 78.9%<sup>[19]</sup> of 115 IVDAs/HBsAg carriers<sup>[57,58]</sup>.

In 1988, a study showed an HDV prevalence of 10.3% (3/29) in children with acute hepatitis B, and 1.4% (1/68) in children with chronic HBV. No asymptomatic HBsAg carrier child tested positive for HDV<sup>[59]</sup>.

## HDV IN JAPAN

In Japan, certain areas are highly HDV prevalent, especially Miyako Islands in Okinawa<sup>[60]</sup>. A study published in 1990 has assessed the prevalence of HDV infection in Japan at different time periods. Hepatitis D was first observed in 1979-1983 and the prevalence was 16% in acute hepatitis B, 6.8% in HBV carriers, and 26% in chronic liver disease. Anti-HDV was later rarely observed. The findings of this study suggest limited sporadic HDV infection in Japan<sup>[61]</sup>. In 1993, a study compared the HDV prevalence rates between area of high HBV incidence, i.e. Kamigoto Islands and an area of average HBV carriage rate, i.e. Oita City. The HDV prevalence in Kamigoto Islands was 8.3%, while that in Oita City was 0%. The study pointed towards the possible risk of outbreak of this infection in HBV prevalent areas in the future<sup>[62]</sup>.

As compared to other parts of the country, Okinawa Islands, especially Miyako Islands, which are located in the southernmost part of the country, are considered to be endemic for the virus, where HDV genotype II b is prevalent<sup>[60]</sup>. In 1995, the HDV prevalence in Miyako Islands was 23.5%<sup>[63]</sup>. In 1998, the HDV prevalence in

Miyako Islands was 21.1%. It has been suggested that the rate of HDV prevalence is likely to increase with increasing age or underlying disease severity<sup>[64]</sup>. However, in 2000, the HDV prevalence further decreased to 8.5% among the 4728 inhabitants of the islands<sup>[65]</sup>.

In Irapu Islands, Okinawa the HDV prevalence among HBsAg-positive patients was 23.6% in 1997, which indicated another high-prevalence area in Okinawa. The incidence rates were different in the seven districts of Irapu Islands, and ranged from 0% to 63.3%<sup>[66]</sup>.

## HDV IN KOREA

In Korea, HDV prevalence was estimated to be 0.85% in 1985. In 2003, a study was conducted in which 194 HBsAg-positive Korean patients were tested for anti-HDV, out of which, seven (3.6%) tested positive. Six of these patients had HCC and one had cholangiocarcinoma. Therefore, HDV was mainly associated with patients with HCC with a prevalence rate of approximately 4%, which has not changed greatly during the past 20 years<sup>[67]</sup>.

## HDV IN INDONESIA

In Indonesia, only a few studies are available on the prevalence of HDV, thus, this infection does not seem to be a major problem in this area unlike some other Asian countries. A study published in 1988 assessed the prevalence of hepatitis D in pregnant women in Bandung, a densely populated area of Indonesia. Out of the 926 pregnant women included in the study, only 2.8% (26) were carriers of HBsAg, among which, none tested positive for delta antibodies in spite of the fact that in this Indonesian population, HBsAg was frequent<sup>[68]</sup>. However, in 2003, the prevalence was found to be < 0.5% in the HBsAg carriers of Surabaya, which is also very low<sup>[69]</sup>.

## HDV IN MALAYSIA

In Malaysia, hepatitis D was first described in 1986 in some population groups. The HDV prevalence was found to be 12.5% in cases of acute hepatitis B, 6.7% in homosexual individuals, and 17.8% in drug abusers who were positive for HBsAg<sup>[70]</sup>. In 1989, the HDV prevalence was found to be 4.9%<sup>[71]</sup>. In 1996, 0.9% of the 923 jaundiced patients were found to be positive for anti-HDV<sup>[72]</sup>. In 1985, surveillance results for the detection of anti-HDV in IVDAs showed an absence of anti-HDV. However, in 1986, a prevalence of 17.8% was observed in the same group. The prevalence increased to 20% in 1989 and in 1994, 34% of the drug addicts tested positive for anti-HDV<sup>[73]</sup>.

## HDV IN THAILAND

In Thailand, hepatitis D is prevalent among IVDAs, a

high-risk group for viral hepatitis. A study conducted in 1988 tested 84 HBsAg-positive IVDAs, of which, 65.48% showed anti-HDV positivity. The HDV prevalence in 20 chronic hepatitis patients was 11.11% and 8.33% in 12 cirrhotic patients. No anti-delta antibodies were detected in 46 asymptomatic carriers<sup>[74]</sup>. A study in 2002 tested 55 HBsAg-positive sera of IVDAs, among which, 12 (21.8%) tested positive for anti-HDV. Among these anti-HDV-positive sera, eight (66%) tested positive for HDV RNA, and all had genotype I virus<sup>[75]</sup>.

Another study in 2002 tested 269 sera from the Hmong people of Northern Thailand for the seroprevalence of viral hepatitis. Despite the high seroprevalence of 76.0% for hepatitis B, the seropositivity of HDV was only 0.7%<sup>[76]</sup>.

### HDV IN PHILIPPINES

A study was conducted in 1990 to estimate the prevalence of HDV. Of the 64 patients with acute viral hepatitis, 1.6% tested positive for HDV. HBV was present in 40.6% of the acute viral hepatitis patients<sup>[77]</sup>.

### HDV IN VIETNAM

Vietnam is considered to be highly endemic for hepatitis B, which is one of the most important public health concerns. In order to estimate the prevalence of HBV and HDV in this area, a cross-sectional seroprevalence study was conducted in Thai Binh Province in 2007. Nineteen percent of the samples were HBsAg-positive, out of which, 1.3% were positive for HDV<sup>[78]</sup>. Thus, HDV does not seem to be prevalent in this HBV-endemic area. The results of another study conducted in Ho Chi Minh City in 2003 has shown that, except for HDV, other hepatitis viruses are spreading among the patients with liver diseases<sup>[79]</sup>.

### HDV IN AUSTRALIA

A study was conducted in Melbourne to establish the epidemiology of hepatitis D over a period of 15 years. Three thousand nine hundred and eighty-six HbsAg-positive patients were tested for HDV markers between 1971 and 1985. Hepatitis D markers were detected mostly in IVDAs and among their close contacts, and the results suggested the introduction of HDV in this group in 1970. The delta infection prevalence in carriers with no chronic liver disease was the highest (19.2%) among the IVDAs. Out of the 23 carriers with recurrent acute hepatitis, all tested positive for HDV markers and 20.1% of the carriers with chronic liver disease tested positive for the HDV markers<sup>[80]</sup>.

Apart from IVDAs, homosexual men are another high-risk group for HBV and HDV. In a study from Sydney in 1989, 204 homosexual men with acute or chronic HBV were tested for markers of HDV (total antibody to delta and delta antigen). Eight tested positive

for total antibody to delta, whereas delta antigen was detected in only one of the tested individuals, which showed a total HDV prevalence of 4.4%. All individuals who tested positive for the markers were IVDAs<sup>[81]</sup>.

### PACIFIC ISLANDS

Kiribati is an island located in the central tropical Pacific Ocean. HDV prevalence in this island is said to be very high. A serological survey was undertaken between May 1985 and February 1986 in which blood samples collected from 13 different places of the Southeast Asia and Pacific region were tested for HIV, HBV and HDV. The maximum HDV prevalence was observed in Kiribati, which was 84% in HBsAg-positive patients<sup>[82]</sup>. Another study in 1989 reported a prevalence of 69% (90/130) in individuals infected with HBV<sup>[83]</sup>.

Nauru, an isolated Pacific Island is considered hyperendemic for HDV. High HDV prevalence was reported here in 1986, in a study in which 2645 HBsAg-positive patients from several places in the Western Pacific were tested for HDV<sup>[84]</sup>. According to the results of a national epidemiological survey, published in 1989, in which 88% of the population was screened for HBV and HDV, 69.1% were reported positive for HBV markers, whereas HDV superinfection was observed in 22.7% of hepatitis B carriers<sup>[85]</sup>.

### HDV IN SAUDI ARABIA

HDV prevalence in Saudi Arabia was 8% (3/36) in HBsAg carriers in 1986<sup>[86]</sup>. The prevalence in the Riyadh area in the same year was 22.2% in patients with chronic hepatitis B, 7.9% in those with acute hepatitis B, and 6.7% in HBsAg carriers. In Najran, the prevalence was 9.6% in HBsAg carriers, and 5.3% in Al-Hafouf. In the areas of Khaiber and Jaizan, no anti-delta was found in the tested HBsAg carriers<sup>[87]</sup>. In 1987, a high HDV prevalence of 32% was detected in HBsAg-positive Saudi patients with liver disease, while the prevalence was 13% in patients with other illnesses. In healthy individuals, the prevalence was found to be 5.4%<sup>[88]</sup>. In 1988, the prevalence was 8% in HBsAg carriers in Gizan, an area considered hyperendemic for HBV<sup>[89]</sup>. A prevalence rate of 9.7% was detected in HBsAg-positive pregnant women in 1988. However, follow-up of 17 infants showed no indication of perinatal transmission<sup>[90]</sup>. In 1991, the prevalence in HBsAg-positive patients was found to be 17.6%<sup>[91]</sup>. In 1998, a study conducted in Jeddah showed an HDV prevalence of 13.6%. The HDV prevalence in IVDAs/carriers of HBsAg was 14.7% while there was 0.0% prevalence in non-IVDAs positive for HbsAg<sup>[92]</sup>.

In 2004, the HDV prevalence among HBsAg-positive healthy donors was 3.3%, while that in clinic- and hospital-based HBsAg patients was 8.6%. HDV infection is expected to decrease in Saudi Arabia with decreasing HBV prevalence due to global vaccination<sup>[93]</sup>.

## HDV IN OMAN

In Oman, according to a study conducted in 1991, the HDV prevalence was 7.7% (1/13) in HBsAg-positive dialysis patients and 22.2% (2/9) in HBsAg-positive renal transplant patients who have been previously transfused<sup>[94]</sup>. In 1994, HbsAg was detected in 11% of patients with kidney transplants and 12.7% of patients on dialysis. Anti-HDV was detected only in one HBsAg-positive patient on dialysis and two HbsAg carriers with renal transplants, which shows a low HDV prevalence among these patients<sup>[95]</sup>.

## HDV IN LEBANON

Hepatitis D was first detected in Lebanon in 1987 when a study reported 57% HDV prevalence in patients with chronic active hepatitis<sup>[96]</sup>. In 2007, the results of a study in which 258 HBsAg-positive patients from 10 health centers were included showed 1.2% (3/258) HDV prevalence, which shows a decrease in prevalence since 1987<sup>[97]</sup>.

## HDV IN TURKEY

In Turkey, like many other countries, a decline in HDV infection has been observed, but it is still a significant public health concern<sup>[98]</sup>. A recently published meta-analysis of HDV seropositivity has shown the decline in HDV infection but also points to the significant health concern in low socioeconomic parts of the country<sup>[99]</sup>. HDV prevalence is much higher in the southeast of the country, being 27% in chronic hepatitis B patients and 46% in hepatitis-B-induced cirrhosis patients. This is in comparison to the HDV prevalence in the West of the country of 5% in chronic hepatitis B patients and 20% in hepatitis-B-induced cirrhosis patients. The analysis also compared prevalence of HDV before and after 1995. It was observed that HDV prevalence in chronic hepatitis B patients decreased from 38% to 27% in Southeast Turkey and from 29% to 12% in Central Turkey. HDV prevalence in cirrhosis patients has decreased from 66% to 46% in Southeast and from 38% to 20% in West Turkey<sup>[99]</sup>.

## CONCLUSION

The prevalence of hepatitis D shows a decreasing trend due to preventive measures like vaccination against hepatitis B and awareness campaigns with regard to risk factors for the transmission of hepatitis B and D. Although preventive measures against hepatitis B including vaccination have decreased the prevalence of hepatitis D, there is no effective way of preventing HDV infection in HBV carriers in endemic areas. This can only be achieved by educating such individuals to prevent further exposures to risk factors. In spite of the global trend of decline, significant and persistent transmission is present in some countries.

## REFERENCES

- 1 **World Health Organization.** Hepatitis Delta [WHO/CDS/CSR/NCS/2001.1]. Available from: URL: [http://www.searo.who.int/EN/Section10/Section1027\\_9489.htm](http://www.searo.who.int/EN/Section10/Section1027_9489.htm)
- 2 **Fonseca JC.** [Hepatitis D] *Rev Soc Bras Med Trop* 2002; **35**: 181-190
- 3 **Rizzetto M.** Hepatitis D: the comeback? *Liver Int* 2009; **29** Suppl 1: 140-142
- 4 **Koytak ES, Yurdaydin C, Glenn JS.** Hepatitis d. *Curr Treat Options Gastroenterol* 2007; **10**: 456-463
- 5 **Moatter T, Abbas Z, Shabir S, Jafri W.** Clinical presentation and genotype of hepatitis delta in Karachi. *World J Gastroenterol* 2007; **13**: 2604-2607
- 6 **Shakil AO, Hadziyannis S, Hoofnagle JH, Di Bisceglie AM, Gerin JL, Casey JL.** Geographic distribution and genetic variability of hepatitis delta virus genotype I. *Virology* 1997; **234**: 160-167
- 7 **Farci P.** Delta hepatitis: an update. *J Hepatol* 2003; **39** Suppl 1: S212-S219
- 8 **Casey JL, Brown TL, Colan EJ, Wignall FS, Gerin JL.** A genotype of hepatitis D virus that occurs in northern South America. *Proc Natl Acad Sci USA* 1993; **90**: 9016-9020
- 9 **Hsieh TH, Liu CJ, Chen DS, Chen PJ.** Natural course and treatment of hepatitis D virus infection. *J Formos Med Assoc* 2006; **105**: 869-881
- 10 **Mumtaz K, Hamid SS, Adil S, Afaq A, Islam M, Abid S, Shah HA, Jafri W.** Epidemiology and clinical pattern of hepatitis delta virus infection in Pakistan. *J Gastroenterol Hepatol* 2005; **20**: 1503-1507
- 11 **Smedile A, Lavarini C, Farci P, Aricò S, Marinucci G, Dentico P, Giuliani G, Cargnel A, Del Vecchio Blanco C, Rizzetto M.** Epidemiologic patterns of infection with the hepatitis B virus-associated delta agent in Italy. *Am J Epidemiol* 1983; **117**: 223-229
- 12 **Sagnelli E, Stroffolini T, Ascione A, Chiamonte M, Craxi A, Giusti G, Piccinino F.** Decrease in HDV endemicity in Italy. *J Hepatol* 1997; **26**: 20-24
- 13 **Navascués CA, Rodríguez M, Sotorriño NG, Sala P, Linares A, Suárez A, Rodrigo L.** Epidemiology of hepatitis D virus infection: changes in the last 14 years. *Am J Gastroenterol* 1995; **90**: 1981-1984
- 14 **Seetlani NK, Abbas Z, Raza S, Yakoob J, Jafri W.** Prevalence of hepatitis D in HBsAg positive patients visiting liver clinics. *J Pak Med Assoc* 2009; **59**: 434-437
- 15 **Chakraborty P, Kailash U, Jain A, Goyal R, Gupta RK, Das BC, Kar P.** Seroprevalence of hepatitis D virus in patients with hepatitis B virus-related liver diseases. *Indian J Med Res* 2005; **122**: 254-257
- 16 **Irshad M, Acharya SK.** Hepatitis D virus (HDV) infection in severe forms of liver diseases in north India. *Eur J Gastroenterol Hepatol* 1996; **8**: 995-998
- 17 **Singh V, Goenka MK, Bhasin DK, Kochhar R, Singh K.** A study of hepatitis delta virus infection in patients with acute and chronic liver disease from northern India. *J Viral Hepat* 1995; **2**: 151-154
- 18 **Jaiswal SP, Chitnis DS, Artwani KK, Naik G, Jain AK.** Prevalence of anti-delta antibodies in central India. *Trop Gastroenterol* 1999; **20**: 29-32
- 19 **Bhattacharyya S, Dalal BS, Lahiri A.** Hepatitis D infectivity profile among hepatitis B infected hospitalised patients in Calcutta. *Indian J Public Health* 1998; **42**: 108-112
- 20 **Banker DD, Desai P, Brawner TA, Decker RH.** Hepatitis delta virus infection in Bombay. *Trans R Soc Trop Med Hyg* 1992; **86**: 424-425
- 21 **Amarapurkar DN, Vishwanath N, Kumar A, Shankaran S, Murti P, Kalro RH, Desai HG.** Prevalence of delta virus infection in high risk population and hepatitis B virus related liver diseases. *Indian J Gastroenterol* 1992; **11**: 11-12

- 22 **Ghuman HK**, Kaur S. Delta-hepatitis. *Indian J Pediatr* 1995; **62**: 691-693
- 23 **Ghuman HK**, Prabhakar H. Prevalence of hepatitis A, B, C & D in Ludhiana. *Indian J Med Sci* 1995; **49**: 227-230
- 24 **Thomas PP**, Samuel BU, Jacob CK, John TJ, Shastry JC. Low prevalence of hepatitis D (delta) virus infection in a nephrology unit in south India. *Trans R Soc Trop Med Hyg* 1991; **85**: 652-653
- 25 **Murhekar MV**, Murhekar KM, Arankalle VA, Sehgal SC. Hepatitis delta virus infection among the tribes of the Andaman and Nicobar Islands, India. *Trans R Soc Trop Med Hyg* 2005; **99**: 483-484
- 26 **Alavian SM**. We have more data regarding epidemiology of hepatitis D in Iran but there are defects to be filled yet! *Hepatitis Mon* 2008; **8**: 245-247
- 27 **Shahinsaz L**, Sabahi F, Karimi M, Behzadian F, Alavian SM, Zand V. Detection and genotyping of hepatitis D virus from HBsAg positive patients in Iran using RT-PCR. *Iran J Biotechnol* 2006; **4**: 174-179
- 28 **Taghavi SA**, Sedighi S, Mehrabani D, Khademolhosseini F. Hepatitis D in Chronic Active Hepatitis B: Prevalence, Liver Enzyme Levels and Histopathology- an Epidemiological Study in Shiraz, Southern Iran, 2003-2004. *Hepatitis Mon* 2008; **8**: 248-251
- 29 **Rezvan H**, Forouzandeh B, Taroyan S, Fadaiee S, Azordegan F. A study on delta virus infection and its clinical impact in Iran. *Infection* 1990; **18**: 26-28
- 30 **Karimi A**, Amini S, Amirkhani A. Investigation and Comparison of hepatitis D prevalence in dialysis patients and the donors of HBsAg carrier. *Teb va Tazkie* 2000; **36**: 30-35
- 31 **Alavian SM**, Assari Sh, Manzoori-Joybari H, Moghani Lankarani M, Doroudi T, Haji-Beigi B, Hajarizade B. Frequency and risk factors of hepatitis D virus in hepatitis B patients. *Govaresh* 2005; **10**: 21-26
- 32 **Gholamreza R**, Shahryar S, Abbasali K, Hamidreza J, Abdolvahab M, Khodaberdi K, Danyal R, Nafiseh A. Seroprevalence of hepatitis B virus and its co-infection with hepatitis D virus and hepatitis C virus in Iranian adult population. *Indian J Med Sci* 2007; **61**: 263-268
- 33 **Roshandel G**, Semnani S, Abdolahi N, Besharat S, Keshtkar AA, Jashaqani H, Moradi A, Kalavi K, Jabbari A, Kabir MJ, Hosseini SA, Sedaqat SM, Danesh A, Roshandel D, Hedayat-Mofidi SM. Prevalence of hepatitis D virus infection in hepatitis B surface antigen-positive subjects in Golestan province, northeast Iran. *J Microbiol Immunol Infect* 2008; **41**: 227-230
- 34 **Hassanjani Roshan MR**, Beigi AA, Soleimani MJ. [Prevalence of anti-HDV in chronic carrier of HBV in Babol] *Babol Med J* 2002; **6**: 50-54
- 35 **Zahedi MJ**. [Serologic Prevalence of Hepatitis D in HBsAg Positive Patients in Kerman, South of Iran, 2002-2003]. Kerman University of Medical Sciences and Health Services. 2003. Document No. 81/55
- 36 **Torabi SE**, Ebrahimpor S, Maljaie SH, Naghili B. Seroepidemiological study of HDV in HBsAg-positive individuals in Tabriz. *Urmia Med J* 2002; **4**: 290-297
- 37 **Vaziri S**, Mansouri F, Sayad B, Afsharian M, Janbakhsh A, Karami M. Hepatitis D virus infection among HIV-HBV co-infected patients in Kermanshah, West of Iran. *Hepatitis Mon* 2008; **8**: 252-257
- 38 **Jacobson IM**, Dienstag JL, Werner BG, Brettler DB, Levine PH, Mushahwar IK. Epidemiology and clinical impact of hepatitis D virus (delta) infection. *Hepatology* 1985; **5**: 188-191
- 39 **Wang DQ**, Cheng HH, Minuk GY, Liu LH, Anand CM, Stowe TC, Wang HX, Ying DC, Tu YR, Buchan KA. Delta hepatitis virus infection in China. *Int J Epidemiol* 1987; **16**: 79-83
- 40 **Mai K**. [Study on hepatitis delta virus infection in China] *Zhonghua Liuxingbingxue Zazhi* 1989; **10**: 21-23
- 41 **Hao LJ**, Li L, Zhang YY, Song PH. A study on hepatitis D virus infection in liver tissues of patients with hepatitis B in China. *J Tongji Med Univ* 1990; **10**: 65-68
- 42 **Chen GH**, Zhang MD, Huang W. Hepatitis delta virus superinfection in Guangzhou area. *Chin Med J (Engl)* 1990; **103**: 451-454
- 43 **Zhao X**. [The seroepidemiological observation on hepatitis delta virus infection] *Zhonghua Liuxingbingxue Zazhi* 1990; **11**: 202-204
- 44 **Zhang JY**, Jin ZH, Wang CJ. [A seroepidemiological study on hepatitis D virus (HDV) infection in Henan Province, China] *Zhonghua Liuxingbingxue Zazhi* 1995; **16**: 365-368
- 45 **Chen X**, Xuan M, Yin Y. [Study of HDV infection in Shandong province] *Zhonghua Liuxingbingxue Zazhi* 1998; **19**: 138-140
- 46 **Li J**, Wang J, Tian K, Wang Y, Zhang L, Huang H. Epidemiology of hepatitis B, C, D and G viruses and cytokine levels among intravenous drug users. *J Huazhong Univ Sci Technol Med Sci* 2006; **26**: 221-224
- 47 **Lok AS**, Wong A, Sporton S, Lai CL, Liu V, Chung HT. Hepatitis D virus superinfection remains a rare occurrence in non-drug abusers in Hong Kong. *J Hepatol* 1992; **14**: 332-334
- 48 **Chen DS**. Viral hepatitis: from A to E, and beyond? *J Formos Med Assoc* 2003; **102**: 671-679
- 49 **Lu SN**, Chen TM, Lee CM, Wang JH, Tung HD, Wu JC. Molecular epidemiological and clinical aspects of hepatitis D virus in a unique triple hepatitis viruses (B, C, D) endemic community in Taiwan. *J Med Virol* 2003; **70**: 74-80
- 50 **Huo TI**, Wu JC, Lin RY, Sheng WY, Chang FY, Lee SD. Decreasing hepatitis D virus infection in Taiwan: an analysis of contributory factors. *J Gastroenterol Hepatol* 1997; **12**: 747-751
- 51 **Tsai JF**, Margolis HS, Fields HA, Chang WY, Tsai JH. Hepatitis delta virus superinfection among patients with chronic hepatitis B in southern Taiwan. *Scand J Infect Dis* 1990; **22**: 403-405
- 52 **Wu JC**, Wang YJ, Hwang SJ, Chen TZ, Wang YS, Lin HC, Lee SD, Sheng WY. Hepatitis D virus infection among prostitutes in Taiwan. *J Gastroenterol Hepatol* 1993; **8**: 334-337
- 53 **Chen CJ**, Tseng SF, Lu CF, Lin HC, You SL, Chen CS, Hwang SJ, Hsieh SF, Hsu ST. Current seroepidemiology of hepatitis D virus infection among hepatitis B surface antigen carriers of general and high-risk populations in Taiwan. *J Med Virol* 1992; **38**: 97-101
- 54 **Kao JH**, Chen PJ, Lai MY, Chen DS. Hepatitis D virus genotypes in intravenous drug users in taiwan: decreasing prevalence and lack of correlation with hepatitis B virus genotypes. *J Clin Microbiol* 2002; **40**: 3047-3049
- 55 **Hsu HM**, Wang YF, Lo SH, Sun HC, Yip KK, Chen JS, Chuang CH, Chen DS. Hepatitis D virus infection among intravenous drug abusers in Taiwan: analysis of risk factors and liver function tests. *J Med Virol* 1990; **31**: 76-81
- 56 **Chung DC**, Ko YC, Chen CJ, Chen ER, Wu CC, Wu PS. Seroepidemiology of hepatitis B virus, hepatitis D virus, and human immunodeficiency virus infections among parenteral drug abusers in southern Taiwan. *J Med Virol* 1989; **28**: 215-218
- 57 **Chen PJ**, Chen DS, Chen CR, Chen YY, Chen HM, Lai MY, Sung JL. Delta infection in asymptomatic carriers of hepatitis B surface antigen: low prevalence of delta activity and effective suppression of hepatitis B virus replication. *Hepatology* 1988; **8**: 1121-1124
- 58 **Lee SD**, Wang JY, Wu JC, Chiang YT, Tsai YT, Lo KJ. Hepatitis B and D virus infection among drug abusers in Taiwan. *J Med Virol* 1986; **20**: 247-252
- 59 **Hsu HY**, Chang MH, Chen DS, Lee CY. Hepatitis D virus infection in children with acute or chronic hepatitis B virus infection in Taiwan. *J Pediatr* 1988; **112**: 888-892
- 60 **Sakugawa H**, Nakasone H, Nakayoshi T, Kawakami Y, Miyazato S, Kinjo F, Saito A, Ma SP, Hotta H, Kinoshita



- M. Hepatitis delta virus genotype IIb predominates in an endemic area, Okinawa, Japan. *J Med Virol* 1999; **58**: 366-372
- 61 **Tamura I**, Ichimura H, Koda T, Katayama S, Kurimura O, Kurimura T. Hepatitis delta virus infection in different time periods in Japan. *J Gastroenterol Hepatol* 1990; **5**: 407-410
- 62 **Iwanami E**, Yano M, Koga M, Shirahama S, Tsuda T. Local spread of HDV infection transiently occurring in Japan. *J Gastroenterol Hepatol* 1993; **8**: 565-568
- 63 **Sakugawa H**, Nakasone H, Shokita H, Nakayoshi T, Kinjo F, Saito A, Yamashiro A, Miyagi Y. Seroepidemiological study of hepatitis delta virus infection in Okinawa, Japan. *J Med Virol* 1995; **45**: 312-315
- 64 **Nakasone H**, Sakugawa H, Shokita H, Nakayoshi T, Kawakami Y, Kinjo F, Saito A, Shinjo M, Adaniya H, Mizushima T, Taira M. Prevalence and clinical features of hepatitis delta virus infection in the Miyako Islands, Okinawa, Japan. *J Gastroenterol* 1998; **33**: 850-854
- 65 **Arakawa Y**, Moriyama M, Taira M, Hayashi N, Tanaka N, Okubo H, Sugitani M. Molecular analysis of hepatitis D virus infection in Miyako Island, a small Japanese island. *J Viral Hepat* 2000; **7**: 375-381
- 66 **Sakugawa H**, Nakasone H, Shokita H, Kawakami Y, Nakachi N, Adaniya H, Mizushima T, Nakayoshi T, Kinjo F, Saito A, Taira M, Takaesu H, Onga N. Seroepidemiological study on hepatitis delta virus infection in the Iribu Islands, Okinawa, Japan. *J Gastroenterol Hepatol* 1997; **12**: 299-304
- 67 **Jeong SH**, Kim JM, Ahn HJ, Park MJ, Paik KH, Choi W, Kim J, Han CJ, Kim YC, Lee JO, Hong YJ, Park HY, Jeong HH, Yoon MY, Lee M, Lee KH. [The prevalence and clinical characteristics of hepatitis-delta infection in Korea.] *Korean J Hepatol* 2005; **11**: 43-50
- 68 **Vranckx R**, Reniers J, Alisjahbana A, Ngantung W, Sugita E, Meheus A. Prevalence of anti-delta antibodies in pregnant women in Bandung, Indonesia. *Trop Geogr Med* 1988; **40**: 17-19
- 69 **Lusida MI**, Surayah, Sakugawa H, Nagano-Fujii M, Soetjipto, Mulyanto, Handajani R, Boediwarsono, Setiawan PB, Nidom CA, Ohgimoto S, Hotta H. Genotype and subtype analyses of hepatitis B virus (HBV) and possible co-infection of HBV and hepatitis C virus (HCV) or hepatitis D virus (HDV) in blood donors, patients with chronic liver disease and patients on hemodialysis in Surabaya, Indonesia. *Microbiol Immunol* 2003; **47**: 969-975
- 70 **Sinniah M**, Dimitrakakis M, Tan DS. Delta hepatitis in Malaysia. *Southeast Asian J Trop Med Public Health* 1986; **17**: 229-233
- 71 **Tan DS**, Dimitrakakis M, Mangalam S, Lopez CG, Ooi BG. Prevalence of hepatitis delta virus infection in Malaysia. *Singapore Med J* 1989; **30**: 34-37
- 72 **Saat Z**, Sinniah M, Kin TL, Baharuddin R, Krishnasamy M. A four year review of acute viral hepatitis cases in the east coast of peninsular Malaysia (1994-1997). *Southeast Asian J Trop Med Public Health* 1999; **30**: 106-109
- 73 **Duraisamy G**, Zuridah H, Ariffin Y, Kek CS. Hepatitis delta virus in intravenous drug users in Kuala Lumpur. *Med J Malaysia* 1994; **49**: 212-216
- 74 **Louisirirotchanakul S**, Wasi C, Uneklabh C, Phutiprawan T, Suwanagool S, Chainuvati T, Thongcharoen P. High prevalence of delta virus infection in Thai intravenous drug abusers. *Southeast Asian J Trop Med Public Health* 1988; **19**: 191-195
- 75 **Theamboonlers A**, Hansurabhanon T, Verachai V, Chongsrisawat V, Poovorawan Y. Hepatitis D virus infection in Thailand: HDV genotyping by RT-PCR, RFLP and direct sequencing. *Infection* 2002; **30**: 140-144
- 76 **Louisirirotchanakul S**, Myint KS, Srimee B, Kanoksinsombat C, Khamboonruang C, Kunstadter P, Wasi C. The prevalence of viral hepatitis among the Hmong people of northern Thailand. *Southeast Asian J Trop Med Public Health* 2002; **33**: 837-844
- 77 **Sy NE**, Macalagay PS, Paulino GP, Fallarme VD, Reyes RS, Sangalang RP, Ranoa CP, Long GW. Serologic classification of acute viral hepatitis at San Lazaro Hospital, Manila, Philippines. *Southeast Asian J Trop Med Public Health* 1990; **21**: 69-75
- 78 **Nguyen VT**, McLaws ML, Dore GJ. Highly endemic hepatitis B infection in rural Vietnam. *J Gastroenterol Hepatol* 2007; **22**: 2093-2100
- 79 **Tran HT**, Ushijima H, Quang VX, Phuong N, Li TC, Hayashi S, Xuan Lien T, Sata T, Abe K. Prevalence of hepatitis virus types B through E and genotypic distribution of HBV and HCV in Ho Chi Minh City, Vietnam. *Hepatol Res* 2003; **26**: 275-280
- 80 **Dimitrakakis M**, Waters MJ, Wootton AL, Gust ID. Epidemiology of hepatitis D virus (delta) infection in Melbourne over a 15-year period. *Med J Aust* 1986; **145**: 128-130
- 81 **Bodsworth NJ**, Donovan B, Gold J, Cossart YE. Hepatitis delta virus in homosexual men in Sydney. *Genitourin Med* 1989; **65**: 235-238
- 82 **Brindle RJ**, Eglin RP, Parsons AJ, Hill AV, Selkon JB. HTLV-1, HIV-1, hepatitis B and hepatitis delta in the Pacific and South-East Asia: a serological survey. *Epidemiol Infect* 1988; **100**: 153-156
- 83 **Tibbs CJ**. Delta hepatitis in Kiribati: a pacific focus. *J Med Virol* 1989; **29**: 130-132
- 84 **Dimitrakakis M**, Crowe S, Gust I. Prevalence of delta infection in the western Pacific region. *J Med Virol* 1986; **18**: 335-339
- 85 **Speed BR**, Dimitrakakis M, Thoma K, Gust ID. Control of HBV and HDV infection in an isolated Pacific Island: 1. Pattern of infection. *J Med Virol* 1989; **29**: 13-19
- 86 **Ashraf SJ**, Arya SC, Arendrup M, Krogsgaard K, Parande CM, Orskov B, Ageel AR. Frequencies of hepatitis B, delta and HTLV-III virus markers in Saudi Arabia. *Liver* 1986; **6**: 73-77
- 87 **el-Hazmi MA**, Ramia S. Epidemiology of delta agent infection in Arabia: geographical distribution and prevalence of anti-delta. *Vox Sang* 1986; **50**: 216-219
- 88 **Ramia S**, el-Hazmi MA, Vivian PA, Waller DK, Mushahwar IK, Frösner GG. Delta agent infection in Riyadh, Saudi Arabia. *Trans R Soc Trop Med Hyg* 1987; **81**: 317-318
- 89 **Arya SC**, Ashraf SJ, Parande CM, Tobeiqi MS, Ageel AR. Hepatitis B and delta markers in primary hepatocellular carcinoma patients in the Gizan area of Saudi Arabia. *APMIS Suppl* 1988; **3**: 30-34
- 90 **Ramia S**, Bahakim H. Perinatal transmission of hepatitis B virus-associated hepatitis D virus. *Ann Inst Pasteur Virol* 1988; **139**: 285-290
- 91 **Massoud M**, Helmy O, Saleh WA. Hepatitis D anti-bodies in some HBs Ag positive in Saudis at Riyadh. *J Egypt Soc Parasitol* 1991; **21**: 561-565
- 92 **Njoh J**, Zimmo S. Prevalence of antibody to hepatitis D virus among HBsAg-positive drug-dependent patients in Jeddah, Saudi Arabia. *East Afr Med J* 1998; **75**: 327-328
- 93 **Al-Traif I**, Ali A, Dafalla M, Al-Tamimi W, Qassem L. Prevalence of hepatitis delta antibody among HBsAg carriers in Saudi Arabia. *Ann Saudi Med* 2004; **24**: 343-344
- 94 **Aghanashinikar PN**, al-Dhahry SH, al-Marhuby HA, Buhl MR, Daar AS, Al-Hasani MK. Prevalence of hepatitis B, hepatitis delta, and human immunodeficiency virus infections in Omani patients with renal diseases. *Transplant Proc* 1992; **24**: 1913-1914
- 95 **Al-Dhahry SS**, Aghanashinikar PN, Al-Marhuby HA, Buhl MR, Daar AS, Al-Hasani MK. Hepatitis B, delta and human immunodeficiency virus infections among Omani patients with renal diseases: A seroprevalence study. *Ann Saudi Med* 1994; **14**: 312-315
- 96 **Farci P**, Burroughs AK, Thomas HC, Shamma'a M. Delta

- hepatitis in Lebanon. Prevalence studies and a report on six siblings with chronic delta-positive active hepatitis. *J Hepatol* 1987; **4**: 224-228
- 97 **Ramia S**, El-Zaatari M, Sharara AI, Ramlawi F, Farhat B. Current prevalence of hepatitis delta virus (HDV) infection and the range of HDV genotypes in Lebanon. *Epidemiol Infect* 2007; **135**: 959-962
- 98 **Yurdaydin C**. Delta hepatitis in Turkey: decreasing but not vanishing and still of concern. *Turk J Gastroenterol* 2006; **17**: 74-75
- 99 **Değertekin H**, Yalçın K, Yakut M, Yurdaydin C. Seropositivity for delta hepatitis in patients with chronic hepatitis B and liver cirrhosis in Turkey: a meta-analysis. *Liver Int* 2008; **28**: 494-498
- 100 **el Zayadi A**, Ponzetto A, Selim O, Forzani B, Lavarini C, Rizzetto M. Prevalence of delta antibodies among urban HBsAg-positive chronic liver disease patients in Egypt. *Hepatogastroenterology* 1988; **35**: 313-315
- 101 **Darwish MA**, Shaker M, Raslan OS, Abdel-Raouf T. Delta virus infection in Egypt. *J Egypt Public Health Assoc* 1992; **67**: 147-161
- 102 **Morcós MM**, Mikhail TH, Hanna WM, Abdel-Fattah S, el-Rasad MM, Wassef EL. The prevalence of delta virus infection in chronic liver disease in Egyptian children in comparison with some other countries. *Panminerva Med* 2000; **42**: 97-100

S- Editor Li LF L- Editor Kerr C E- Editor Zheng XM