

Original Article

Assess the knowledge of dentists regarding Hepatitis B serological profile: a cross-sectional studyQurat-ul-ain Tariq¹, Shazia Tariq², Mariam Ajmal Tareen¹, Iftikhar Uddin², Fahad Qiam¹¹ *Khyber College of Dentistry, Peshawar, Pakistan*² *Gajju Khan Medical College, Swabi, Pakistan*³ *University of Agriculture, Peshawar, Pakistan***Abstract**

Introduction: The primary aim of the study was to determine the knowledge of dental practitioners regarding HBV serological markers. Second objective was to determine prevalence of occupational exposures to HBV amongst dentists.

Methodology: A questionnaire was constructed pertaining to various aspects of HBV serology; validated by an expert panel; and piloted at 49 dentists. A Cronbach-alpha value of 0.7 was attained and thus extensive survey was conducted among dentists in routine practise treating hepatitis B patients at dental teaching hospitals in Peshawar, KP. The data was analysed using SPSS v.22.

Results: A response rate of 58% (a total of 290 respondents) was attained. All respondents were vaccinated against HBV. Over 50% reported not to follow Standard precautions for every patient. Overall, 20.3% experienced HBV exposure, eight were administered PEP. Fifty-four percent of FYS; 74.5% PGTs and 71.6% of faculty dentists correctly answered: HBsAg to be the 'serological hallmark of HBV infection'; this was the most correctly answered question. Sixty-four percent dentists failed to identify the infectious carrier phase. Over 50% of dentists in each category failed to correctly answer 5/8 of the HBV serology.

Conclusions: Over 20% reported HBV occupational exposure but zero transmissions. Majority of dentists did not have correct information on HBV serological profile which may jeopardise cross-infection control. Further education on HBV serological markers and its clinical relevance to dentistry along with stringent adherence to Standard precautions is recommended.

Key words: Hepatitis B; serological markers; education; occupational blood exposures; dentists.

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Introduction

According to the 2018 Hepatitis B (HepB) guidelines set by American Association of the Study of Liver Disease (AASLD) all citizens born in a country with $\geq 2\%$ prevalence of hepatitis B surface antigen (HBsAg) are at high risk of chronic hepatitis B (CHB) and need to be screened [1]. Several studies conducted in the past decade across various regions of Pakistan among various groups observed HBsAg seroprevalence of $\geq 3\%$ [2-6]. Khyber Pukhtunkhwa (KP) province has a huge burden of hepatitis B with over 10 million chronic carriers [7]. Hepatitis B virus (HBV) has several proteins detectable in serum and of clinical significance: presence of HBsAg establishes diagnosis of infection. Persistence of HBsAg over 6 months defines chronicity. Sero-conversion to anti-HBs is an index for clearance and immunity – it is usually spontaneous in acute infection but rare in CHB. Sero-reversion to HBsAg can occur in resolved cases. Hepatitis B e Antigen (HBeAg)-positivity is indicative

of active viral replication and infectivity. The risk of HBV infection following percutaneous inoculation is 6% (HBeAg-negative source) to 30% (HBeAg- positive source) as opposed to 1.8% for hepatitis C virus (HCV) and 0.3% for human immunodeficiency virus (HIV) [1,8,9].

Most individuals who test positive for HBsAg have CHB [10]. Combinations of these serological markers along with alanine transferase levels (ALTs) and liver fibrosis markers define various phases of CHB – detailed in ANNEXURE 1 [1,11]. Liver disease often hinders haemostasis and alters metabolism of certain drugs. For such patients additional workup may be required prior to dental treatment [12]. The study solely focuses on HepB because HBV has a greater risk of infection after inoculation; various serological markers; potential infectivity in the inactive carrier state and transmission is easily preventable by adequate vaccination as opposed to HCV and HIV infections. Primarily, the aim of this research was to determine the

current level of knowledge of dentists regarding HepB serological markers. This is pertinent to a dental practitioner for prevention of cross-infection and subsequent reduction in the burden of HBV in the communities and for appropriate management of CHB patients. We also hoped to determine prevalence and characteristics of HBV occupational exposures among dentists. To date, such work is non-existent in literature.

Methodology

This descriptive cross-sectional questionnaire-based study was conducted on foundation-year dentists (FYs), post-graduate trainees (PGTs) and faculty members of 4 main dental teaching hospitals in Peshawar, KP in April 2019. Hepatitis B-positive patients routinely receive dental treatment at these hospitals. Only dentists in routine clinical practice were included in this study. A questionnaire was constructed formatted into 12 questions: the first 4 questions asked respondents ‘if they follow standard precautions for each patient’; ‘how often they treated hepatitis B patients’ and ‘if they had completed HBV vaccination regimen’ ‘if they experienced HBV occupational exposure’. This question was tagged with further inquiries regarding number, type and cause of exposure, their current serum HBsAg status and being managed with PEP. The next 8 items pertained to various aspects of HBV serology with multiple-choice answers and ‘I don’t know’ option. The last question inquired regarding need for further educational programs on HepB serology. The questionnaire was presented to a 6-membered expert panel comprising of a Haematologist, a Microbiologist, dental graduate in Masters of Research and three Oral Maxillofacial Surgeons, all of whom found the tool to be acceptable. The survey was further piloted at 49 dentists, the data

of which were analysed by reliability scale: Cronbach-alpha. Permission was sought from Ethical and Research committee at Khyber College of Dentistry for collection of blood samples and subsequent analysis for serum HBsAg by Enzyme Linked Immunosorbent Assay (ELISA) of any HBV exposed dentist. Approval was given for the survey but refused for blood sampling and HBsAg analysis due to lack of resources. The confidentiality of each respondent answers was assured. Results of the pilot survey were not included in final analysis. All statistical analysis (counts, percentages and Pearson chi-square associations) was performed using Statistical Package of Social Sciences v.22 software program.

Results

Pilot questionnaire was replied with reasonable reliability with a Cronbach-alpha value of 0.7. Therefore, an extensive survey was carried out. It was responded by 290 dentists, forming a response rate of 58%. A hundred and ten (37.9%) were FYs; 106 (36.6%) were PGTs and 74 (25.5%) were faculty members in routine clinical practise. There was a significant association (p -value = 0.000) between designation and years of clinical experience with many faculty members having over 5 years of experience, PGTs having 1- 5 years and FYs having less than a year. Overall, 49.7% of dentists claimed to follow Standard precautions of infection-control for every patient. Fifty-six percent reported to treat Hepatitis B positive patients occasionally, 19.3% stated monthly and 19.7% on a weekly basis – of these 63.2% were FY-dentists. There was significant association (p -value = 0.001) between designation of dentist and how often they treated HepB patients (Table 1). All respondents stated they had completed vaccination against HBV. Overall, 20.3%

Table 1. Responses to introductory items (along with chi-square association between the 2 variables).

RESPONSES TO INTRODUCTORY QUESTIONS:					P VALUE
1. FOLLOW ‘STANDARD PRECAUTIONS’ FOR EACH PATIENT					
DESIGNATION	YES	SOMETIMES	ONLY FOR POSITIVE PATIENTS	DO NOT FOLLOW	0.327
FY	57 (51.8%)	11 (10%)	40 (36.4%)	2 (1.8%)	
PGT	48 (45.3%)	22 (20.8%)	35 (33%)	1 (0.9%)	
FACULTY	39 (52.7%)	9 (12.2%)	26 (35.1%)	0	
2. PERFORM TREATMENT OF HEPATITIS B POSITIVE PATIENTS					
	WEEKLY	MONTHLY	OCCASIONALLY	DO NOT TREAT	0.001
FY	36 (32.7%)	21 (19.1%)	45 (40.9%)	8 (7.3%)	
PGT	12 (11.3%)	21 (19.8%)	69 (65.1%)	4 (3.8%)	
FACULTY	9 (12.2%)	14 (18.9%)	48 (64.9%)	3 (4.1%)	

have experienced at least one HBV occupational exposure, of which 49.2% were FYs and 39% PGTs (Table 2). Pearson chi-square demonstrated significant association between designation and exposure with a *p*-value of 0.012 and significant association (*p*-value=0.001) between how often dentists treated HepB patients and being exposed. Needlestick/sharps injury was the most commonly reported exposure. All exposed dentists stated their current serum HBsAg-status to be negative, forming a zero HBV transmission rate. Eight reported being managed with post-exposure immunoprophylaxis (PEP) after their exposure. Responses to question regarding HBV serology are given in Table 3. The correct answers are in bold. A total of 192 dentists (66.2%) correctly stated serological presence of HBsAg to be the hallmark of HBV infection but only 42.4% thought anti-HBs to be index of recovery/immunity. Alarming, 114 (39.3%) dentists said they would consider an ‘HBsAg-positive with low/undetectable HBV DNA levels’ as HepB negative, while 25.2% ticked ‘I don’t know’. Question 6 regarding ELISA was second most correctly answered by 57.9% and question 2 was third most correctly answered by 55.9%. Overall, less than half of dentists correctly answered 5 out of 8 questions. Over 94% of respondents stated they needed further educational programs on Hepatitis B serology.

Discussion

There are several KAP surveys conducted on dentists/students regarding HBV but not a single question regarding serological aspect of HBV. There are few studies testing the seroprevalence of HBsAg in dentists. While some research has been conducted on occupational blood exposures (OBE) among health care workers (HCW) –none of them demonstrate prevalence of HBV OBEs among dentists. Because of the absolute novelty of this particular research topic, a conventional comparative discussion cannot be written. The dental teaching hospitals of this study have assigned separate dental units and equipment for Hepatitis B, C and HIV positive patients. Standard precautions are recommended by the Centre of Disease Control (CDC) whenever contact with patient’s bodily fluids is expected, regardless of infection status [13]. A third of dentists reported following these measures only with known hepatitis B-positive patients. A greater number of foundation-year dentists treated Hepatitis-positive patients on a weekly basis than PGTs and faculty. This discrepancy is perhaps because some of these dental teaching hospitals have allotted FY-dentists on the ‘HBV HCV HIV-positive’ dental units. Twenty percent

Table 2. Responses regarding HBV exposure.

Responses of those who answered 'Yes' to HBV occupational exposure in the past year	
Designation	
FY	30 (49.2%)
PGT	24 (39.3%)
Faculty	7 (11.5%)
Type of exposure	
Needlestick/sharps injury	29 (47.5%)
Mucosal membrane exposure	21 (34.4%)
Needlestick/Sharps Injury and	3 (4.9%)
Mucosal Membrane Exposure	
Non-intact skin exposure	8 (13.1%)
Cause of exposure	
Lack of time	11 (18.0%)
Following improper technique	23 (37.7%)
Both	22 (36.1%)
Accidentally	1 (1.6%)
Lack of resources	3 (4.9%)
Lack of concentration	1 (1.6%)
Frequency of exposure	
1-2 times	49 (80.3%)
3-4 times	9 (14.8%)
≥5 times	3 (4.9%)
Being managed with Post-exposure prophylaxis (PEP)	
Yes	8 (13.1%)
No	53 (86.9%)

of dentists reported HBV OBE at least once, almost half of whom were FY-dentists followed by trainees. Therefore, increased HBV OBE may be related to frequent interactions with HBsAg-positive patients or may be related to work proficiency. A similar study found the incidence of self-reported OBE decreased with a decrease in number of daily beds served per HCW. It also reported that in ‘doctors’ category, interns followed by residents and then clinical fellows reported most OBEs respectively [14]. In the present work, all exposed respondents reported ‘HBsAg-negative status presently’. Permission for laboratory confirmation of this was not given. This supposed zero HBV transmission rate has been demonstrated in other long-term follow-up studies [14,15]. This is most likely due to adequate vaccination of HCWs and PEP management. At our institutes it is mandatory for all dentists, clinical technicians and sanitary personnel to be vaccinated against HBV as per recommendations of CDC and that PEP is administered to those inadequately or unvaccinated.

With regards to HepB serology, the presence of HBsAg in serum indicates current active infection or inactive carrier state [1,16,17]. Over 70% of trainees and faculty dentists and 54% of FYs correctly stated HBsAg to be the hallmark of HB infection. However, a

substantial portion of FYs (30.9%) stated they did not know despite the fact that every patient seeking consultation or treatment at our institutes is screened for HBsAg. If positive, then is assigned to 'positive' dental units. The test is renewed after 3 months. Even with this filter, placed by the institute, lack of understanding of this test and its significance would be detrimental to cross-infection control particularly in private practice. Relative to the previous question, fewer dentists correctly defined CHB to be persistence of serum HBsAg for over 6 months. Acute HBV infection can be asymptomatic in 50-70% and chronic infection is usually indolent during the early immune-tolerant phase and the inactive carrier phase [17]. Immune-clearance or active phase of the disease is characterised by high ALTs, liver damage, hepatitis, cirrhosis etc. Cheilitis, xerostomia, petechiae, lichen planus among other oral

conditions have been known to manifest in patients with liver disease. Chronic liver disease (CLD) is associated with high perioperative morbidity and mortality. Major complications include excessive bleeding and toxicity of drugs like some general anaesthetics [12,18]. Physician consultation and pre-operative hemodynamic assessment and meticulous management of drugs administered is required in CLD patients undergoing elective surgery [18,19]. An even smaller percentage of dentists correctly stated that the serological presence of Antibody to Hepatitis B surface antigen (Anti-HBs) indicates immunity (or recovery from infection in case of positive Anti-HBc). Acute HBV infection in immunocompetent adults is usually self-limiting requiring mere supportive management. Less than 5% of adults develop chronic infection after acute HBV exposure. The seroconversion of HBsAg to Anti-HBs

Table 3. Responses to HBV serology questions (% within designation).

Question	Answer choices	Designation		
		FY Total 110 (100%)	PGT 106 (100%)	Faculty 74 (100%)
1. Hallmark of HBV infection is the serological presence of	HBeAg	11 (10.0%)	14 (13.2%)	9 (12.2%)
	HBsAg	60 (54.5%)	79 (74.5%)	53 (71.6%)
	HBcAg	5 (4.5%)	4 (3.8%)	7 (9.5%)
	I don't know	34 (30.9%)	9 (8.5%)	5 (6.8%)
2. Persistence of HBsAg over 6 months indicates	Acute infection	17 (15.5%)	11 (10.4%)	5 (6.8%)
	Chronic infection	51 (46.4%)	67 (63.2%)	44 (59.5%)
	Fulminant infection	1 (0.9%)	2 (1.9%)	3 (4.1%)
	I don't know	41 (37.3%)	26 (24.5%)	22 (29.7%)
3. Hallmark of recovery from HBV infection	Anti-HBs	48 (43.6%)	44 (41.5%)	31 (41.9%)
	Anti-HBe	12 (10.9%)	29 (27.4%)	14 (18.9%)
	Anti-HBc	7 (6.4%)	7 (6.6%)	4 (5.4%)
	I don't know	43 (39.1%)	26 (25.5%)	25 (33.8%)
4. Time period for which serum HBsAg status is monitored after acute HBV exposure	First month	32 (29.1%)	24 (22.6%)	6 (8.1%)
	1-2 months	20 (18.2%)	12 (11.3%)	5 (6.8%)
	2-3 months	13 (11.8%)	24 (22.6%)	18 (24.3%)
	3-4 months	19 (17.3%)	29 (27.4%)	22 (29.7%)
	I don't know	26 (23.6%)	17 (16.0%)	23 (31.1%)
5. If serum HBsAg-negative and anti-HBc positive, which additional marker is tested for in further tests (if any)	HBeAg	13 (11.8%)	12 (11.3%)	13 (17.6%)
	HBV DNA	35 (31.8%)	42 (39.6%)	33 (44.6%)
	No further test	9 (8.2%)	11 (10.4%)	4 (5.4%)
	I don't know	53 (48.2%)	41 (38.7%)	24 (32.4%)
6. If patient is detected positive on ICT for first time, then	Advise ELISA	56 (50.9%)	62 (58.5%)	50 (67.6%)
	Advise PCR	21 (19.1%)	27 (25.5%)	14 (18.9%)
	Treat patients as positive	7 (6.4%)	5 (4.7%)	0
	Treat patient as negative	0	0	1 (1.4%)
	I don't know	26 (23.6%)	12 (11.3%)	9 (12.2%)
7. HBV DNA undetectable on PCR but ELISA report positive	Treat patient as negative	32 (29.1%)	48 (45.3%)	34 (45.9%)
	Treat patients as positive	42 (38.2%)	38 (35.8%)	23 (31.1%)
	I don't know	36 (32.7%)	20 (18.9%)	17 (23.0%)
8. Minimal protective anti-HBs level after completion of two months of HBV vaccination (mIU/mL)	12	7 (6.4%)	9 (8.4%)	6 (8.1%)
	50	23 (20.9%)	15 (14.2%)	11 (14.9%)
	100	22 (20.0%)	33 (31.1%)	15 (20.3%)
	I don't know	58 (52.7%)	49 (46.2%)	42 (56.8%)

in CHB is rare [1,17]. MacMahon et al and Magalhaes et al conducted longitudinal studies on 1536 with chronic HBV infection and 100 inactive carriers and found that 6.9% and 4% cleared HBsAg over 12.6 years and 10 years respectively [20,21]. The clearance was quicker in older carriers and those who tested HBeAg-negative initially. Nevertheless, immunosuppression may result in reactivation (abrupt appearance or rise in HBV DNA, sero-reversion to HBsAg) in *resolved* infections [17].

HBV can reactivate *spontaneously* in 25-30% of inactive carriers [17]. MacMahon et al found one or more reactivations in 17% of cases with a median of 3 reactivations and Magalhaes et al reported reactivation in 10% of the cohort [20, 20]. So, essentially there is no cure for CHB. CHB infected individuals act as a reservoir for the virus. Therefore, regardless of ‘undetectable’ HBV DNA levels on Polymerase Chain Reaction (PCR) report, an individual testing positive for HBsAg on ELISA should be considered as HBV infected and infectious. Majority of FYs (38.2%) stated they would treat these patients as HBV positive. Majority of faculty (45.9%) and PGTs (45.3%) stated they would consider such patients as HBV negative and hence these patients may have evaded the ‘positive’ units. This will be detrimental to other patients and to the dentist particularly when standard precautions for each patient are not practised.

HBeAg-positive source has a high infectivity factor. HBeAg is tolerogenic: allowing the virion to evade immune system and establish infection *in vivo* [22]. Also, its serological presence is associated with high HBV DNA levels. Seroconversion to anti-HBe and marked reduction in HBV DNA is associated with remission of disease in majority of patients [1,11]. Perhaps this may have lead few dentists to incorrectly assume HBeAg to be hallmark of infection and anti-HBe to indicate immunity.

HBV DNA is used to evaluate anti-viral therapy and detect reactivation and occult infection [23]. Occult HBV infection is rare and is characterised by HBsAg-negative, Anti-HBc positive and usually undetectable *serum* DNA levels however, HBV covalently closed circular DNA (cccDNA) is frequently found in infected hepatocytes through liver biopsy. It acts as a transcription-template for HBV and permits persistence of infection. [11,23]. Majority of PGTs (39.6%) and faculty (44.6%) correctly answered that HBV DNA will be tested for in case of positive anti-HBc and negative-HBsAg. Majority of FYs (48.2%) stated they did not know. Hence, because there is a possibility –albeit rare –an HBsAg-negative individual may harbour an occult

infection, it is mandatory to practice the standard precautions of infection -control for every patient and ideally patients should be screened for both HBsAg and anti-HBc.

After acute exposure, HBsAg status of HCP should be monitored for at least 10 weeks, 2.5months, as HBsAg is detectable in serum between 10 days to 10 weeks following exposure [1, 11]. Knowing this is essential for dentist particularly one who is unvaccinated, incompletely or inadequately vaccinated. A third of respondents (34.1%) incorrectly thought < 2 months were sufficient while 22.8% ticked ‘I don’t know’.

Anti-HBs titre of 12mUI/ml two months after completion of the vaccine series is considered protective and adequate vaccination [20]. Less than 10 dentists in each category answered this correctly. Though unaware of the correct titre, it is reassuring that dentists thought of higher thresholds to be protective. Anti-HBs levels differentiate vaccine responders from non-responders. Non-responders are characterised by anti-HBs levels < 10UI/mL after vaccination and require PEP administration which is most effective within first 24 hours. [20]. PEP regimen consists of revaccination (≥ 1 dose) with or without HepB immunoglobulin (HBIG) [1,24]. This is mandated at our institute after acute exposure to known HBV source. Upon the principle of considering every patient as potentially infectious, a dentist should check their anti-HBs levels after vaccination to ensure adequate immunisation. Henceforth, no post-exposure management is necessary regardless of patients HBsAg status [24].

Several studies have shown Enzyme-linked immunosorbent assay (ELISA) to be significantly more specific than rapid immunochromatographic tests (ICT) with a false negativity rate of 1.3% opposed to 12.3% for ICT [25]. Therefore, a patient testing HBsAg-positive on ICT for the first time needs to be verified by ELISA in case of false positive result. Twelve dentists thought no further testing is required and to treat patient as HBV-positive whilst one dentist thought to treat as negative. Correct knowledge of this is pertinent to prevent a non-infected patient being treated within working environment of hepB-infected patients.

The aforementioned data and discussion highlight the clinical relevance of HBV serological markers to safe dental practice; the need for adequate vaccination and the need to follow standard precautions for each patient to reduce risk of horizontal transmission. The greater number of HBV occupational exposures occurring in foundation-year dentists and trainees may

be related to frequent interactions with hepatitis B patients and/or work proficiency. Although laboratory confirmation of the reported ‘negative’ HBsAg-status of exposed dentists was not permitted –a limitation of this study, the zero transmission rate is probable, because of adequate vaccination and PEP administration to those exposed.

Conclusion

Poorly answered survey indicates the dire need to educate dentists regarding HBV serological markers with their clinical relevance. Failure to do so may contribute to horizontal transmission of the disease and mismanagement of CHB patients.

Recommendations

Along with further education, we recommend stringent adherence to standard protocol of infection-control for every patient and ideally foundation-year dentists should have relatively less interaction with HepB-positive patients as they are less proficient workers naturally.

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Annex – Supplementary items

Supplementary Table 1.

Chronic Hepatitis B (CHB)

1. HBsAg present for ≥ 6 months
2. Serum HBV DNA varies from undetectable to several billion IU/mL
3. Subdivided into HBeAg positive and negative. HBV-DNA levels are typically $> 20,000$ IU/mL in HBeAg-positive CHB, and lower values (2,000-20,000 IU/mL) are often seen in HBeAg-negative CHB.
4. Normal or elevated ALT and/or AST levels
5. Liver biopsy results show chronic hepatitis with variable necroinflammation and/or fibrosis

Immune-Tolerant CHB

1. HBsAg present for ≥ 6 months
2. HBeAg positive
3. HBV-DNA levels are very high (typically >1 million IU/mL).
4. Normal or minimally elevated ALT and/or AST
5. Liver biopsy or non-invasive test results showing no fibrosis and minimal inflammation

Immune-Active CHB

1. HBsAg present for ≥ 6 months
2. Serum HBV DNA $> 20,000$ IU/mL in HBeAg-positive CHB and $> 2,000$ IU/mL in HBeAg-negative CHB
3. Intermittently or persistently elevated ALT and/or AST levels
4. Liver biopsy or non-invasive test results show chronic hepatitis with moderate or severe necroinflammation and with or without fibrosis

Inactive CHB

1. HBsAg present for ≥ 6 months
 2. HBeAg negative, anti-HBe positive
 3. Serum HBV DNA $< 2,000$ IU/mL
 4. Persistently normal ALT and/or AST levels
 5. Liver biopsy confirms absence of significant necroinflammation. Biopsy or noninvasive testing show variable levels of fibrosis
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