Dental Treatment as a Risk Factor for Hepatitis B and C Viral Infection. A Review of the Recent Literature

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ABSTRACT

Background & Aim: Patients chronically infected either with hepatitis B (HBV) or hepatitis C virus (HCV) are at increased risk of developing cirrhosis, end stage liver disease and hepatocellular carcinoma. Different risk factors were found to be associated with the transmission of these viruses in various settings. HBV and HCV transmission seems to be also acquired by non-parenteral and non-sexual routes. A large number of patients infected with HCV might have non identifiable routes of viral acquisition. Hence, viral hepatitis transmission risk factors identification is the main way to reduce infection. Dental treatment may be one of such risk factors, and this aspect is addressed in the present literature review, drawing information from existing literature.

Methods: An online database search was conducted, limited to publications from January 1999 to February 2012 on specific aspects of HBV and HCV infection, including articles on risk factors, markers of infection, dentistry, epidemiology and transmission. Relevant material was evaluated and reviewed.

Results: Overall, 53 studies which met the selection criteria were evaluated. Although these studies were from different geographical regions of varied socioeconomic status and study populations and assessed different dental procedures, using different types of statistical analysis, we found that, although weak, there is an all-time risk of HBV and HCV infection during dental treatment. This is more important in developing countries where the rate of hepatitis infected individuals is higher. There is a need for more studies on this subject, properly planned, controlled and analyzed.

Conclusion: Dental treatment can be included among the risk factors of HBV and HCV infection. This risk can easily be eliminated using standard precautionary measures.

Key words: hepatitis B virus (HBV) – hepatitis C virus (HCV) – dental treatment – risk factor – dentist – review.

INTRODUCTION

At the beginning of the third millennium, hepatitis B virus (HBV) remains a major public health problem globally; more than two billion people have been infected worldwide, and of these, 350-400 million suffer from chronic infection [1, 2]. Approximately one million people become infected in Europe [3] and 200 to 300 thousand infections occur in the USA annually. Corresponding data is not available for the Asian and African endemic regions, but the higher prevalence of HBV in these areas would lead to much higher infection rates than in other parts of the world [4]. Chronic HBV infection has been identified as one of the most important causes of liver failure and hepatocellular carcinoma (HCC) [5-8].

Similarly, hepatitis C virus (HCV) is recognized as a disease of global importance [9]. More than 170 million people are chronically infected, and the disease can lead to the same adverse outcomes as in the case of HBV [2]. Although the incidence of HCV infection is significantly lower than of HBV, the rate of chronically infected individuals is much higher; around 70% of those infected become chronic carriers [10]. To date, there is no available vaccine for HCV prevention and developing such a vaccine in the near future seems far-fetched. Hence, defining the probable routes of transmission and eliminating them is the only practical way to reduce HCV infection [10-12]. In the USA, the prevalence of HCV infection is estimated to be higher than that of infection with human immunodeficiency virus (HIV) or even HBV [13]. Thus, more epidemiologic studies are needed to better assess the risk factors leading to exposure to the virus [14].

Intravenous drug use, unprotected sexual contact with multiple partners, viral exposure during medical procedures
such as dialysis and surgery, accidental exposure such as needlestick injuries and vertical transmission from mother to child are the common routes of infection with both HBV and HCV [3, 15-17]. Surprisingly, the transmission of HBV and particularly HCV seem not to happen by parenteral and sexual routes always. Indeed, up to 40% of patients infected with HCV may have non identifiable routes of viral acquisition [18, 19]. This might lead us to other plausible sources of infection transmission. During recent years special attention was dedicated to the understanding of other transmission modes. To date, many papers have discussed the probability of risk factors such as tattooing, piercing and medical and dental treatments on viral hepatitis transmission. We recently reviewed the presence of viral hepatitis particles in oral fluids and it has been demonstrated that both HBV and HCV can be transmitted via saliva and gingival cervical fluid [20].

Dentists and dental health care workers (DHCWs) are at a high risk of infection with both HBV and HCV during their daily occupational experiences [21]. Similarly, they can infect their patients by such agents if adequate infection control policies are not applied [22]. As evidence, there are 9 reports on infected dentists and oral surgeons who transmitted the virus to their patients during dental procedures during 1974 and 1982 [23]. To our knowledge, there is no report of either patients or dental staff infection in a dental setting. Nonetheless, it does not seem reasonable to deny such a probability [24]. Previous reports have shown that HBV and HCV can persist in the environment and plaster casts for more than one day and one week respectively [25, 26].

Previous studies evaluated the risk of dental procedures on HBV and HCV infection. Additionally, we previously reported on the issue of HBV infection in dentistry as a forgotten topic [22]. The aim of this review is to clarify the probability of HBV and HCV transmission within dental environments.

METHOD

The authors conducted a literature search using Medline/ PubMed (using MeSH terms such as Hepatitis B, HBV, Hepatitis C, HCV, risk factors, transmission, infection and dent* in different combinations of the words), Scopus, EMBASE/Excerpta medica, Cochrane database and Google scholar for international journals, and websites of Iranian Universities and IranMedex for local articles.

The following types of studies were considered suitable for review: review articles (systematic and narrative), case-control studies, investigative studies before-and-after an intervention, observational studies, surveys and reports on both HBV and HCV transmission probability, and infection control procedures in dental clinics. The results were limited to the period from the beginning of 1999 to February 2012, but no language limitation was considered in case the abstract contained enough data for our study requirements. The papers on risk factors, viral markers, dentistry, epidemiology and transmission were obtained and all relevant material was evaluated and reviewed.

Studies containing the following patient/subject groups were included in our review: different groups of infected participants with HBV and HCV compared with non-infected populations, dental personnel and their role in the transmission chain, as well as the probability of outbreaks in dental clinics.

Two reviewers (NM and SMA) independently evaluated the articles using a NHS center for reviews and disseminations standard checklist. In case of any discrepancies between the two reviewers, a discussion was conducted to resolve the issue.

RESULTS

The search strategy extracted 2,651 articles of which 1,988 were excluded according to the selection criteria, after scanning and discussing. The remaining 667 articles were scrutinized more closely to ensure that they would be suitable for inclusion. The full texts of 240 articles were available, and of these 53 were enrolled in the analyses.

Our search results retrieved two types of articles more frequently: a) case-control studies comparing defined risk factors (containing dental treatments or associated phenomena) in a group of infected individuals with non-infected subjects, and b) articles reporting the rate of defined risk factors (containing dental treatments or associated phenomena) in infected individuals only. The first type compared the prevalence of each risk factor in infected and non-infected population. Hence, depending on the applied statistical analysis (univariate or multivariate addressing confidence interval and a p-value - if available), the role of the risk factors was more tangible. In the second type of studies the prevalence of each risk factor was descriptively reported only and no further analysis was performed. According to differences in associated factors between HBV and HCV, each virus is discussed separately, under its relevant subheading.

Dental treatment as a risk factor for HBV infection

Despite the significance of HBV transmission in dental settings, only a few reports were found discussing the subject. The results of such studies varied totally from identifying dental treatment as a risk factor for HBV infection to a non-risk factor. In almost all studies HBV positivity was confirmed by testing hepatitis B surface antigen (HBsAg) in serum samples of the participants.

A case-control study by Pourshams et al in 2004 revealed no association between dental treatments and HBV infection in a group of 44 infected and 1,035 of their non-infected matched family members in Northern Iran [27]. Another study from Edirne, Turkey by Otkun et al in 2005 also showed dental treatment as a non-risk factor for HBV infection in pediatrics [28]. Ozer et al in a study again in Turkey in 2011 on 129 patients and 219 control subjects confirmed the results of the previous reports showing that although the frequency of dental treatment was higher in the HBV positive group, it was not statistically significant [29].

A study by Zhang et al in China showed no association between dental treatments and acute HBV infection type B2 and C2 in a population of 294 HBV positive, 588 matched controls and 572 family members of the cases [30].

A study performed in Pakistan revealed that dental treatment was not associated with HBV infection in a community of pediatrics [31]. The results of a systematic review
on HBV risk factors in the same country in 2011 was in contrast to the previous report showing dental procedures as an HBV risk factor for health care workers and children [32].

In an Indian study in 2010, Jagannathan et al found no association between HbsAg status and dental treatment in a group of 71 HBV positive blood donors in Bangalore after multivariate analysis [33]. Conversely, another study again from India in 2011 evidenced the history of previous surgeries (including gynecological and dental treatments) as a risk factor for HBV infection in a population of pregnant women [34].

In a study performed in Nigeria in 2011, dental intervention was not found as a risk factor for HBV (P-value: 0.8) [35]. The role of dental treatments in HBV transmission in a number of studies during the past 13 years is shown in Table I. Relative statistical data such as odds ratio, confidence interval and P-value are shown if they were available.

**Dental treatment as a risk factor for HCV infection**

The number of studies evaluating dental treatment as a risk factor for HCV infection was more than similar studies on HBV. However, the variation of the results was equally diverse. In these studies HCV infection was confirmed either by HCV antibody or HCV RNA in the serum samples of the participants.

Murphy et al in a study on 2,316 HCV seropositive and 2,316 HCV seronegative blood donors in the USA found that dental treatment is not associated with HCV infection [45]. On the other hand, Trasancos et al in a descriptive study in Australia in 2001 showed that 85.2% of 54 HCV infected individuals had a history of tooth extraction and 35.2 had a complex dental treatment such as root canal therapy [46]. Again, in another study of 178 Korean HCV positive patients in 2002, dental treatment was not found as a risk factor for the transmission of HCV genotypes 1b and 2a [47].

Accordingly, a study in France in 2006 by Karmochkine et al showed that dental treatment was not associated with HCV infection in a group of 450 infected individuals with unexplained route of infection after multivariate analysis [48].

In a study in Pakistan in 2006, Jafri et al demonstrated that dental treatment is not associated with HCV seropositivity in children [41]. In another study from the same country, in a pediatric community, dental treatment was not identified as a risk factor for HCV infection [31]. The authors of another study again in Pakistan classified HCV infected participants into three groups. Amongst 854 participants 60.3% enrolled in a multifactorial transfer group, 15.9% were enrolled in specific factor transfer group and 23.8% were in an unidentified risk factor group. Dental treatment was found as the most identified risk factor (32.6%) in the first group [49]. Again in Pakistan, a study in a poor rural area showed that, despite the fact that dental treatment was not considered as a risk factor for HCV in the whole population, it was significantly higher in the infected females than in uninfected ones [50].

The results of a study in Turkey in 2005 showed that frequent dental treatment and tooth extraction were higher in HCV seropositive individuals than uninfected ones (P-value<0.05 and P-value <0.01, respectively) [51]. Accordingly, Karaca et al in another study in the same country reached the same conclusion finding dental treatment as one of the most common risk factors defined in their checklist [27.5% of 320 anti-HCV seropositive patients] [52]. In contrast, no statistically significant difference was found between 254 HCV positive and 260 HCV negative control subjects in dental procedures in a study in Iran in 2006 [53]. Two studies on Egyptian rural women in 2006 and 2008 showed that though dental treatment increased HCV infection, the phenomenon was not statistically significant [54, 55].

In 2007 Kerzman et al, in a study on HCV positive immigrants from former Soviet Union and native Israeli patients, found that gum surgery - as one of the most common surgeries in the oral cavity - might be related to HCV positivity in subjects from the former Soviet Union but not in the native Israeli ones [56].

A study in Madagascar in 2008 revealed that dental treatment might be associated with HCV infection in an urban area [57]. In contrast, three studies from Australia, Romania and Nigeria in recent years found that dental treatment was not associated with HCV positivity [35, 58, 59]. Detailed breakdown of the results of studies on dental treatment as a risk factor for HCV infection during past years is shown in Table II. Relative statistical data such as odds ratio, confidence interval and P-value are shown if they were available.

### Table I. Risk of dental treatment on HBV transmission in past years *

<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>Study population</th>
<th>N studied (% exposed)</th>
<th>Odds ratio</th>
<th>Confidence interval</th>
<th>Significance status</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iran</td>
<td>2012</td>
<td>Blood donors</td>
<td>48 (60.4)</td>
<td>NA</td>
<td>NA</td>
<td>0.951</td>
<td>[36]</td>
</tr>
<tr>
<td></td>
<td>2005*</td>
<td>Chronic HBV positive patients</td>
<td>500 (17.4)</td>
<td>1.8</td>
<td>1.17-2.77</td>
<td>0.007</td>
<td>[37]</td>
</tr>
<tr>
<td></td>
<td>2004*</td>
<td>Volunteer blood donors</td>
<td>2447 (11.5)</td>
<td>1.96</td>
<td>1.59-2.42</td>
<td>&lt;0.001</td>
<td>[38]</td>
</tr>
<tr>
<td>Jordan**</td>
<td>2010</td>
<td>Patients with a confirmed diagnosis of old or active hepatitis B infection</td>
<td>100 (49)</td>
<td>2.47</td>
<td>1.37-4.44</td>
<td>0.004</td>
<td>[39]</td>
</tr>
<tr>
<td>Pakistan</td>
<td>2009</td>
<td>Male patients with chronic HBV</td>
<td>327 (36**)</td>
<td>2.1</td>
<td>1.5-2.8</td>
<td>0.001</td>
<td>[40]</td>
</tr>
<tr>
<td></td>
<td>2006</td>
<td>3533 children 1 to 15 years of age</td>
<td>65 (0)</td>
<td>-</td>
<td>-</td>
<td>0.150</td>
<td>[41]</td>
</tr>
<tr>
<td>Italy†</td>
<td>2001</td>
<td>Infected patients</td>
<td>3120 (2.5)</td>
<td>2.7</td>
<td>1.6-4.5</td>
<td>&lt;0.05</td>
<td>[42]</td>
</tr>
<tr>
<td>Mexico</td>
<td>2001</td>
<td>Rural Mexico</td>
<td>64 (NA)</td>
<td>2.43</td>
<td>1.01-5.86</td>
<td>&lt;0.05</td>
<td>[43]</td>
</tr>
<tr>
<td>Moldova*</td>
<td>1999</td>
<td>Acute HBV patients ≥15 years</td>
<td>70 (15.7)</td>
<td>21</td>
<td>3.7-120</td>
<td>0.001</td>
<td>[44]</td>
</tr>
</tbody>
</table>

*Most surveys did not have sufficient data on dental treatment and were therefore excluded; **Unhygienic dental care was evaluated in this studies; ***History of dental extraction, scaling and filling; † Oral surgery; * Anaesthetic injection at the dentist
A big part of viral hepatitis affected patients are infected with either HBV or HCV [80]. Identification of a large number of patients with an unknown route of viral hepatitis transmission suggests other possible transmission modes. To date, applying different infection precaution methods reduced the number of new infections remarkably for both HBV and HCV. Therefore, identification and elimination of other possible transmission routes will play a significant role in viral hepatitis restriction.

The issue of viral hepatitis infection in dentistry is an important one [22, 26]. To date there has been no definite conclusion on the role of dental treatment in viral hepatitis transmission; whether from patient to patient, dentist to patient or vice versa.

While evaluating the studies, available data were so limited for many papers that we were only able to use conclusions of the authors. In addition, differences in the assessed papers also prevented us from reaching a specific conclusion. For example, the results of papers might be influenced by the origin of the studies. Reports that addressed dental treatment as a risk factor for viral hepatitis infection were mostly from Middle East, Africa and Eastern Europe, possibly due to non adherence to guidelines on infection control in those regions, and probably through the use of nondisposable or reusable syringes and the lack of sufficient sterilization technology; whereas studies in the US, Western Europe and Australia generally have not reported any association between medical or dental procedures and viral hepatitis infection [56].

Different dental procedures (e.g. tooth extraction, gum surgery or root canal therapy) were evaluated in different

<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>Study population</th>
<th>N studied (%) exposed</th>
<th>Odds ratio</th>
<th>Confidence interval</th>
<th>Significance status</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pakistan</td>
<td>2012</td>
<td>2000 citizens of Kech, Balochistan province; a poor rural area of Pakistan</td>
<td>110 (40.0)</td>
<td>1.47</td>
<td>0.99-2.18</td>
<td>0.056</td>
<td>[50]</td>
</tr>
<tr>
<td>2010</td>
<td>Individual positive for anti-HCV antibody</td>
<td>476 (25.4)</td>
<td>1.25</td>
<td>1.03-1.51</td>
<td>0.02</td>
<td>[60]</td>
<td></td>
</tr>
<tr>
<td>2009*</td>
<td>Male patients suffering from chronic infection</td>
<td>723 (38%***)</td>
<td>2.3</td>
<td>1.8-3.0</td>
<td>0.001</td>
<td>[40]</td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>Patients infected with HCV</td>
<td>281 (34.9)</td>
<td>NA</td>
<td>NA</td>
<td>0.001</td>
<td>[61]</td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>Pregnant women in Karachi hospitals</td>
<td>119 (32.8)</td>
<td>1.66</td>
<td>1.01-2.70</td>
<td>0.042</td>
<td>[62]</td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>3533 children 1 to 15 years of age</td>
<td>55 (1.9)</td>
<td>0.6</td>
<td>0.1-4.3</td>
<td>0.598</td>
<td>[41]</td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td>Positive patients with HCV family history</td>
<td>1.7</td>
<td>0.8-3.3</td>
<td>&gt;0.05</td>
<td></td>
<td>[63]</td>
<td></td>
</tr>
<tr>
<td>2001</td>
<td>Male adults HCV positive patients in Rawalpindi/Islamabad</td>
<td>56.1</td>
<td>1.7</td>
<td>0.9-3.1</td>
<td>&gt;0.05</td>
<td>[64]</td>
<td></td>
</tr>
<tr>
<td>China</td>
<td>2011</td>
<td>HCV positive patients</td>
<td>305 (150)</td>
<td>4.76</td>
<td>2.00-8.41</td>
<td>&lt;0.01</td>
<td>[65]</td>
</tr>
<tr>
<td>2010</td>
<td>HCV positive patients unassociated with injection drug use</td>
<td>48 (58.3)</td>
<td>0.82</td>
<td>0.42-1.59</td>
<td>&lt;0.1</td>
<td>[66]</td>
<td></td>
</tr>
<tr>
<td>Egypt</td>
<td>2011</td>
<td>500 school children aged between 6 and 15 years</td>
<td>29 (24.1)</td>
<td>6.81</td>
<td>2.69-17.39</td>
<td>&lt;0.01</td>
<td>[67]</td>
</tr>
<tr>
<td>2009</td>
<td>Patients newly diagnosed with HCV</td>
<td>X (16)</td>
<td>0.7</td>
<td>0.2-2.3</td>
<td>&gt;0.05</td>
<td>[68]</td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>Asymptomatic HCV infection in Egyptian children</td>
<td>18 (27.8)</td>
<td>3.5</td>
<td>1.13-10.82</td>
<td>0.07</td>
<td>[69]</td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td>Anti–HCV in subjects &lt;30 years of age, upper Egypt</td>
<td>17</td>
<td>1.5</td>
<td>1.0-2.2</td>
<td>0.08</td>
<td>[70]</td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td>Anti–HCV in subjects &gt; 30 years old, upper Egypt</td>
<td>69.1</td>
<td>1.0</td>
<td>0.8-1.4</td>
<td>0.75</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mongolia</td>
<td>2007</td>
<td>Elementary school infected patients</td>
<td>87 (5.7)</td>
<td>1.5</td>
<td>1.4-1.648</td>
<td>0.024</td>
<td>[72]</td>
</tr>
<tr>
<td>Tunisia</td>
<td>2007</td>
<td>Population in highly endemic area of northwest Tunisia</td>
<td>57 (5%)</td>
<td>0.68</td>
<td>0.38-1.21</td>
<td>0.19</td>
<td>[73]</td>
</tr>
<tr>
<td>Vietnam</td>
<td>2007</td>
<td>Infected patients in a rural population in Northern Vietnam</td>
<td>8 (50)</td>
<td>2.45</td>
<td>0.61-9.89</td>
<td>0.19</td>
<td>[74]</td>
</tr>
<tr>
<td>Brazil**</td>
<td>2007</td>
<td>Hepatitis C virus carriers</td>
<td>24 (24.4)</td>
<td>3.6</td>
<td>1.50-8.68</td>
<td>&lt;0.0001</td>
<td>[75]</td>
</tr>
<tr>
<td>Iran</td>
<td>2002</td>
<td>Volunteer blood donors</td>
<td>193 (79.6)</td>
<td>0.4</td>
<td>0.2-0.6</td>
<td>&lt;0.05</td>
<td>[76]</td>
</tr>
<tr>
<td>Uzbekistan</td>
<td>2001</td>
<td>Patients in low risk group</td>
<td>4</td>
<td>1.8</td>
<td>1.3-2.7</td>
<td>&lt;0.01</td>
<td>[77]</td>
</tr>
<tr>
<td>Italy¥</td>
<td>2001</td>
<td>Infected patients</td>
<td>1023 (2.7)</td>
<td>2.8</td>
<td>1.4-5.7</td>
<td>&lt;0.05</td>
<td>[42]</td>
</tr>
<tr>
<td>Peru</td>
<td>2000</td>
<td>Blood donors, hemodialysis patients, hemophilic patients, and gastroenterology patients</td>
<td>1438 (NA)</td>
<td>1.19</td>
<td>1.10-1.29</td>
<td>&lt;0.01</td>
<td>[78]</td>
</tr>
<tr>
<td>Greece</td>
<td>2000</td>
<td>Individuals who visited the participating GPs</td>
<td>92.5</td>
<td>3.79</td>
<td>1.25-11.50</td>
<td>0.018</td>
<td>[79]</td>
</tr>
</tbody>
</table>

**Time sequence was not considered when comparing the results of two studies from one country; **Most surveys did not have sufficient data on dental treatment and were therefore excluded and time sequence was not considered when comparing the results of two studies from one country; **Dental treatment conducted by people not certified in dentistry; Simple dental procedures; Multiple dental procedures; Oral surgery; the authors of this study adjusted risk factors according to age; NA: not available; GP: general practitioner.

**DISCUSSION**

A big part of viral hepatitis affected patients are infected with either HBV or HCV [80]. Identification of a large number of patients with an unknown route of viral hepatitis transmission suggests other possible transmission modes. To date, applying different infection precaution methods reduced the number of new infections remarkably for both HBV and HCV. Therefore, identification and elimination of other possible transmission routes will play a significant role in viral hepatitis restriction.

The issue of viral hepatitis infection in dentistry is an important one [22, 26]. To date there has been no definite conclusion on the role of dental treatment in viral hepatitis transmission; whether from patient to patient, dentist to patient or vice versa.
studies. More seriously, some others assessed treatments performed by an uncertified person. Additionally, different types of analyses (such as descriptive or multivariate/univariate analytic) were used to evaluate the roles of HBV and HCV risk factors. So, all the findings could not be added together to reach a specific answer on the defined question.

Interestingly, in some studies despite initial results showing an association between viral hepatitis and dental treatment, when further analysis applied it was identified that such results might be influenced by the time of the operation or participants’ age. As an example, Habib et al found no difference on receiving dental treatment between infected and non-infected studied groups after adjusting the age of the participants [71]. Plus, another study in Madagascar obtained HCV positivity in a rural group in Madagascar as the dental treatment concerned more elderly people. Such phenomenon could be explained by the lack of infection precautionary methods in healthcare workers (e.g. poor sterilization procedures and unsafe injections) at the time. Until the early 1990s, most primary health care programs were supplied with glass or plastic syringes designed to be washed and sterilized between uses. Earlier, boiling was deemed acceptable for decontaminating these syringes, but evidence on the thermostability of resistant spores and hepatitis viruses prompted a change to steam sterilizers or pressure cookers. These decontamination procedures were highly dependent upon the availability of fuel for heating, regular maintenance of the sterilizers, availability of spare parts, well trained health care workers, and good management and control procedures. Lack of one or more of these essential conditions often resulted in the use of contaminated injection equipment. The introduction of disposable syringes and needles designed for single use tended to exacerbate the problem because the conditions and culture of scarcity still prevailed; disposable products could be easily reused, and they were not designed to be cleaned and sterilized [57]. It can be claimed that a number of studies that proved the role of dental treatment in viral hepatitis infection did not adjust the time of the operation or their population age. In addition, different studies used different groups of participants (e.g. blood donors, injecting drug users or children) and such study designs makes it hard to reach a definite conclusion.

In a study in 2001, Enomoto et al reported that there was no evidence of HCV transmission in surgical and dental patients at university hospitals, and unrecognized transmission of HCV may be a rare event in this setting [81]. Nonetheless, there are reports which indicate that transmission to a dentist is possible. Hasegawa et al found both anti-HCV and HCV RNA in hemostatic gauzes from infected patients referred to dental clinics, even after being kept at room temperature for 24 hours [82]. There are also reports that show infected patients are routinely referred to dental clinics for invasive dental treatments. For example, in a study in Japan Takata et al reported that, in a sample of 404 patients with impacted mandibular third molars, 3 were HBsAg (0.7%) and 13 of 340 were HCV-seropositive (3.8%) [83].

As a serious problem in a number of developing countries, dental treatments can be performed by unqualified dentists (called “experimental dentists” - practitioners that are not academically qualified, but have worked as a dental assistant for a while). The results of some previous reports identified increased infection risk of patients receiving treatment by this group [84]. In a study of chronic HBV infection in Iran, Sali et al revealed that dental treatment by qualified dentists was not a risk factor for viral hepatitis. Nonetheless, visits to uncertified dentists increased the risk of HBV infection. Lack of appropriate education and training on infection control might be the reason of the phenomenon [37]. Uncertified dentists are allowed to work in a number of developing countries such as Iran, Jordan, India and Brazil [39, 75]. Since viral hepatitis is generally more common in such countries, work permission of the group is more serious. This risk can be reduced by preventing unqualified dentists from working. If achieving this aim is too difficult, health policy makers can make unqualified dental practitioners participate in infection control programs, so that they can be informed of the importance of safe hygienic procedures.

In a study on blood donors, HBV infection in known high risk occupations such as dentists, was not shown to be a risk factor [85]. During recent years special attention was dedicated to educate dentists on probable occupational infection. Using personal protective equipments such as gloves, shields, facemasks and HBV vaccination reduced the prevalence of dentists infected by viral hepatitis dramatically.

With regard to the relationship between tooth extraction and viral hepatitis infection obtained in a couple of studies [46, 51], it seems too superficial to consider the role of dental treatment as an independent viral hepatitis risk factor, while socioeconomic status as well as other conditions of the participants also affect the results. Also people with lower socioeconomic status who are exposed to viral hepatitis risk factors prefer to use cheaper dental cares such as tooth extraction sometimes performed by unqualified dentists due to economical restrictions. In addition, dental problems such as tooth loss are observed in specific conditions such as addiction more commonly. Attention to such confounding factors may help us better to secure risk factors of viral hepatitis infection.

It is alarming that though the possibility of HBV infection is simply preventable by using a HBV vaccine, a number of dental personnel still have not been vaccinated. There are dentists and DHCWs who have not received all required vaccine doses. Plus, since not all vaccinees show immune system response, checking antibody titer is an essential part of the infection precaution which is performed by just a small number of vaccinees [86-88]. More seriously there are still a number of DHCWs who do not routinely use protective equipments such as shields, gowns and more seriously face masks or gloves. The necessity of continuous infection control education for all DHCWs is obvious and more efforts should be made to prepare them with the most efficient protective strategies [89, 90].

Although it has been described that reported risk factors in self-reported questionnaires from infected individuals can be influenced by several confounding factors [91], it is still the most commonly used way to evaluate the risks. In this review, all of the material was obtained from such reports.

After the implementation of widespread vaccination programs for HBV, especially among infants, its incidence is on the decrease. But we are facing new sources of infection
transmission, including medical procedures. Fortunately, some newer studies showed that dental treatment was a non-risk factor for HCV infection.

In preparing this paper, we noted that available reports are mostly from developing countries, as this risk has been reduced remarkably in developed countries with adequate precautionary measures. The quality of the studies reviewed was not good generally and in a large number of them, statistical data was not available, especially among those which did not find a significant relationship between dental treatment and infection with HBV and HCV; this is the reason why the results in the tables mostly suggest dental treatment as a risk factor. There is therefore a need for more studies on this subject, properly planned, controlled and analyzed. If possible, prospective cohort studies evaluating dental treatment as a risk factor for viral hepatitis transmission are also recommended.

**CONCLUSIONS**

Although most studies have not found dental treatment to be a risk for HBV and HCV, there is evidence that it may pose a risk [65]. Despite the importance of the subject, to our knowledge no previous article has reviewed the association of dental treatment with viral hepatitis infection. Considering the results of the studies enrolled in this review, it should be highlighted that although weak, there is an all-time risk of HBV and HCV infection during dental treatment. This is more important in developing countries where the rate of hepatitis infected individuals is higher. In addition, in such countries economic limitations might affect adhering infection precautionary methods by the clinicians and cultural issues might cause patients to conceal their infection. Hence, it is safe to mention the following recommendation for viral hepatitis prevention in a dental setting: 1. effort on increasing the level of knowledge in the general population as well as DHCWs regarding the infection risk of dental treatment by holding workshops and programs together with media; 2. preventing unqualified dentists practicing in certain parts of the world and/or making them use infection prevention systems; 3. monitoring hospitals' infection control systems; 4. universal use of efficient prevention tools such as HBV vaccine; 5. checking infection status of DHCWs and considering special strategies for infected ones. It is certainly the case that in recent years, DHCWs have become more aware of HBV and HCV infection, and of prevention measures. Besides the issues appraised in this paper, there is undoubtedly an HBV and especially HCV transmission risk in a dental care environment, and during dental treatment. This risk can be easily eliminated using standard precautionary measures.

**Conflicts of interest:** None to declare.

**REFERENCES**


