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ORIGINAL ARTICLE

Bernd Niederhagen
Martin Wolff
Thorsten Appel
Jens-Jörg von Lindern
Stefaan Bergé

Location and sanitation of dental foci in liver transplantation

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B. Niederhagen (✉) · M. Wolff
T. Appel · J.-J. von Lindern · S. Bergé
Department of Oral and Maxillofacial Surgery, University Hospital, Sigmund-Freud-Strasse 25, 53105, Bonn, Germany
E-mail: niederhagen@uni-bonn.de
Tel.: +49-228-2876385
Fax: +49-228-2874334

Abstract The literature describes various treatment concepts for the pre-operative sanitation of septic foci in the oromaxillofacial area prior to liver transplantation. There are no uniform guidelines, and so far, a connection between dental foci and postoperative infection after transplantation has not yet been proven. Taking into account the complications occurring during focus sanitation, the appropriate extent of, and the most suitable point of time for, focus sanitation have to be ascertained. The clinical and radiological findings from 80 patients were analyzed, with particular attention being paid to dental foci prior to liver transplantation. The complications performed in 39 sanitations and the oral hygiene status of 37 patients were included in the analysis. All the obtained findings were correlated to the etiology of the liver disease and the Child-Pugh stage. Former alcoholics had significantly poorer oral hygiene and more foci than non-alcoholics. After sanitation, complications occurred more frequently in alcoholics (43.8%) and patients in Child-Pugh stage C (41.2%) than in the other groups. Secondary bleeding, severe in some cases, occurred in a total of 15.4% of all patients, despite coagulatory preparations. We can conclude that, given the high rate of complications found in this study after sanitation prior to transplantation, the demand for radical prophylactic dental sanitation should be reconsidered. Rather, it would appear more appropriate for only absolutely necessary sanitation to be carried out prior to transplantation and for the definitive measures to be postponed until after transplantation when liver function has stabilized.

Keywords Liver transplantation · Dental focus · Focus location · Dental sanitation · Complications

Introduction

The pre-operative location of septic foci in the maxillofacial area, and the subsequent sanitation of these foci, are firmly established elements of the evaluation program prior to a liver transplantation (LTx). Ideally, the objective of these measures is the achievement of a focus-free status in the oromaxillofacial area in order to avoid dentogenic postoperative infections during immunosuppressive therapy [13]. The affected patients awaiting LTx are often in a terminal stage of liver failure and consequently suffer from coagulation disorders, reduced protein synthesis, and greater susceptibility to infections. During the sanitation of dentogenic foci, this can give rise to problems such as hemorrhagic complications, wound infections, and wound-healing disorders.

Various treatment concepts for the sanitation of dental septic foci are described in the literature, but there are no uniform guidelines, and the literature still fails to furnish proof of a causal relationship between a dental focus and postoperative sepsis after transplantation [2, 13, 14, 23, 25].

The aim of the present study was to assess the appropriate extent of, and the optimal point of time for, dental sanitation, taking into account the nature and scope of complications occurring after dental surgery in patients with liver failure awaiting LTx.

Patients and methods

A total of 80 consecutive patients, 55 men (68.8%) and 25 women (31.2%), who had been assessed for LTx at the Surgical Clinic of Bonn University from 1992 to 1998 was available for a retrospective study. Additional patients with acute liver failure ($n=18$) during this period were excluded. Prior to LTx, all 80 patients were examined for dental septic foci at the Department of Oral and Maxillofacial Surgery, the Department of Oral Surgery, or by their regular dentist. The clinical, laboratory chemistry, and radiological findings obtained were evaluated, as were the records from 39 focus sanitations, including the associated hemostasiological preparation and complications (wound-healing disorders, secondary bleeding).

The patient population was divided into two groups. Patients with alcohol-related liver disease constituted the 'former alcoholics' group ($n=25$), the rest constituted the 'non-alcoholics' group ($n=55$). The average age of all patients examined was 47 (range: 15–72) years). Ten patients (12.5%) were in Child-Pugh stage A, and 35 patients(43.8%) in Child-Pugh stage B or C.

We examined the type and number of X-ray images taken for focus location, the diagnosed focal findings, the number of patients with foci, the number of foci per patient (few: 1–3; several: 4–6; many: 7–9; very many: >10), the extent of sanitation (tooth extraction or surgical extraction) and the complications occurring. The data on oral hygiene status (good, moderate, or poor) could be additionally established in only 37 patients. All findings were correlated to the etiology of the liver disease and the Child-Pugh stage.

Statistical analyses were performed with the fourfold table (χ^2 test) and the U test (Mann-Whitney). A significance level of 0.05 was selected (U test: $P<0.05$; χ^2 test: $\chi^2>3.84$).

Results

Focus location

Oral hygiene status

Oral hygiene status could be assessed for 37 patients, comprising 13 alcoholics and 24 non-alcoholics, in the framework of focus location. Of the non-alcoholics, 25% ($n=6$) displayed 'good' dental care, while no patient in the group of alcoholics had 'good' oral hygiene. Of the alcoholics, 61.5% ($n=8$), and 41.6% of the non-alcoholics ($n=10$), had 'poor' oral hygiene.

X-ray diagnosis

Of the 80 patients, six (7.5%) could be examined only clinically. The remaining 74 patients were also examined radiologically. The following recording techniques were used in this context: orthopantogram (OPG), status X-ray, single-tooth film, or a combination of these, according to the dental status of the patients. The most frequent combination of these images was the panorama image with additional single-tooth films ($n=29$) (36.3%). It was striking to note that almost all the patients ($n=28$) in this group with extensive radiological diagnosis displayed septic foci requiring treatment.

Focal findings

In the overall population ($n=80$), a total of 327 foci were diagnosed in 52 patients (65%). The group of alcoholics ($n=25$) accounted for 151 foci in 18 patients (72%), this yielding an average of 6.04 foci per patient in this group. In the group of non-alcoholics ($n=55$) 176 foci were counted in 34 patients (61.8%) , resulting in a statistically significantly lower average value of 3.20 foci per patient ($P<0.05$; U test) (Table 1). The greater part (38.9% of 18) of the alcoholics with foci had more than ten teeth with foci, while only a few (1–3) teeth with foci were diagnosed in most (50% of 34) of the non-alcoholics (Fig. 1).

It was striking to note that the focal findings dependent on oral hygiene, such as parodontally damaged and, in particular, decayed and devitalized teeth, occurred significantly more often among the alcoholics ($\chi^2>3.84$; fourfold table). In contrast, the remaining focal findings beyond the control of the patient, such as cysts or retained teeth, were approximately equally common to both groups.

Focus sanitation

In total, 52 patients (65%) had a set of teeth requiring sanitation, while the teeth of 28 patients (35%) did not

Table 1 Number of foci

Parameter	All patients $n=80$	Alcoholics $n=25$	Non-alcoholics $n=55$	Significance
Patients with focus	52 (65%)	18 (72%)	34 (61.8%)	$\chi^2<3.84$
Total foci	327	151	176	–
Foci per patient	4.08	6.04	3.20	$P<0.05$

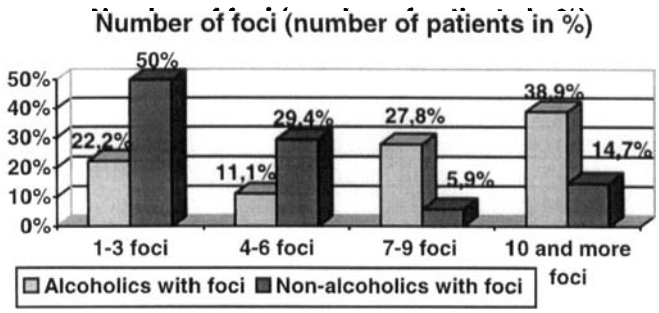

Fig. 1 Number of foci per patient (number of patients in percent)

need sanitation, including those of the six patients who were examined only clinically. As the poor general condition and coagulation status of some patients forbade tooth sanitation prior to LTx, the planned focus sanitation could be performed in only 39 of the 52 patients. These 39 patients comprised 16 alcoholics and 23 non-alcoholics. Of these 39 patients, 17 were in Child-Pugh stage B, and a further 17 in stage C at the time of sanitation; the remaining five patients were in Child-Pugh stage A. Dental surgery was performed a total of 210 times. Hemorrhagic complications or wound-healing disorders occurred during or after the intervention in 23.1% of the patients (nine of 39) in the course of these tooth extractions and other surgical treatment.

We found that in general, complications occurred significantly more frequently both in the group of former alcoholics and among the patients in Child-Pugh stage C ($\chi^2 > 3.84$; fourfold table). Of the alcoholics, 43.8% (seven of 16) and 41.2% (seven of 17) of the patients in Child-Pugh stage C developed complications, whereas only 8.7% (two of 23) of the non-alcoholics, 11.8% (two of 17) of the patients in Child-Pugh stage B, and none of the patients in Child-Pugh stage A, displayed complications.

The coagulation status of a total of 20.5% (eight of 39) of the patients was so poor that they had to be prepared for dento-alveolar surgery by being given coagulation-promoting medication and fresh plasma. However, three of these patients, nevertheless, developed hemorrhagic complications, despite this substitution. In 30 patients, sanitation was performed on an outpatient basis under local anesthesia. Because complications occurred or were to be feared, the treatment of nine patients had to be carried out under hospital monitoring, in six cases, with general anesthesia.

Complications

In the present study, complications (wound-healing disorders, bleeding) occurred in a total of 23.1% (nine of 39) of the patients undergoing sanitation, either during or after the 210 dental surgery interventions. Complications were significantly ($\chi^2 > 3.84$) more frequent in alcoholics (43.8%) and patients in Child-Pugh stage C (41.2%) than in all other patients.

Wound-healing disorders

Three (7.7%) patients, all of them alcoholics in Child-Pugh stage C, developed wound-healing disorders. After therapy with local nursing measures and systemic antibiotic treatment, no further complications arose.

Hemorrhagic complications

Of the patients, six (15.4%), including four former alcoholics, and only two non-alcoholics, suffered slight to massive bleeding during or after surgery. Of these patients, four were in Child-Pugh stage C.

In three cases, the bleeding could be stopped within a few hours by local measures (hemostyptics, swabs and tight suture), without requiring systemic coagulation therapy. The other three patients with hemorrhagic complications had all been given comprehensive treatment with coagulation-promoting medication and fresh plasma in preparation for the operation. They nonetheless developed postoperative secondary bleeding, which was treated by local measures and by continuation of the hemostasiological therapy initiated prior to the operation. In one of these patients, massive, diffuse, life-threatening hemorrhaging occurred during the surgical removal of four retained teeth. This necessitated the administration of six transfusions of packed cells, and the remainder of the planned sanitation had to be abandoned.

Discussion and conclusion

In our study, the group of patients with alcohol-related liver disease prior to LTx displayed far poorer oral hygiene, substantially more parodontally damaged teeth, significantly ($\chi^2 > 3.84$) more deeply carious teeth and, on average, significantly ($\chi^2 < 3.84$) more septic foci than the other patients. A comparable result was also observed in the study by Plachetzky et al. [17]. As in the present study, the authors found that the average number of foci per patient was significantly ($P < 0.05$) higher among former alcoholics (1.59) than among non-alcoholics (0.64). If there is a connection between oral hygiene and the number of foci, this supports the theory voiced in several studies that, as a result of the social and psychological causes and effects of alcohol abuse, alcoholics generally tend to neglect oral hygiene, which leads to the higher incidence of dental and parodontal diseases [1, 15, 17, 18]. It must be remembered in this context that

a highly selective population of former alcoholics with good compliance is involved. However, it remains questionable whether the oral hygiene status can be rated as a compliance criterion in relation to alcohol relapse.

The occurrence of hemorrhagic complications in patients with liver failure in connection with dental surgery is assessed differently in the literature. Morimoto et al. [14] and Thomson and Langton [23] report isolated cases of severe hemorrhagic complications occurring during sanitation of the teeth of patients with liver diseases. In their study, Plachetzky et al. [17] found that 43.8% (seven of 16) of the patients awaiting LTx developed hemorrhagic complications in the course of pre-operative dental sanitation. In contrast, the studies by other authors were unable to detect a higher rate of complications in connection with dental surgery prior to LTx [3, 19]. However, as the latter two studies contain no precise information as to the genesis and Child stage of the liver disease of the patients studied, the statements are not directly comparable with the results of the present study.

The values given in the literature for the incidence of secondary bleeding after dental surgery in patients without hemorrhagic disorders are substantially lower than ours. According to a follow-up examination of 589 healthy patients by Schneider [20], the rate after simple tooth extractions was roughly 3%. Chiapasco et al. [4] conducted a follow-up examination of 1,500 healthy patients and stated the probability of secondary bleeding following the surgical removal of wisdom teeth as being 0.47%. It nevertheless remains to be noted that, according to the present study, in agreement with the literature and particularly compared with the healthy population, there is a substantially increased risk of severe hemorrhagic complications, especially among Child stage C patients and alcoholics awaiting LTx, even if hemostasiological preparations are made beforehand.

Because of their poor coagulation status, 20.5% (eight of 39) of the patients undergoing sanitation in this study had to be prepared for the planned surgery by treatment with fresh plasma and coagulation-promoting medication. Nevertheless, hemorrhagic complications still occurred in three of these eight patients. This intensive hemostasiological preparation and substitution therapy, and also hospitalization for forensic reasons, which became necessary in nine patients, constitute major expense factors. This must be taken into account when dental treatment is planned prior to LTx, as must the physical and mental stress imposed on the patients by radical, extensive dental sanitation.

In our study, 7.7% (three of 39) of the patients, all of whom were alcoholics in Child stage C, developed wound-healing disorders. In their study on the mechanisms triggering systemic infections in patients with cirrhosis of the liver, Barnes et al. [2] also stated soft-tissue inflammation as a possible source of infection. As these patients have a predisposition for bacterial sepsis [9, 25], the risk of sepsis caused by wound-healing disorders following dental sanitation must be taken into consideration in addition to the risk of sepsis following transplantation as a result of dental sanitation not being performed prior to LTx. In addition, there is also the risk of acute wound-healing disorders following dental surgery, necessitating postponement of the vitally necessary transplantation [21].

Controversial opinions can be found in the literature regarding the extent of dentogenic foci and the intensity of focus sanitation prior to LTx. Some authors advocate radical sanitation prior to organ transplantation, going as far as to favor extraction of all teeth and provision of dentures for patients with poor oral hygiene and compliance [6, 10, 12]. In contrast, other authors, such as Eigner et al. [7] and Plachetzky et al. [17], favor only the extraction of teeth with radiologically visible peri-apical inflammation. However, these studies fail to consider the loss of quality of life as a result of losing all ones teeth and having to adapt to wearing dentures.

The literature is largely unanimous in stating that dental sanitation should definitely be carried out prior to LTx. The reason for this is the risk of postoperative infections caused by dental foci, which may turn out to be fatal under immunosuppressive therapy [7, 10, 12, 14]. Although postoperative infections with a lethal outcome can develop after LTx, a critical examination of the literature failed to reveal any study in which a systemic infection with fatal outcome under immunosuppressive therapy could definitely be attributed to a dentogenic cause. In their studies, Cuervas-Mons et al. [5], Kusne et al. [11] and George et al. [8] examined the causes of postoperative, sometimes lethal infections following LTx. However, none of these studies indicates dentogenic foci as triggering the infections. While Svirsky and Saravia [22] and Wilson et al. [24] described systemic infections after organ transplantations on the basis of a number of case reports, and also established a link between these infections and dental foci, the authors failed to provide unequivocal, e.g., microbiological, evidence to support this assumption.

Plachetzky et al. [17] point out that there is no study that demonstrates a reduced rate of complications after LTx as a result of sanitation of the dentogenic foci prior to LTx. Sonner et al. [21] carried out a clinical and radiological dental follow-up examination on 143 patients undergoing LTx and immunosuppressive therapy. No connection could be found between general infections or transplant rejection reactions and the dental status of the patients in question. Peters et al. [16] investigated the incidence of infective complications under immunosuppressive therapy during and after bone marrow transplantation in connection with the occurrence of teeth displaying pathological peri-apical alterations. It was

found that there was no difference between a group of sanitized patients and a group of non-pretreated patients regarding the incidence of infective complications.

A further problem when locating foci prior to LTx is that the terms 'dentogenic focus' and 'dental findings requiring sanitation' are not clearly defined. The nature and scope of pre-operative dental screening and the choice of radiological examination method for locating foci are not uniform, although the number of pathological findings is, of course, dependent on the intensity of the search. This results in subjective diagnostic decisions by the dentist.

To conclude, in summary, we can state that the prevailing recommendations in the literature regarding focus location and focus sanitation are based on the assumption, which is not scientifically confirmed to date, that dentogenic foci can trigger lethal, life-threatening, or serious infections following LTx. In particular, the call for unconditional, prophylactic, radical anitation must by critically reviewed with a view to our results, which indicated hemorrhagic complications and wound-healing disorders, especially in alcoholics and Child stage C patients, and to the substantial loss of quality of life for the patients and the costs involved. It would, therefore, seem more appropriate to wait until after transplantation and, as soon as stabilization of liver function and coagulation has taken place, to carry out a less radical dental sanitation than one additionally considering dental prosthetics. According to our results, the general principle should be only to carry out absolutely necessary sanitation prior to transplantation. This includes teeth with peri-apical inflammation, complaints, or pain. Non-irritating retained teeth, teeth with sub-optimal root fillings, and carious teeth should, in our experience, initially be preserved.

In addition, it is necessary to define the term 'dentogenic focus' and the extent of the absolutely necessary sanitation prior to LTx in a generally applicable, interdisciplinary manner (dentist, LTx team), in order to standardize the guidelines of the various transplantation centers regarding dental sanitation, to assess the success of, and the necessity for this pre-operative measure in a prospective, multicenter study.

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