Acute medical complications and the medical risk-related history in the general dental practice
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CHAPTER 4

Acute medical complications in 277 general dental practices
Abstract

Background.
Due to the aging of the population on one hand and both medical and dental innovations on the other, the number of medical complications which occur during dental treatment is expected to rise. In order to prevent such complications, dental practitioners have used a medical risk-related history which includes risk determination and preventive measures (together the MRRH system). In this study, the medical complications which occurred in their practice have been compared with those recorded by a control group.

Methods.
First, a tested registration form was used. In addition, the group using the MRRH system had previously attended a 1-day introductory course devoted to the MRRH system. Furthermore, a power analysis was used to determine the group sizes. The registration period was set at 1 year, during which the dentists sent in monthly reports. Only patients over the age of 18 were included, after having given their oral consent. An independent diagnosis was given of all registered medical complications by two different internists.

Results.
A total of 208 medical complications were reported: 45 complications were reported by the 62 dentists who used the MRRH system (reference group) and 163 by the 215 dentists of the control group. First, it should be noted that some reports did not register vital signs; this is reflected in categories such as ‘no diagnosis’, ‘collapse eci’ and ‘others’. Second, the study has revealed that the reference group has registered the heart rate and the frequency of breathing of patients more frequently than the control group. Also, a relatively lower percentage of complications was recorded within the reference group due to the intravenous injection of local anesthetics.

Conclusions.
The number of medical complications recorded in the two groups shows little variation. There is a considerable difference, however, in the nature of these complications.

Keywords. dental care; medical emergencies; medical history taking.
Chapter 4: Acute Medical Complications

Introduction

Medical complications are known to occur in general dental practices\(^1\). Little is known, however, about the frequency and the nature of those complications. Due to the retention of natural teeth, the increase of medical outpatient care, and the aging of the population\(^2\), more medically compromised patients are expected to visit the general dental practice. In addition, new techniques\(^4,5\) such as implantology and periodontal surgery place higher demands on the general health of a patient than conservative dentistry.

It is the dentist’s responsibility to acquire the necessary skills in order to identify patients with medical problems or taking medication, who thus may be at risk during dental treatment\(^6-11\). When the medical history of a patient is taken before dental treatment, this could act as an important tool in identifying all medical problems known to the dental patient\(^7,12,13\).

In the present study, a validated patient-administered medical risk-related history\(^3\) (MRRH) has been used by a group of dentists. In each case, the MRRH has been verbally verified by the dentist. It has been developed especially for the detection of systemic diseases which interfere with treatment in the general dental practice\(^14\). Furthermore, the MRRH has been linked to the ASA risk system, which was modified for use in the general dental practice. Four ASA risk scores are relevant for general dentistry\(^15\). For instance, when a patient indicates that he has no medical problems that might interfere with dental treatment, he is classified as ASA I. A patient with a mild to moderate systemic disease which, however, does not limit his daily activity is classified as ASA II. A patient with a moderate systemic disease that limits daily activity but does not leave the patient incapacitated is classified as ASA III. A patient with a severe systemic disease that limits daily activity and furthermore poses a constant threat to his life is classified as ASA IV.

The main questions of the MRRH are designed to detect relevant medical problems, while the subquestions define the degree of severity and the possible risk of those problems. These possible risks provide the basis for preventive measures, which are included in the MRRH system. In order to reduce the risk of acute medical complications, the dental treatment initially proposed by the dentist may have to be adjusted.\(^6,11,17,18\)

So far, the nature and the number of medically compromised patients in the general dental
practice have been the subject of several studies.\textsuperscript{13,15,16} First, the novelty of the present study lies in the immediate registration of the medical complication on a registration form. This form contains several specific questions on medical complications which has enabled two internists, working independently, to reach a similar diagnosis. Apart from the aforementioned registration and diagnosis procedure, the influence of the use of the MRRH on the registered medical complications was examined.

The aims of the present study have been to determine the frequency and the nature of medical complications in general dental practices and to determine whether there is a difference between the frequency and the nature of medical complications recorded by general dental practitioners who use the MRRH system and those who do not.
Subjects and Method

Patients and Dentists
At the outset of the study, a total of 301 dentists were asked to participate. Of this group, 77 dentists used the validated MRRH system (reference group) and 224 dentists did not (control group). The reference group attended a 1-day introductory course, focusing on the MRRH system and the interaction between relevant diseases and dental treatment. Furthermore, use of certain preventive measures was recommended.

Special attention was given to the automatic aspiration syringe. The control group was subdivided into 54 dentists (24%) who were not accustomed to taking a medical history and a group of 170 (76%) dentists who generally did take an anamnesis, usually consisting of a few general questions.

The dentists were asked to record all medical complications that occurred in their practice during a period of 1 year, regardless of the severity. For this purpose, a medical complication was defined as “a temporary or permanent deterioration in the patient's physical condition during his stay in the dental practice. This is reflected in a change of vital signs, such as the level of consciousness, heart rate, the frequency and nature of breathing, and additional diagnostic symptoms.” The dentists were asked to record each medical complication, from the moment the patient entered the dental practice (including the stay in the waiting room) until the moment of departure. The patients involved were asked for their informed consent\(^{19,20}\). In accordance with the Tokyo-Helsinki convention, only patients over the age of 18 were included in this study, which was furthermore approved by the medical ethical committee of the Academic Medical Centre in Amsterdam.

Registration
Two internists and one dentist cooperated in drawing up a standard registration form, so as to provide a solid basis for registration. General dental practitioners (n=11) were then asked to evaluate the registration form. Also, to prevent possible loss of information, additional open questions were added to provide an opportunity of describing in full the medical complication and diagnosis.

Each month, the participants of the study were asked to return the registration form stating whether any medical complication had occurred. If no registration form was sent in, the re-
search team contacted the dentist by phone. If a medical complication had occurred, the dentist was asked a number of questions regarding the medical complication. For example, an inventory was made of the brand, type and quantity of the administered local anesthetics. Copies of the registration form were available on request. Every three months, all dentists received a bulletin designed to instruct, inform, and motivate the participating dentists. In addition, the department of the research team could be reached by phone to answer any medical or dental questions.

The medical complications recorded were independently diagnosed by two internists. If no initial agreement on the diagnosis was reached, the dentist or the patients were asked additional questions. In view of the extra information acquired, the internists would again deliberate and reach a consensus.

Using the program Stat Exact, the chi-square test and the Fisher's exact test for small numbers were employed to compare proportions. As for the group sizes, they were originally based on a power analysis of a pilot study \(^{21}\) (power=0.79).
Results

Patients and Dentists

At the onset of the study, 301 dentists agreed to participate. In the following months, 14 (4.7%) of them withdrew, giving the following reasons: illness (5); lack of time or loss of interest (6); and unknown (3). Furthermore, a number of dentists (10) were excluded after a postregistration survey showed that they had used the MRRH system only infrequently.

Ultimately, the data from 277 dentists were used for statistical analysis. This group consisted of 62 dentists using the MRRH system (reference group) and 215 dentists not using it (control group). During 1 year, the dentists registered 237 medical complications. Of these complications, 29 cases were excluded from analysis either because they occurred just outside the registration period (10) or because they involved patients under the age of 18 (19).

Consequently, a total of 208 medical complications were analysed; the 62 dentists using the MRRH registered a total of 45 medical complications, whereas the control group, consisting of 215 dentists, registered a total of 163 complications (Table 1).

Table 1:
Data of 208 Medical Complications registered in 277 General Dental Practices.

<table>
<thead>
<tr>
<th></th>
<th>Reference group (n=62)</th>
<th>Control group (n=215)</th>
<th>Significance (P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of medical complications</td>
<td>45</td>
<td>163</td>
<td>-</td>
</tr>
<tr>
<td>Total number of dentists with medical complications</td>
<td>24</td>
<td>90</td>
<td>0.63*</td>
</tr>
<tr>
<td>Mean age of the patients (yrs)</td>
<td>32.8 ± 9.4</td>
<td>36.4 ± 14.8</td>
<td>0.47**</td>
</tr>
<tr>
<td>Gender of the patients</td>
<td>M:22, F:23</td>
<td>M:72, F:91</td>
<td>0.57*</td>
</tr>
</tbody>
</table>

Significance estimation by use of *a chi square test and ** Mann-Whitney test with α= 0.05.
As the chi-square test requires independent observations, the numbers of medical complications mentioned above were not used to compute a significance level. Furthermore, the control group and the reference group showed no relative differences either in the age and the gender of the patients or in the percentage of dentists who reported at least one medical complication.

Table 2:
Vital Signs Registered by Both Groups in 208 Medical Complications

<table>
<thead>
<tr>
<th>Vital Signs</th>
<th>Reference group (n=45)</th>
<th>Control group (n=163)</th>
<th>Significance chi square test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consciousness</td>
<td>45</td>
<td>163</td>
<td>*</td>
</tr>
<tr>
<td>Heart rate</td>
<td>24</td>
<td>60</td>
<td>$P = 0.045$</td>
</tr>
<tr>
<td>Frequency of breathing</td>
<td>13</td>
<td>24</td>
<td>$P = 0.03$</td>
</tr>
<tr>
<td>Nature of breathing</td>
<td>18</td>
<td>60</td>
<td>$P = 0.70$</td>
</tr>
</tbody>
</table>

* Known for all medical complications in both groups.

Registration

In 52.4% of the cases, the independent diagnoses made by the two internists were exactly the same. In 33.2% of the cases, there was no initial consensus. Moreover, in 14.4% of the cases, at least one internist was unable to make an initial diagnosis, one of the reasons being the absence of the registration of vital signs. Whether the patient was treated by dentists of the reference group did not influence the diagnosis of the two internists (contingency coefficient = 0.083, Pearson chi-square probability = 0.49).

Medical complications

Table 2 shows four vital signs registered by dentists during medical complications. The patient's state of consciousness was established for all medical complications registered: if this information was not reported spontaneously, additional questions were asked. The loss of consciousness was reported in 18 medical complications in the reference group and 51 cases
Figure 1:
Medical Complications which occurred in the reference group and control group.

- primary hyperventilation
- intravenously injection
- vasovagal collapse
- orthostatic collapse
- collapse eci
- no diagnosis
- grand mal epilepsy
- vertebro basill. insuff.
- others

% per group

Reference
Control

Figure 2:
Medical Complications which occurred in the control group

- myocardial infarction
- angina pectoris
- arrhythmia
- hypoglycaemia
- type I allergy
- persistent bleeding
- goitre bleeding
- VCI syndrome

% per group
in the control group (no difference, \( P = 0.27 \)). Vital signs, like the heart rate and the frequency and nature of breathing, were not recorded consistently for all medical complications. The first two vital signs in Table 2 were noted more often in the reference group (\( P = 0.045 \) and \( P = 0.03 \)). The registration form contained no questions concerning blood pressure or temperature, as these procedures are not customary in dental practices in The Netherlands.

Figure 1 and 2 show the consensus of diagnoses by the internists. In Fig. 1, the categories 'vasovagal collapse', 'orthostatic collapse', and 'collapse e.c.i.' (of unknown origin) include both the patients who lost consciousness and those who did not. Complications due to the intravenous injection of local anesthesia were noted under the heading 'intravenous injections'. Medical complications of the type 'grand mal epilepsy' were the only ones included in the MRRH and reported by both groups. The category 'others' contains several types of medical complications of a low incidence.

**Table 3:**
Type of Treatment in 208 Medical Complications Registered in Both Groups.

<table>
<thead>
<tr>
<th>Type of treatment</th>
<th>Reference group (n=45)</th>
<th>Control group (n=163)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Checkup</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Restoration\cavity preparation</td>
<td>10</td>
<td>36</td>
</tr>
<tr>
<td>Crown preparation</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>Endodontics</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>Extraction</td>
<td>15</td>
<td>61</td>
</tr>
<tr>
<td>Combination of treatments</td>
<td>5</td>
<td>21</td>
</tr>
<tr>
<td>Remaining</td>
<td>5</td>
<td>19</td>
</tr>
<tr>
<td>Unknown</td>
<td>3</td>
<td>5</td>
</tr>
</tbody>
</table>

*Note. Significance estimation by means of Fisher's exact test is 0.85 for all categories.*

Figure 2 shows the medical complications which occurred less frequently. Furthermore, they occurred in the control group only. One patient died of a myocardial infarction in the dental
Chair. As for the allergic reactions recorded, they were all of type 1, the immediate-type allergy. The abbreviation VCI syndrome stands for vena cava inferior syndrome.

Table 4:
Use of Local Anesthesia of 208 Medical Complications in Both Groups.

<table>
<thead>
<tr>
<th>Local Anaesthetics (LA) *</th>
<th>Reference group (n=45)</th>
<th>Control group (n=163)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. LA used</td>
<td>Yes:34, no:7, missing:4</td>
<td>Yes:139, no:17, Missing:7</td>
</tr>
</tbody>
</table>

*Significance estimation by use of a chi square statistic on question 1: 0.28, question 2: 0.08.

Table 3 shows the dental procedures during which medical complications occurred. The category 'combinations' refers to treatment sessions in which more than one dental procedure was carried out, for example, a restoration followed by the extraction of a different element. In relation to the total number of medical complications, no differences were found between the reference group and control group during these dental procedures, as shown in Table 3.

Table 5 shows the exact time at which the medical complication occurred. In the diagnosis of the internists, the information provided by the dentist concerning the number of carpules and additional injections is related to toxicity.

In 11.5% of the medical complications, the assistance of a specialist or a general practitioner was required and in 6.0%, the incident was acute. In 3.2% of the cases, an ambulance was required and the patient had to be hospitalized.
Table 5:
Time of 208 Medical Complications in Both Groups.

<table>
<thead>
<tr>
<th>Time of medical complication</th>
<th>Reference group (n=45)</th>
<th>Control group (n=163)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waiting room</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Before dental treatment</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>During administration of LA</td>
<td>1</td>
<td>24</td>
</tr>
<tr>
<td>Just after administration of LA</td>
<td>9</td>
<td>48</td>
</tr>
<tr>
<td>During ensuing dental treat-</td>
<td>13</td>
<td>26</td>
</tr>
<tr>
<td>ment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>After dental treatment</td>
<td>16</td>
<td>46</td>
</tr>
<tr>
<td>Unknown</td>
<td>-</td>
<td>7</td>
</tr>
</tbody>
</table>

*Significance estimation by use of Fisher's exact test of 0.03 for all categories under 'time of medical complications'.

Chapter 4: Acute Medical Complications
Discussion

Patients and dentists
As shown in this study, medical complications do occur in the general dental practice. The data for this study were collected during 1 year in 277 dental practices. All in all, 208 medical complications were analyzed.

Registration
Several mechanisms were used to improve the dentists' cooperation. Their participation required an interest in medical prevention and a willingness to make time for the registration, which meant that a random group assignment was impossible. One dentist in the control group stated that at least one patient had fainted every month, but he had not considered this worthy of reporting. This attitude may have contributed to the relatively low percentage of patients in the control group who suffered a collapse (Fig. 1).

Another dentist of the control group reported a minor medical complication which after further inquiry proved to be severe. The complications reported by these two dentists had not been noted down on the registration forms and were therefore not included in this study. In addition, it was taken into account that the internists were asked to evaluate a 'paper' patient. Furthermore, open questions were added on the registration form and additional questions were put to the dentists, mainly with regard to vital signs. If the internists could not reach a unanimous opinion after further deliberation, the medical complication was labeled 'no diagnosis'. This category contains both minor and severe complications.

Medical complications
An important part of the diagnosis of the medical complications consists of the registration of vital signs (Table 2). Therefore, the study includes information on the level of consciousness of all patients. In 33.2% of the medical complications, the patient lost consciousness. It should be noted that the state of unconsciousness is in itself a dangerous condition, due to the risk of airway obstruction and asphyxia.

The heart rate and the frequency of breathing were not noted down consistently by all dentists. In relation to the number of medical complications, however, the dentists of the reference group reported relatively more problems of this nature. In general, the dentists
participating in the study were not used to registering vital signs, since the training of these skills is not part of the dental curriculum, as it is in the United States. However, European dentists are expected to carry out first aid and cardiopulmonary resuscitation during a medical emergency.

Grand mal epilepsy, which is mentioned in the MRRH, occurred in both groups of dental practices. This is probably due to the fact that the onset of a grand mal attack can not be blocked. The only measures that can be taken serve to prevent tongue bite (mouth prop). Nitroglycerin, for instance, can block an attack of angina pectoris and is often prescribed as a preventive measure or a therapy.

It should be noted that the reference group recorded a relatively lower percentage of complications due to intravenous injection of a local anesthetics. This is consistent with the use of an aspiration syringe (Table 4) by a relatively larger number of dentists in the reference group; the use of this kind of syringe was recommended during the instruction course.

Figure 2 shows several complications that occurred in the control group; these complications correspond with the medical problems dealt with in the MRRH system, such as angina pectoris, myocardial infarction, arrhythmia, hypoglycemia, persistent bleeding due to anticoagulant therapy, and type 1 allergy. The five medical complications listed above are related to systemic disorders which can be linked directly to age. Therefore, especially when dealing with patients over the age of 45, it is important for the dentist to assess the patient’s medical condition prior to dental treatment.

One of the results of this study links the type of dental treatment to the occurrence of a medical complication (Table 3). A relatively high percentage of medical complications occurs during extraction and restoration treatment, as dental treatment involving extractions often heightens dental stress. Where in the reference group a relatively high percentage of medical complications occurred during or after dental treatment, the medical complications in the control group occurred for the most part just after the administration of a local anesthetic or after dental treatment (Table 5). The latter finding is related to the higher occurrence of intravenous injections of a local anesthetic in the control group.
In Table 6, a comparison is made between this study and two other independent studies\textsuperscript{24,25}. The percentages in Table 6 are related to the total number of complications. Compared to the two other studies, the number of syncope of vasovagal, orthostatic or unknown origin was relatively low. Rows 2 and 3 state the cases of cerebral hypoxia with diminished consciousness, taking into account the same causes of syncope as above. No differentiation in the definition of 'syncope' is given in the first two studies, however, and it is possible that 'syncope' includes cerebral hypoxia and, in case of the first study\textsuperscript{24}, postural hypotension. In our study fewer reports than usual were made of the complications angina pectoris and asthma bronchiale; this may be due to the use of nitroglycerin as a preventive measure in the reference group. On the other hand, more than usual reports were made of medical complications as a result of intravenous injections and hyperventilation in the present study. One might add that hyperventilation is a controversial term which renders a comparison of studies from different countries of origin rather difficult.

Despite the taking of preventive measures, medical complications occur in dentistry. In this study, the degree of prevention was linked directly to the use of the medical risk-related history and the accompanying standard preventive measures. In this study, only acute medical complications were recorded, which is considered to be only a percentage of the total number of medical complications due to dental treatment. Moreover, medical complications as a result of general anesthesia or intravenous sedation were not included. It is clear that, in addition to the MRRH system, first-aid training and emergency equipment play an important role in the prevention of medical complications. The early recognition of prodromes, a correct registration of vital signs and the use of adequate emergency measures to stabilize the patient's condition are imperative\textsuperscript{7}. This is why adequate dental training including medical programs should be provided within the dental curriculum and in postgraduate courses\textsuperscript{26-28}. 
### Table 6:
Comparison between Three Studies on the Occurrence (in Percentages) of Medical Complications in the General Dental Practice.

<table>
<thead>
<tr>
<th>Complication</th>
<th>Steward &amp; Lado(^{24})</th>
<th>Malamed(^{25})</th>
<th>Present study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Registration period</td>
<td>10 years</td>
<td>10 years</td>
<td>1 year</td>
</tr>
<tr>
<td>Number GDP</td>
<td>1304</td>
<td>4309*</td>
<td>277</td>
</tr>
<tr>
<td>N accidents(100%)</td>
<td>11646</td>
<td>30.608</td>
<td>208</td>
</tr>
<tr>
<td>Syncope</td>
<td>67.5</td>
<td>50.3</td>
<td>23.1</td>
</tr>
<tr>
<td>Postural hypotension</td>
<td>-</td>
<td>8.0</td>
<td>5.8</td>
</tr>
<tr>
<td>Cerebral hypoxie eci /vasovagal</td>
<td>-</td>
<td>-</td>
<td>14.9</td>
</tr>
<tr>
<td>Angina pectoris</td>
<td>9.8</td>
<td>8.3</td>
<td>1.0*2.4**</td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Cardiopulmonary arrest</td>
<td>.5</td>
<td>1.0</td>
<td>.5***</td>
</tr>
<tr>
<td>Arrhythmia</td>
<td>-</td>
<td>-</td>
<td>1.4</td>
</tr>
<tr>
<td>Backward/forward failure</td>
<td>.1</td>
<td>.1</td>
<td>-</td>
</tr>
<tr>
<td>CVA/TIA</td>
<td>.3</td>
<td>.2</td>
<td>1.4</td>
</tr>
<tr>
<td>Diabetic coma</td>
<td>.9</td>
<td>.4</td>
<td>-</td>
</tr>
<tr>
<td>Hypoglycemia</td>
<td>1.1</td>
<td>2.9</td>
<td>1.0</td>
</tr>
<tr>
<td>Epilepsy grand mal</td>
<td>4.3</td>
<td>5.2</td>
<td>4.8</td>
</tr>
<tr>
<td>Asthma</td>
<td>6.0</td>
<td>4.6</td>
<td>-</td>
</tr>
<tr>
<td>Mild allergic reaction</td>
<td>-</td>
<td>8.4</td>
<td>-</td>
</tr>
<tr>
<td>Anaphylactic reaction' shock</td>
<td>1.0</td>
<td>1.0</td>
<td>1.9</td>
</tr>
<tr>
<td>Local anesthesia complications</td>
<td>7.9</td>
<td>3.6</td>
<td>14.4***</td>
</tr>
<tr>
<td>Hyperventilation</td>
<td>-</td>
<td>4.3</td>
<td>11.1</td>
</tr>
<tr>
<td>Continued bleeding</td>
<td>-</td>
<td>-</td>
<td>1.4</td>
</tr>
<tr>
<td>Vena cave inferior-syndrom</td>
<td>-</td>
<td>-</td>
<td>1.4</td>
</tr>
<tr>
<td>No diagnosis</td>
<td>-</td>
<td>-</td>
<td>8.2</td>
</tr>
<tr>
<td>Others</td>
<td>-</td>
<td>3.0</td>
<td>6.7</td>
</tr>
</tbody>
</table>

* Private practice dentists.

** In three medical complications angina pectoris occurs as a secondary effect (Hyperventilation, TIA, arrhythmia). Primary angina pectoris: 1.0%, secondary angina pectoris: 2.4%.

*** Cardiopulmonary arrest as a result of a myocardial infarction.
**** Medical complications due to intravenous injections

Conclusions

In this study, an inventory is made of several characteristics of medical complications in two types of general dental practices. First, no relative difference was found between the number of medical complications in the group which used the MRRH system (reference group) and the control group. However, a relative difference was found in the nature of the medical complications registered. The medical complications due to medical problems mentioned in the MRRH were registered only by the control group, with the exception of grand mal epilepsy. Also, the vital signs were not always noted down in a consistent manner. On the other hand, the reference group did register more problems involving heart rate and frequency of breathing during medical complications.

From this study follows that both in undergraduate and postgraduate training in The Netherlands and in Europe, more attention should be paid to the prevention of medical calamities using the medical history of a patient. Equal attention should be paid to the importance of registering the vital signs when dealing with such incidents.
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Chapter 4: Acute Medical Complications