Does access to general dental treatment affect the number and complexity of patients presenting to the acute hospital service with severe dentofacial infections?

Abstract
Aim: This is a retrospective study to review the treatment and management of patients presenting with odontogenic infections in a large urban teaching hospital over a four-year period, comparing the number and complexity of odontogenic infections presenting to an acute general hospital in two periods, as follows: Group A (January 2008 to March 2010) versus Group B (April 2010 to December 2011). The background to the study is ‘An alteration in patient access to primary dental care instituted by the Department of Health in April 2010’.

Objectives: a) to identify any alteration in the pattern and complexity of patients’ presentation with odontogenic infections following recent changes in access to treatment via the Dental Treatment Services Scheme (DTSS) and the Dental Treatment Benefit Scheme (DTBS) in April 2010; and, b) to evaluate the management of severe odontogenic infections.

Method: Data was collated by a combination of a comprehensive chart review and electronic patient record analysis based on the primary discharge diagnosis as recorded in the Hospital In-Patient Enquiry (HIPE) system.

Results: Fifty patients were admitted to the National Maxillofacial Unit, St James’s Hospital, under the oral and maxillofacial service over a four-year period, with an odontogenic infection as the primary diagnosis. There was an increased number of patients presenting with odontogenic infections during Group B of the study. These patients showed an increased complexity and severity of infection. Although there was an upward trend in the numbers and complexity of infections, this trending did not reach statistical significance.

Conclusions: The primary cause of infection was dental caries in all patients. Dental caries is a preventable and treatable disease. Increased resources should be made available to support access to dental care, and thereby lessen the potential for the morbidity and mortality associated with serious odontogenic infections. The study at present continues as a prospective study.
Introduction

Spreading dental orofacial infections are potentially life threatening. The airway can be compromised and there is also the potential for spread to the deep anatomical fascial spaces and the mediastinum. Patients commonly present to oral and maxillofacial surgery units for the acute management of severe odontogenic infections. There is a significant morbidity, and on occasion mortality, associated with these infections. There remains a reported mortality of 8% from deep cervical abscesses, despite early antibiotic and surgical management.

In April 2010 the Department of Health and Children altered the access to primary dental care for a significant percentage of the population. Two million people are entitled to benefit under the Dental Treatment Benefit Scheme (DTBS, i.e., pay-related social insurance [PRSI] payers and their dependant spouses). A further 1.4 million people are covered under the Dental Treatment Services Scheme (DTSS, i.e., people entitled to a medical card). The current economic difficulty in Ireland has resulted in fewer patients attending for regular dental care. Since 2010, most patients with a medical card are now only entitled to an annual oral examination and two emergency fillings or extractions free of charge. Those who are covered under the PRSI scheme are now only entitled to an annual oral examination.

In the United Kingdom, research has shown a dramatic increase in the number of patients requiring admission for the management of spreading dental infections following the alteration from the fee per item system in 2006 to a banding system within the UK National Health Service. Information was gathered by a combination of chart review and electronic patient record analysis to ensure that only patients with an odontogenic infection were included. Those with non-odontogenic infections were excluded. The following information was sourced from the database: patient demographics; referral source; length of hospital stay; infection source; investigations undertaken; documentation of mouth opening; antimicrobial therapy; and, management undertaken by the oral and maxillofacial surgery team. The information collected was analysed using a Microsoft Excel database.

Methods

This retrospective study was conducted at the National Maxillofacial Unit, St James’s Hospital, one of the largest urban hospitals in Ireland. Children are not treated in this hospital and were not included in the study. The study evaluated patients with a primary discharge diagnosis of odontogenic maxillofacial infection. These patients were retrospectively identified and selected from St James’s Hospital patients with WHO ICD 10 discharge codes: K122 (cellulitis and abscess of the mouth); J391 (other abscess of the jaw); K052 (acute periodontitis); K113 (abscess of salivary gland); and, K102 (inflammatory conditions of the jaw) between January 1, 2008, and December 31, 2011.

Results

Fifty patients were admitted to the National Oral & Maxillofacial Unit over the study period (January 2008 to December 2011) with severe odontogenic infections. The study population (n = 50) was divided into two groups as follows: Group A – January 2008 to March 2010 (26 months); and, Group B – April 2010 to December 2011 (20 months). The alteration in the schemes for patient access to primary dental care commenced in April 2010.

Gender

A male to female predominance was seen each year, with a total of 34 males (68%) and 16 females (32%) (Figure 1). There were 14 males and seven females in Group A and 20 males and nine females in Group B.

Age

The age range was 15–91 years, with a mean of 38.5 and median of 33 years (Figure 2). There was a non-significant increase in age in Group A (34.2) versus Group B (41.2) (p = 0.33).
versus a mean of 18.6 mm in Group B. The mean mouth opening was 11.5 mm in Group A, requiring the use of awake fibreoptic intubation and operative difficulties in relation to tooth extraction. The mean mouth opening was 11.5 mm in Group A versus a mean of 18.6 mm in Group B.

Table 1: Patient referral source

<table>
<thead>
<tr>
<th>Referral source</th>
<th>%</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute hospital</td>
<td>52</td>
<td>26</td>
</tr>
<tr>
<td>GDP/GMP</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>Dental hospital</td>
<td>16</td>
<td>8</td>
</tr>
<tr>
<td>Self-referral</td>
<td>12</td>
<td>6</td>
</tr>
</tbody>
</table>

Table 2: Percentage of involvement of fascial space

<table>
<thead>
<tr>
<th>Anatomic space</th>
<th>%</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Submandibular</td>
<td>42</td>
<td>21</td>
</tr>
<tr>
<td>Buccal</td>
<td>16</td>
<td>8</td>
</tr>
<tr>
<td>Infratrobral</td>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td>Parapharyngeal</td>
<td>8</td>
<td>4</td>
</tr>
</tbody>
</table>

Table 3: Comparison of patient groups

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Mean age</td>
<td></td>
</tr>
<tr>
<td>34.26</td>
<td>41.20</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>14 M 7 F</td>
<td>20 M 9 F</td>
</tr>
<tr>
<td>Referral source</td>
<td></td>
</tr>
<tr>
<td>15 acute hospital</td>
<td>27 acute hospital</td>
</tr>
<tr>
<td>6 primary care</td>
<td>2 primary care</td>
</tr>
<tr>
<td>Involved tooth</td>
<td></td>
</tr>
<tr>
<td>LL7</td>
<td>LL6/LL7</td>
</tr>
<tr>
<td>Length of hospital stay</td>
<td>4.18</td>
</tr>
<tr>
<td>CT scan</td>
<td></td>
</tr>
<tr>
<td>2/21</td>
<td>15/29</td>
</tr>
<tr>
<td>General anaesthesia</td>
<td></td>
</tr>
<tr>
<td>14/21</td>
<td>21/29</td>
</tr>
<tr>
<td>Local anaesthesia</td>
<td></td>
</tr>
<tr>
<td>5/21</td>
<td>5/29</td>
</tr>
</tbody>
</table>

Referral source

Tertiary referrals from other acute hospitals were the most common referral source (n = 42, 84%), where oral and maxillofacial services are not available, with the further referrals from primary carers, namely general medical practitioners and dentists (n = 8, 16%). In Group A there were 15 acute hospital referrals versus six from primary care, and in Group B there were 27 acute hospital versus two primary care referrals.

Comorbidity

Predisposing factors such as alcoholism, immunosuppression, uncontrolled diabetes mellitus and multiple underlying medical conditions are reported to increase the risk of odontogenic infection. Medical history was recorded in all patients (n = 50). A total of 76% (n=38) of patients had an unremarkable medical history. One patient had documented evidence of type II diabetes mellitus. Other conditions recorded included hypertension, alcoholic liver disease, hypothyroidism, COPD, ischaemic heart disease and hyperlipidaemia. No patients were on steroid therapy, chemotherapy or radiotherapy.

Admission temperature

Admission temperature in the emergency department was recorded in 44% of cases (n = 22). A pyrexia is considered to be a temperature of greater than 37.5°C. Only one case of pyrexia was recorded in these patients at 38.5°C. No pyrexia was recorded in Group A and one pyrexia was recorded in Group B.

Trismus

Mouth opening was identified in 40% (n = 20). The interincisal distance recorded ranged from 3-30 mm, with a mean of 17.4 mm. Severe trismus can lead to increased difficulties for anaesthetic colleagues, with intubation often requiring the use of awake fibreoptic intubation and operative difficulties in relation to tooth extraction. The mean mouth opening was 11.5 mm in Group A versus a mean of 18.6 mm in Group B.

Tooth involvement

Chow et al. in 1978 identified how infections most commonly involve the mandibular molar teeth. In this study, 58% (n = 29) of the carious teeth involved the mandibular molar teeth. The mandibular second molar was the tooth most frequently involved (24%, n = 12). The left side is more frequently involved than the right. Dental caries was the only cause of odontogenic infections identified. The involved tooth was most commonly the mandibular left second molar in Group A, versus the mandibular left second molar and mandibular left first molar in Group B.

Anatomic space

Odontogenic soft tissue infections usually spread through the fascial spaces in their vicinity. The most frequent single space infection was the submandibular (42%, n = 21), followed by the buccal (16%, n = 8), infraorbital (12%, n = 6) and parapharyngeal (8%, n = 4). There were five submandibular space infections in Group A versus 16 in Group B. Multi-space infections most frequently involve the submental and submandibular spaces bilaterally, giving rise to Ludwig’s angina, which occurred in 8% (n = 4).

Radiographic investigations

Facial radiographs, including orthopantomogram (OPG) or computed tomography (CT) scans, were performed on all patients on admission. In Group A, 2/21 patients had a CT whereas in Group B 15/29 had a CT.

Admission white cell count

All patients had an initial full blood count carried out. Leucocytosis was identified in 44% (n = 22), with an elevated white cell count (WCC) above the laboratory reference ranges of 4-11 x 10⁹. The WCC ranged from 3.8-23.8, with a mean of 11.09. There was a non-significant difference between Group A and Group B (p = 0.5).

Hyperglycaemia

Fasting and/or random blood glucose levels were checked in 74% (n = 37) of patients. A total of 16% (n = 6) of these patients demonstrated hyperglycaemia. This may signify the presence of underlying diabetes mellitus or the body’s response to stress, which the infection causes. There were three patients in both Group A and Group B.

Antimicrobial management

All patients received high dose intravenous antibiotics. The most commonly prescribed regimen consisted of broad-spectrum cover with co-amoxiclav and metronidazole given to the patients empirically on admission. Patients with an allergy to penicillin were treated with intravenous clindamycin. A microbiological swab was sent for culture and sensitivity in 58% (n = 29). In 22% of cases (n = 11), the choice of antibiotic was changed or an additional antibiotic was required. This was due to an infection not responding to treatment, or when culture and sensitivity results from a microbiological swab of the abscess advised a change of regimen.

Surgical management

Some 92% (n = 45) of patients required surgical intervention from the oral and maxillofacial team. This included formal incision and drainage of the abscess in 28% (n = 14), or incision and drainage with dental extractions also
being performed in 62% (n = 31). Some 10% (n = 5) of patients were treated by antibiotics only and did not require surgical intervention. Some 70% (n = 35) of patients who required operative interventions were managed under general anaesthetic, with the remaining 22% (n = 10) of procedures being performed under local anaesthetic. Fourteen operations were performed under general anaesthetic in Group A compared to 21 under general anaesthetic in Group B.

The length of time from admission to surgical intervention was assessed, with 44% (n = 22) of patients brought to the operating theatre on the first day of admission over the four-year period, and it was found that an increased number of patients were brought to theatre on the first day of admission as the years progressed: eight patients in Group A compared to 14 patients in Group B.

**Length of stay**
The length of stay (LOS) ranged from two to 37 days, with a median of 5.5 days. The LOS increased from 4.18 days in Group A to 6.79 days in Group B. This difference in LOS was not statistically significant (p = 0.33).

**Discussion**
This study has shown that odontogenic infections are a significant source of morbidity. It is accepted that these infections also have the potential for mortality in the population. The study reviewed 50 patients over a four-year period. The retrospective nature of the study would predispose to an underestimation of the number of patients presenting with odontogenic infection requiring hospital admission, and an upward trend during the study period is evident. It is likely that many more patients are suffering from dental abscesses, not requiring hospital admission, and are managed in the community. Changes in patient access to primary dental care since April 2010, and the burden this has placed on the population with medical card and DTBS entitlements, has placed a barrier for patients receiving appropriate and timely primary dental care. This has led to the worrying trend of increasing numbers of patients accessing the emergency department, and ultimately requiring secondary and tertiary level care for the management of dental infections. This pattern of clinical presentation and treatment of these patients also has significant financial implications for the health service with the need for prolonged hospital and often ICU admission, investigations, advanced imaging and surgical care. This is particularly relevant in regard to dental caries, which is a preventable and treatable disease, invariably treatable in a primary dental care setting.

Odontogenic infections are more common in males and this is reflected in our and other studies. This male–female predominance has been documented in several similar studies, including a five-year retrospective study at San Francisco General Hospital, where a 65% male predominance was seen. Infections of dental origin affect a very wide age range. Age was not a statistically significant factor in increased admissions between the 2008/2009 cohort and the 2010/2011 cohort (p = 0.33). It is hypothesised that the older population may be at less risk because they have fewer teeth. However, this is likely to change due to better oral hygiene and dental care leading to patients retaining their teeth for longer. However, all adults in Ireland over 70 years are entitled to a medical card, so arguably they have been most affected by the decreased availability of services on the scheme, and the advantages accrued by earlier action will be reduced.

The most frequent source of referrals are other acute hospitals, and this highlights the need for improved access to primary dental care at an earlier point in the disease process. Dental caries is both a preventable and treatable disease. There was an alarming trend, with an 80% (n = 12) increase in referrals from acute hospitals between the 2008/2009 cohort and the 2010/2011 group. This is at variance with other studies but may reflect the centralisation of the oral and maxillofacial service in Ireland.

The presence of coexisting medical conditions can increase the risk of developing severe infection or sepsis. Peters et al. in 1996 showed the underlying medical condition and the location of the infection to be the best predictors of length of hospital stay. However, the majority of our patients had an unremarkable medical history, which highlights the unpredictable nature of odontogenic infections and again is indicative of advanced untreated dental disease.

Temperature is an accepted clinical predictor of acute infection and a way to monitor the patients’ response to treatment. An area of poor record in the study is that admission temperature in the emergency department is recorded in less than half the patients (44%, n = 22). This may reflect a deficiency in the record keeping, but temperature is recorded routinely on the wards. The clinical examination is critical in the assessment of these patients with reference to the severity of the infection and the potential for airway compromise. Restricted mouth opening is an important predictor of the difficulty of intubation and is important for operative access. With trismus identified in 40% (n = 20) of the patients, the early consultation with anaesthetic colleagues is essential to avoid the possibility of making a difficult intubation even more cumbersome. Early intervention is of importance in these cases.

This study confirms the results of previous studies in relation to the mandibular dentition being the source of the majority of the infection, with the left second molar tooth being most commonly associated. The submandibular space is most frequently involved, which is unsurprising given the anatomic relationship to the roots of the posterior mandibular molar teeth.

The increased use of CT in relation to odontogenic infection over time is indicative of the increased concern for potential airway compromise. It also reflects the increased access to CT technology, which has significantly improved clinicians’ knowledge of the extent of the disease. However, it also highlights the increased use of a valuable resource to treat an essentially preventable disease. This may suggest a trend towards more serious infection in which it was felt the airway was compromised and a CT would be required to allow the anaesthetist to assess the difficulty of intubation preoperatively.

Peters et al. concluded that the WCC on admission appears to have positive correlation to the length of hospital stay. However, with less than half of the study population showing a leucocytosis on admission, the importance of good clinical examination is emphasised. Further analysis is required to rationalise whether WCC is most useful in assessing improvement or regression of a patient’s response to therapy, rather than as a predictor of actual patient status. The initial WCC on presentation to hospital was not statistically significant between the two groups analysed (p = 0.5). However, a trend towards increased WCC on presentation was noted.

All patients required high dose intravenous antibiotics. In 10% (n = 5), surgical intervention was not required. However patients were admitted for the administration of the antibiotics and the monitoring of vital signs and
supportive care. Despite the conclusions of Wang et al., culture and sensitivity is an important part of the management, as this led to a change of antibiotic regimen in some cases and reflects the complex microbial environment of odontogenic infections.8 Burnham et al. in 2011 highlighted the overprescription of antibiotics by non-dental trained health professionals in the UK, without adequate follow-up or intervention.5 Ideally, dental abscesses should be seen and managed early in the community with oral antibiotics and treatment of the cause, with extraction or drainage if needed. The patient should then be reviewed to ensure that the infection has not progressed to a cervicofacial infection.3,12 Most patients in this study required surgical intervention, either formal incision and drainage, alone or with extraction of the offending teeth. This showed a worrying increase in the number of patients requiring surgical intervention for severe odontogenic infections secondary to dental caries, a condition that is preventable and eminently treatable in the early stages. Interestingly, a higher percentage of patients were brought to theatre on the first day of admission – 38% in Group A compared to 48% in Group B – likely reflecting the more advanced and complex nature of the abscess at presentation. Similarly, this early operative intervention had little impact on length of stay, with the average LOS at 4.9 days in 2008 and 5.6 days in 2011. Again, it is likely that these patients were more seriously septic and took more time to improve despite efficient drainage and antimicrobial therapy. This is unsurprising, as it has been shown that operating room use is a strong predictor of hospitalisation duration.8 The majority of patients required a general anaesthetic, which in itself is associated with morbidity and mortality. Severe odontogenic infections can vary from a local swelling to a life-threatening condition.3,12,13 Patients usually remain hospitalised until the infection resolves or is controlled, and the patient has returned to their baseline functional status. The number of patients with an LOS of greater than four days was also analysed, as this is defined as an unfavourable outcome according to Peters et al.8 After the introduction of the changes to access to dental care in 2010, in excess of 50% of patients had an LOS greater than four days, indicating more serious infection. However, due to the relatively small numbers of patients in both cohorts, the LOS analysed was not statistically significant (p = 0.33).

It was also found that location of infection had a significant impact on length of stay.8 Some 8% (n = 4) of patients in our study developed Ludwig’s angina with no mortality reported. Patients seriously ill from these odontogenic infections commonly require admission to an ICU for airway management and other supportive care. Death from isolated dental infection is rare, but progression to Ludwig’s angina increases the risk of mortality.3,14,15 This highlights the advanced nature of these serious dental infections involving bilateral submental and submandibular spaces and with the mortality associated with Ludwig’s angina recognised at 10%. Early aggressive surgical drainage, with adjunctive intravenous antibiotics and supportive care, are critical to ensuring a good outcome.

Conclusion

Odontogenic infections are serious infections with the potential for significant morbidity and potential mortality if treatment is delayed or neglected. The number of patients requiring secondary and tertiary care for the treatment of odontogenic infections has increased since the introduction of the changes in access to primary dental care in April 2010. The mean length of stay is increasing, with most patients having an in-patient hospital stay of 5.5 days. There is increased use of valuable resources at a secondary level for a preventable and treatable disease, which ideally would be treated in the primary care setting. The primary cause of the odontogenic infection was dental caries in all patients. Increased resources should be made available to reduce barriers to access and thereby lessen the potential for morbidity and mortality associated with serious odontogenic infections.

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Declaration of interest: The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

References