Bacteraemia following debanding and gold chain adjustment

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SUMMARY The purpose of this research was to estimate the prevalence, intensity, and nature of bacteraemia following deband and gold chain adjustment. Forty-nine children, 25 males and 24 females, mean age 15.4 years, attending the Orthodontic Department at the Eastman Dental Hospital were recruited. A cannula was inserted into either the left or the right antecubital fossa using an aseptic technique. A 6 ml sample of blood was taken before treatment and another 6 ml, 30 seconds after either upper deband (n = 42) or gold chain adjustment (n = 7). McNewmar’s test was used to determine differences in the proportion of positive blood cultures and Wilcoxon matched pairs test to compare continuous variables.

There was no significant difference (P > 0.05) in the prevalence of bacteraemia between baseline (eight, 19 per cent) and following upper deband (11, 26 per cent) or between baseline (four, 57 per cent) and gold chain adjustment (four, 57 per cent). There was also no significant difference (P > 0.05) in the intensity of the anaerobic bacteraemia between baseline and following deband or gold chain adjustment.

Although the number of subjects undergoing gold chain adjustment was small, the findings demonstrate that neither upper deband nor gold chain adjustment is associated with a significant bacteraemia.

Introduction

It is clear that an individual’s susceptibility to infective endocarditis (IE) is related to the underlying cardiac lesion. This is particularly so with congenital heart disease where the degree of susceptibility is determined by both the haemodynamic severity of the lesion and whether or not the surgery has been palliative or definitive. These factors further determine if the affected individual has a high, moderate, or low risk of developing IE as a result of instrumentation of a mucosal surface.

The recommendations from the British Cardiac Society (Ramsdale and Turner-Stokes, 2004) are that all dental procedures with a statistically significantly greater bacteraemia post-procedure compared with pre-procedure should be covered by antibiotic prophylaxis in the moderate and high-risk cardiac groups. It is important to emphasize that statistical significance does not equate to clinical significance. The British Society of Antimicrobial Chemotherapy has recently published recommendations (Gould et al., 2004). These state that only subjects with prosthetic valves, surgically constructed systemic or pulmonary shunts and conduits, or a history of IE should be treated with antibiotic prophylaxis. The general consensus of the American Heart Association now appears to be that susceptible individuals are more at risk from everyday procedures such as toothbrushing (Al-Karaawi et al., 2001).

Until very recently, antibiotic prophylaxis for the prevention of IE in susceptible individuals has been recommended for extractions, scaling, and periodontal surgery (Simmons, 1993) and for all dental procedures that are likely to cause gingival bleeding (Horstkotte et al., 2004). Although bleeding is a poor predictor of bacteraemia, the relationship between bacteraemia and dentogingival manipulative procedures is well documented. These procedures include extraction of teeth (Burket and Burn, 1937; Coulter et al., 1990; Roberts et al., 1997), placement of a rubber dam, gingival retraction cord, and matrix band and wedge (Roberts et al., 1998). Provisional data from professional tooth cleaning with a slow handpiece and rubber cup and use of an electric toothbrush with an up and down oscillating movement appear to cause a significant bacteraemia.

Early researchers reported no significant difference in the prevalence of bacteraemia following debanding compared with pre-procedure (Erverdi et al., 2000). The prevalence of bacteraemia following alginate impressions was 31 per cent, placement of separators 36 per cent, fit and placement of molar band 44 per cent, and archwire adjustment 19.4 per cent, but none of these were significantly different from baseline (Lucas et al., 2002b).

Most published work has not reported the intensity of bacteraemia. The technique of broth culture, while enabling a rapid microbial identity, does not provide information about the intensity of bacteraemia. Although the pour plate method has been used (Coulter et al., 1990), it has not been validated. The technique of lysis filtration enables both identification of the micro-organisms and calculation of the intensity of bacteraemia in colony-forming units per millilitre (cfus/ml) of blood and has recently been validated (Lucas et al., 2002a).

The purpose of this investigation was to record the prevalence and intensity of bacteraemia following upper arch debanding and gold chain adjustment using lysis filtration.

Subjects

Ethical approval was granted by the Eastman Dental Institute and Hospital Joint Research and Ethics Committee. Each parent was given an information sheet and was asked for written consent for children aged less than 16 years.
Children aged over 12 years but less than 16 years were asked for verbal consent. Patients aged 16 years and above were given an information sheet and asked for written consent. Toothbrushing was not restricted.

From an initial sample of 84 fit and healthy children and adolescents, 49 were included in the study of which 42 were in the deband group and a further seven underwent gold chain adjustment. The reasons for exclusion from the initial sample were poor venous access (n = 7), refusal to participate (n = 27), and withdrawal of consent (n = 1). Twenty-five subjects were males and 24 females with a mean age of 15.4 years [standard deviation (SD) 1.5 years].

Methods
The same clinical and laboratory techniques were used as reported previously (Lucas et al., 2002a).

Outcome measures
These were as follows:
1. The prevalence of bacteraemia recorded as the number of positive blood cultures and expressed as the percentage prevalence.
2. The intensity of bacteraemia, recorded as the number of cfus/ml of blood.
3. The identity of the bacteria.

Statistical analysis
All data were tested for normality using the Shapiro–Wilk test (Altman, 1991). Categorical data were subjected to cross-tabulation. The McNemar test was used to detect any difference in the proportion of positive blood cultures between baseline and debanding. The Wilcoxon matched pairs test was used to compare continuous variables.

Results

Bacterial dental plaque and gingival inflammation
The mean plaque score was 6.3 (SD 4.6) and the mean gingivitis score 4.6 (SD 3.8; Table 1).

Prevalence of bacteraemia following debanding
There was no significant difference between the proportion of positive cultures at baseline, 19 per cent and post-deband, 26 per cent There was no significant association between the mean plaque and gingivitis score and the number of positive blood cultures following deband (Table 2).

Intensity of bacteraemia following debanding
There was no significant difference in the aerobic, the anaerobic, or the sum of the combined aerobic and anaerobic intensity of bacteraemia (cfus/ml of blood) between baseline and 30 seconds after debanding (Tables 3–5).

Prevalence of bacteraemia following gold chain adjustment
There was no significant difference in the prevalence of bacteraemia between baseline and following adjustment of a gold chain (both 57 per cent; Table 2).

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Bacterial dental plaque and gingivitis scores.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plaque score</td>
<td>Gingivitis score</td>
</tr>
<tr>
<td>n</td>
<td>Mean</td>
</tr>
<tr>
<td>49</td>
<td>6.3</td>
</tr>
</tbody>
</table>

n, number of subjects.

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Prevalence of bacteraemia: number of positive blood cultures.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group</td>
<td>n</td>
</tr>
<tr>
<td>Deband</td>
<td>42</td>
</tr>
<tr>
<td>Gold chain adjustment</td>
<td>7</td>
</tr>
</tbody>
</table>

n, number of subjects; ns, not statistically significant.

<table>
<thead>
<tr>
<th>Table 3</th>
<th>Intensity of bacteraemia as colony-forming units per millilitre of blood: aerobic.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group</td>
<td>n</td>
</tr>
<tr>
<td>Deband</td>
<td>42</td>
</tr>
<tr>
<td>Baseline</td>
<td>0.02</td>
</tr>
<tr>
<td>Post-procedure</td>
<td>0.07</td>
</tr>
<tr>
<td>Gold chain adjustment</td>
<td>7</td>
</tr>
<tr>
<td>Baseline</td>
<td>0.17</td>
</tr>
<tr>
<td>Post-procedure</td>
<td>0.40</td>
</tr>
</tbody>
</table>

n, number of subjects; ns, not statistically significant.

<table>
<thead>
<tr>
<th>Table 4</th>
<th>Intensity of bacteraemia as colony-forming units per millilitre of blood: anaerobic.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group</td>
<td>n</td>
</tr>
<tr>
<td>Deband</td>
<td>42</td>
</tr>
<tr>
<td>Baseline</td>
<td>0.03</td>
</tr>
<tr>
<td>Post-procedure</td>
<td>0.03</td>
</tr>
<tr>
<td>Gold chain adjustment</td>
<td>7</td>
</tr>
<tr>
<td>Baseline</td>
<td>0.05</td>
</tr>
<tr>
<td>Post-procedure</td>
<td>0.02</td>
</tr>
</tbody>
</table>

n, number of subjects; ns, not statistically significant.
Species Baseline Post-procedure
Stomatococcus mucilaginosus 0.21 0.23 0 0
Aerococcus viridans 0.43 0.78 0 0
Streptococcus 0.1 0.2 0 0
negative staphylococci, separators and alginate impressions. These were coagulase-
adjustment were similar to those following placement of
The bacteria isolated following debanding and gold chain
gold chain adjustment (Tables 3 – 5).

Intensity of bacteraemia
There was no significant difference in the aerobic, the
anaerobic, or the sum of the combined aerobic and anaerobic
intensity of bacteraemia between baseline and following
gold chain adjustment (Tables 3–5).

Identity of bacteria isolated
The bacteria isolated following debanding and gold chain
adjustment were similar to those following placement of
separators and alginate impressions. These were coagulase-
negative staphylococci, Micrococcus spp., Aerococcus spp.,
and Stomatococcus mucilaginosus. Bacteria isolated from
the baseline blood samples included Streptococcus spp.,
Corynebacterium spp., coagulase-negative staphylococci,
and Micrococcus spp. (Table 6).

Discussion
The purpose of this research was to investigate the
prevalence, intensity, and identity of bacteraemia following
upper debanding and gold chain adjustment. The baseline
prevalence of bacteria in the deband group (21 per cent)
was of a similar magnitude to that of adolescents undergoing
alginate impressions (23 per cent), placement of separators
(27 per cent; Lucas et al., 2002b), and also following
extractions at timed intervals (14 to 32 per cent; Roberts
et al., 2006). Both the baseline and the post-deband
prevalence were greater than those reported by other
workers (Erverdi et al., 2000, 2001). This is because of
the increased sensitivity of lysis filtration at low concentrations
of bacteria compared with the pour plate or broth culture
technique (Heimdahl et al., 1990; Lucas et al., 2002b).

Recent work has demonstrated that the maximum bacteraemia
following extraction of teeth is between 30 and 60
seconds following the most vigorous dentogingival
manipulation (Roberts et al., 2006). After 60 seconds, the
prevalence of bacteraemia decreases, thus it is important to
ensure that post-operative blood is withdrawn between 30
and 60 seconds post-procedure. In the present investigation,
all the second blood samples were taken 30 seconds post-
procedure to be consistent with earlier work (Lucas et al.,
2002b). Other workers have completed the deband and
blood sampling within 2 minutes (Erverdi et al., 2000,
2001) which is not only not sufficiently accurate but not
comparable with the work reported here.

In addition, subjects for debanding have been recruited
with either ‘acceptable’ oral hygiene (Erverdi et al., 2000)
or following use of chlorhexidine mouthrinse immediately
before debanding (Erverdi et al., 2001). This does not give
a true reflection of the prevalence and nature of bacteraemia
following deband since the placement of full orthodontic
bands increases the mean population of oral bacteria (Bloom
and Brown, 1964).

Although there was no significant difference in the
prevalence and intensity of bacteraemia between baseline
and adjustment of a gold chain, this should be treated with
caution because of the small sample size. A sample size of
934 would be necessary to demonstrate a significant
difference, but this is clearly impractical.

The range of bacteria isolated was similar to that found
after orthodontic procedures (Erverdi et al., 2000; Lucas
et al., 2002b) with a high prevalence of coagulase-negative
Staphylococcus and Micrococcus spp. Streptococcus spp.
have been the most frequently implicated oral micro-
organism in the development of IE (Young, 1987; van der
Meer et al., 1991; Felder et al., 1992; Li and Somerville,
1998). More recently, infection with Staphylococcus spp.,
particularly, S. aureus has increased, causing almost 50 per
cent of cases of IE (Watanakunakorn and Burkert, 1993;
Siddiq et al., 1996; Mylonakis and Calderwood, 2001; Cabell
et al., 2002). In the current investigation, several species of
coagulase-negative staphylococci, including S. hominis,
S. capitis, and S. epidermidis were isolated following
debanding, all of which have been implicated in both
native and prosthetic valve endocarditis (Chu et al., 2004).
Staphylococcus spp. are transient oral colonizers in healthy individuals (Tanner et al., 1994). Between 94 and 100 per cent of healthy adults (Percival et al., 1991) and 84 per cent of healthy children (Miyake et al., 1991) have Staphylococcus spp. in the mouth. In individuals with periodontal disease and in healthy controls, subgingival Staphylococcus spp. has been isolated, predominantly S. epidermidis, S. capitis, S. hominis, and S. warneri (Murdoch et al., 2004). Staphylococcus spp. has also been isolated from the oral mucosa and fit surface in complete denture wearers (Monsenengo, 2000) and the saliva of partial denture wearers (Marsh et al., 1992). The presence of a prosthesis or an orthodontic appliance encourages an increased prevalence of Staphylococcus spp. Hence, the greater prevalence of oral Staphylococcus spp. compared with Streptococcus spp. in this group of adolescents undergoing orthodontic treatment.

Micrococcus spp. have generally been associated with both central venous line infection (Oudiz et al., 2004) and IE namely M. luteus (Seifert et al., 1995; Uso et al., 2003). M. luteus was the most frequently isolated Micrococcus spp. in this investigation and has also been isolated from the gingivae of adults with periodontitis (Anesti et al., 2005).

Conclusions
The findings of this research demonstrate that there is no difference in the prevalence or intensity of bacteraemia between baseline and following debanding of the upper arch or gold chain adjustment. Clearly, the gold chain adjustment group was small and no definitive conclusions can be drawn. It will be interesting to see how these results relate to the new recommendations for the antibiotic prophylaxis of IE which have been recently published by the British Society for Antimicrobial Chemotherapy (Gould et al., 2006).

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