

## The Value of Optimizing Dentition Before Cardiac Surgery

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**A** PATIENT'S TEETH and intraoral tissues are not an anesthesiologist's primary concern before a cardiothoracic procedure. However, the potentially deleterious effects of an untreated oral infection can have wide-reaching implications.<sup>1,2</sup> Recognizing this hazard preoperatively is paramount in order to maximize the overall benefit of the procedure.<sup>3-5</sup> This review elaborates on the association between oral health and cardiovascular disease (CVD) by presenting the rationale for optimizing dentition before cardiac surgery, and reviews the understated role that an anesthesiologist may play in this scenario.

The patient's airway has long been the principal focus for the anesthesiologist. Appropriately, an evaluation of the various predictors of a potentially difficult endotracheal intubation occurs during the preoperative patient assessment. This assessment usually includes a very cursory examination of the patient's dentition or lack thereof. Such an examination is often directed toward the presence of any loose or chipped teeth, any fixed or removable prosthetic dental appliances, and the measurement of the width in finger breadths with respect to a patient's maximal interincisal distance. Determining the susceptibility of any loose teeth and taking appropriate precautions to avoid dental damage in the perioperative period are necessary, yet are not necessarily enough. Preoperatively, the anesthesiologist's attention should extend beyond noting which teeth are vulnerable to a traumatic intubation and include a more thorough evaluation of the overall condition of the patient's dentition.

### ORAL HEALTH AND SYSTEMIC DISEASES

Dental diseases are the most common infectious diseases in the world.<sup>6</sup> The relationship between a patient's dentition and overall systemic health has increasingly gained both scientific and media attention. In May 2000, the United States Surgeon General published the first-ever report on oral health in America.<sup>7</sup> It highlighted the association between oral and systemic health. The report stated, "The mouth reflects general health and well-being. The mouth is a readily accessible and visible part of the body and provides health care providers and individuals with a window on their general health status."

The link between oral bacteria and undesirable systemic effects has been the focus of researchers for many years.<sup>8,9</sup> For example, although infective endocarditis is a rare condition in the general population it continues to be a serious complication, mainly in patients who possess susceptible cardiac conditions. Endocarditis usually develops in individuals with underlying structural cardiac defects who develop a bacteremia.<sup>10</sup> Blood-

borne bacteria may lodge on damaged or abnormal heart valves, the endocardium, or the endothelium near anatomic defects, resulting in this specific type of inflammation.

### Antibiotic Coverage

In the dental office, a patient presenting with a known cardiac condition (eg, mitral valve prolapse with regurgitation) for a dental procedure likely to cause bleeding (eg, periodontal treatment, extractions) is routinely treated with preoperative antibiotics based on current guidelines.<sup>11</sup> However, in the operating room, before a cardiac procedure, a patient with known (or perhaps unknown) dental or periodontal disease may not receive preoperative antibiotics that could minimize the impact of the existing dental disease on the success of the cardiac intervention. According to the American Heart Association, endocarditis associated with cardiac surgery is most often caused by *Staphylococcus aureus*, coagulase-negative staphylococci, or diphtheroids. Antibiotic prophylaxis at the time of cardiac surgery should be directed primarily against staphylococci and be of short duration. First-generation cephalosporins are most often used, but antibiotic selection should be influenced by the susceptibility patterns at each hospital. Prophylaxis with the appropriate antibiotic should be started immediately before the operative procedure, repeated during prolonged procedures to maintain levels intraoperatively, and continued for no more than 24 hours postoperatively to reduce the emergence of resistant bacteria.

### ORAL HEALTH AND CVD

A number of epidemiologic studies have examined the relationship between oral health and CVD.<sup>12,13</sup> Current information regarding the pathogenesis and treatment of CVD suggests that oral health can be an important factor in the exacerbation of preexisting coronary artery disease.<sup>14,15</sup> Oral microbes congre-

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gate as dental plaque, coating the surfaces of the teeth. Dental plaque provides a microhabitat for organisms that can translocate and colonize in other parts of the body, damaging vital organs.

Chronic infections such as periodontal disease may play a role in the initiation and development of CVD. Periodontitis is a local inflammatory process involving a bacterial infection of the supporting structures of the teeth. This disease process is also characterized by systemic inflammatory host responses that may contribute to the reported elevated risk of CVD among patients with periodontal disease.<sup>16</sup> Several periodontal organisms including *Porphyromonas gingivalis*, *Treponema denticola*, *Streptococcus sanguinis*, and *Actinobacillus actinomycetemcomitans* have been detected directly within the atherosclerotic plaque lesion of the vessel wall.<sup>17</sup> Optimizing a patient's dentition and periodontal health has been shown to lower the risk of cardiovascular disease.<sup>18</sup> Also, optimizing a person's oral health is usually dependent on the individual receiving regular professional dental care.<sup>19</sup>

#### Oral Disease and Cardiac Surgery

For many patients, however, obtaining routine intraoral care may be limited by several barriers. Financial constraints, inaccessibility to dental professionals, a lack of patient education, and dental phobia may all contribute to irregularly scheduled or even no visits to the dentist.<sup>20</sup> As a result, such patients may experience a greater incidence of poor oral hygiene, tooth decay, periodontal disease, and oral infections. Moreover, if a patient presents for a major cardiac procedure and has not had a dental examination for many years (possibly decades), the potential for an undetected oral infection is magnified even further. Thus, patients who have not received appropriate preoperative dental treatment are set up for a potentially adverse outcome to their cardiac procedure, even before it commences.

Patients scheduled for cardiac surgery who unknowingly have an intraoral infection may also lack proper education regarding its potential impact on the procedure. Studies have been conducted to assess patients' awareness of the association between oral health and heart disease. Lowry et al<sup>21</sup> designed a qualitative focus-group-based study on patients 3 months post-cardiac surgery. They discovered that patients did not accept the link between their oral health status and their general health. Additionally, the patients revealed that oral health was not included on the agenda of the surgical team and suggested that the surgeon defined what was important to the patient and what was not. The inclusion of the oral health professionals in the presurgical stage has the potential to enhance the importance of oral health in overall systemic health, especially if their role is endorsed by the surgeon.

#### Congenital Heart Disease and Oral Health

Not only do patients show a lack of awareness of the link between oral health and cardiac disease, but parents of pediatric cardiac patients are not being properly educated regarding this association. Balmer and Bu'Lock<sup>22</sup> administered questionnaires to the families of 38 pediatric cardiology patients and conducted brief dental examinations. They found that only 64% of parents were aware of the link between the oral health of

their children and infective endocarditis. Despite being vulnerable congenital heart disease patients, few children with or without known dental disease received basic education regarding oral health. Moreover, Da Silva et al<sup>23</sup> conducted structured interviews with guardians, and oral examinations were performed on 104 children. The authors determined that only 10 of the guardians were aware of the term "heart infection." The guardians displayed unsatisfactory knowledge with respect to the importance of maintenance of good oral health for the prevention of infective endocarditis.

In addition to the poor education of patients regarding this link, the incidence of dental caries in children undergoing such critical procedures is significant. Hayes et al<sup>24</sup> conducted dental screenings on 209 pediatric patients 6 months and older who were scheduled for cardiac surgery. Dental disease was diagnosed in 175 (84%) of the 209 patients: 164 (78%) gingivitis, 60 (29%) caries, 6 (7%) dental abscess, 3 (1%) periodontal abscess, and 5 (2%) pericoronitis. Twenty-four (12%) cardiac surgeries were postponed. The authors concluded that all cardiac surgical patients should have a dental screening before cardiac surgery.

#### PREOPERATIVE DENTAL EXAMINATION

Currently, a dental screening is not a universal occurrence within hospital cardiac services. There are several potential reasons for this omission. First, patient education regarding this association may be lacking.<sup>25</sup> Second, surgeons may overlook the importance of eradicating this potential source of infection before cardiac surgery and therefore do not impress it on their patients preoperatively. Third, patients may not have adequate insurance coverage to address their required dental treatment.<sup>26</sup> As a result, too many patients are now entering the operating room harboring a potentially dangerous intraoral infection that could have been detected with a thorough preoperative dental examination.

A preoperative dental examination<sup>27</sup> may include palpation of extraoral tissues (eg, in the submandibular region) in order to detect any abnormal swelling. Intraoral tissues such as the palate, tongue, floor of mouth, and buccal mucosa are also examined for any lesions or evidence of infection. Exploration of the patient's individual teeth and each existing dental restoration (eg, silver amalgams, composite resins, crowns, and bridges) for new or recurrent decay is also performed. An overall assessment of oral hygiene may also include probing of periodontal pocket depths. The space between a tooth and the surrounding gums (eg, gingiva) widens and deepens as periodontal disease progresses. Pocket depths  $\geq 4$  mm and/or bleeding upon probing are usually indicative of periodontal disease. A series of intraoral radiographs is taken to supplement the clinical examination and may show evidence of tooth decay or an infection occurring at surrounding structures. Bone levels visualized on such films can further support evidence of mild, moderate, or severe periodontal disease. Thus, the palpation and inspection of intraoral tissues, teeth, and their surrounding structures during a clinical examination combined with radiographic evidence provide a thorough assessment of a patient's intraoral health.

Including a dental examination in the preoperative phase before a major operation has been used effectively. Many



**Fig 1. Adult periodontitis.** (Color version of figure is available online.)

patients awaiting transplants for failing organs such as the heart, liver, and kidney possess concomitantly poor dentition and oral hygiene. Patients awaiting a liver transplant, for example, may be on such a list because of alcohol-related cirrhosis of the liver. Such systemic damage is often accompanied by intraoral neglect, which manifests as excessive tooth decay and/or moderate-to-severe periodontal disease. Similarly, patients currently awaiting various cardiac procedures may also possess an oral health condition that is suboptimal and a potential hazard to the surgery's success.

At some medical centers,<sup>28</sup> before a cardiac transplant or another transplantation procedure, it is mandatory for a patient to undergo a complete physical examination by a series of specialists in order to rule out any potential source of infection. Included in this systemic checklist is the requirement of a thorough evaluation by a dentist. A clinical examination, intraoral radiographs, and any other indicated treatment are essential before the patient is "cleared" for surgery from an oral health standpoint. This protocol has yet to become a standard practice used by cardiac teams throughout the country. Although this action is currently often overlooked by the patient, primary physician, and cardiac team, it is the opinion of the authors that its routine implementation should be strongly considered.

Currently, physicians such as internists and cardiologists do not provide routine thorough dental examinations for their patients. However, steps are being taken at medical schools to augment the oral health component within the medical curriculum. Areas of focus include dental caries, periodontal disease, oral cancer, and oral-systemic interactions.<sup>29</sup> In the future, with the surgeon's acceptance of the link between oral health and cardiac disease, the dentist may eventually become a more regularly involved member in the presurgical phase.

#### MANAGEMENT OF PREOPERATIVE ORAL DISEASE

When poor dentition has been identified before cardiac surgery, the benefit of treating the condition before the planned surgery must be evaluated with a proper perspective. Often, a patient presents with a chronic condition such as moderate periodontitis that has been asymptomatic for many years (Fig

1). Multiple teeth may be loose, yet there are no signs of an acute infection and the patient reports no signs of pain or distress. Treatment of this undesirable condition would be ideal, but it is not often practical given the immediacy of a major cardiac procedure. In this situation, the greater perioperative concern may be the potential for an inadvertent swallowing or aspiration of a tooth during intubation or extubation. Comprehensive treatment of such a longstanding periodontal condition usually requires multiple and meticulous dental sessions whose duration may span several months. Such a diseased state is not cured overnight. Therefore, the benefit of properly treating such a chronic condition at the expense of delaying the cardiac procedure, which most likely poses a more urgent and ominous threat to the patient, is usually not practical. In fact, the consequences of postponing a case may include the depressing effect of cancellation on patients and their families because of the high levels of emotional stress and anxiety that are associated with surgery,<sup>30,31</sup> working days lost, and disruption of daily life. There is also the potential for revenue losses incurred by the hospital.<sup>32,33</sup>

However, it is the acute, symptomatic infection, one that presents as an abscess for example (Fig 2), that should be more aggressively treated before the operation. If the tooth is deemed to be nonrestorable, its removal (ie, extraction) may be indicated. Ideally, this procedure should be scheduled at a minimum of 1 week before the operation to ensure proper healing and resolution of the disease process. If endodontic (root canal) therapy is the treatment of choice, an asymptomatic period of 1 month may be beneficial to minimize the potential for recurrence of the infection and adverse effects on the cardiac procedure.

Cardiac surgery already consumes more healthcare resources than any other single therapy<sup>34</sup>; it is estimated to cost \$27 billion annually in the United States.<sup>35</sup> Infection in the setting of a cardiac operation increases morbidity, mortality, and cost.<sup>36,37</sup> Patients undergoing cardiac surgery appear to be at an increased risk for the development of infections, particularly nosocomial, because of the prevalence of multiple surgical wounds, frequent postoperative utilization of invasive



**Fig 2. Dental abscess.** (Color version of figure is available online.)



devices (eg, intra-aortic balloon counterpulsation and pulmonary artery catheter), and the customary use of prophylactic or empiric antibiotics in the perioperative period.<sup>38</sup> If not treated preoperatively, any source of infection, known or not, dental or not, can compromise the outcome of the surgery. Postoperative infections may increase the morbidity rate, delay wound healing, and extend hospital stays beyond the expectations of the patient and the surgeon.<sup>39</sup> In addition to the prolonged duration of recovery, the unfortunate development of a postoperative infection ultimately culminates in higher costs for those involved.<sup>40</sup> Thus, the value of a thorough dental examination and/or the detection of an oral infection before an elective cardiac procedure cannot be underestimated.

It is encouraged that anesthesiologists and certified registered nurse anesthetists (CRNAs) view oral health in the perspective of systemic health. Because an association exists between poor oral hygiene and various systemic diseases, many patients scheduled for cardiac procedures inherently possess poor oral hygiene and untreated odontogenic infections. A patient who is unaware of the presence of an intraoral infection, and/or is uneducated with respect to its significance on his/her upcoming surgery, is even more susceptible to a poor outcome.

So what is the role of an anesthesiologist or nurse anesthetist who may meet the patient for the first time less than 24 hours before the procedure? Like so many other checks in the system, a member of the anesthesia care team may be the final clinical gatekeeper in a long line of caregivers whose objective is to optimize the patient before cardiac surgery. Because a patient presenting to the operating room for a major cardiac procedure with concomitantly poor oral hygiene is fairly common, it may be the anesthesiologist who is the first caregiver to look inside a patient's mouth in years. And it may be the anesthesiologist or CRNA, during a routine preoperative evaluation, who discovers an oral infection that could lead to multiple adverse sequelae postoperatively.

Therefore, for the anesthesia care provider, included in the preoperative airway assessment should be a more thorough



**Fig 3. Dental examination.** (Color version of figure is available online.)

dental examination (Fig 3). Obviously, a detailed inspection of each tooth, all intraoral tissues, and taking dental radiographs by this caregiver are not realistic. However, he/she should be looking for any notable intraoral redness, swelling, purulent discharge, or fistulas that may be signs of an infection. If a suspicious area is visualized, a consultation with a dentist should be considered before proceeding with the surgical procedure. It may also be suggested that the surgery not proceed until a detected dental abscess is thoroughly addressed preoperatively. Initially, this preemptive action may postpone the surgery. In the long run, however, a thorough preoperative dental examination and indicated treatment may save invaluable time and money. Most importantly, this small investment by the anesthesiologist in the preoperative evaluation may yield significant improvements in surgical outcome and overall patient health.

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