

## Relationship of dentistry to cardiology

*George E. Burch, M.D.*

*Nicholas P. DePasquale, M.D.*

*New Orleans, La.*

Although physicians are aware of the importance of good dental care and oral hygiene for maintaining health, there is a tendency to leave the problem of seeking and obtaining dental advice and care to the patient. However, there are many reasons why physicians and, in particular, cardiologists should be more active in advising patients to maintain excellent oral hygiene and dental health and in urging those with poor dental hygiene to obtain satisfactory dental care. The lack of interest of cardiologists in problems related to dentistry is evident when one considers the rarity of papers related to this subject in journals of cardiology and the lack of attention to the dental health of the patient in the teaching and practice of medicine.

The purpose of this presentation is to discuss the relationship and importance of dentistry to cardiology, as well as to demonstrate the need for early and constant care of the teeth not only in the patient with heart disease but in any patient with chronic disease. Although the concepts are presented from the point of view of the cardiologist, they apply to all physicians.

### **Dental pathology**

It is not within the scope of this paper to discuss dental pathology in detail;

however, for purposes of orientation, as well as to illustrate the extent of dental diseases, a partial classification of dental diseases is presented in Table I. By far, the conditions of greatest concern to the cardiologist are those which involve infection of the oral tissues, primarily dental caries and periodontal disease. The importance of these diseases is twofold. First, they may give rise to serious systemic disease, and, second, they take the patient with heart disease to the dentist's office. As indicated below, dental procedures in patients with serious cardiac disease may be associated with a certain degree of risk to cardiac health and to the life of the patient.

It is important to understand the mechanisms by which dental infections may progress to become a source of serious systemic disease.<sup>1</sup> The least complicated form of tooth infection is known as dental caries. In this condition the enamel is demineralized and the dentin is invaded by bacteria, which produces destruction of these tissues. Although a carious tooth may be painful, under ordinary conditions it does not present a threat to general health. However, after trauma to the face, infected fragments of a carious tooth may be aspirated into the lungs, which results in pulmonary abscess or pneumonia. Fur-

From the Department of Medicine, Tulane University School of Medicine, and the Charity Hospital of Louisiana, New Orleans, La.

Supported by grants from the United States Public Health Service.

Received for publication Oct. 17, 1963.

Address correspondence to Dr. Burch, Department of Medicine, Tulane University School of Medicine, 1430 Tulane Ave., New Orleans, La., 70112.

Table I

---

1.	Anomalies of dentition
	Anodontia vera
	Pseudo-anodontia
	Partial anodontia
	Retained and impacted teeth
	Pericoronal infection
	Supernumerary teeth
	Abnormalities of occlusion
2.	Developmental defects
	Hypoplastic defects
	Dystrophy of congenital syphilis (Hutchinson's teeth)
	Mottled teeth
3.	Functional changes
	Attrition
	Abrasion
	Erosion
4.	Traumatic disease
	Occlusal trauma
	Concussion and luxation
	Fracture
5.	Dental caries
	Acute caries
	Chronic caries
	Root caries
6.	Pulp infection
	Hyperemia of pulp
	Acute pulpitis
	Chronic pulpitis
7.	Dento-alveolar abscesses
	Suppurative periodontitis
	Chronic apical periodontitis
	Subperiosteal abscess
	Gingival abscess
8.	Periodontal disease
	Periodontal atrophy
	Atrophy of disease
	Traumatic atrophy
	Gingivitis
	Marginal gingivitis
	Hypertrophic gingivitis
	Marginal periodontitis
	Periodontosis

---

thermore, unless dental carious processes are interrupted by operative dentistry, the dental pulp will almost surely be invaded by pathogenic microorganisms. The resulting pulpitis is usually followed by periapical involvement through the egress of the products of infection by way of the apices of the root. As the infection progresses, this apical lesion becomes more severe and suppuration may occur, with the development of dento-alveolar abscess. As a result of involvement of the dental pulp (pulpitis) and the periapical tissues, bacteria are brought into proximity with

blood vessels and lymphatics and thereby have access to the systemic circulation to cause bacteremia, septicemia, and associated complications, such as subacute bacterial endocarditis. In addition, as the teeth function in mastication, they undergo a plunger-like action which serves to force bacteria into the circulation.

Dental caries is not the only process which may result in disease of the supporting structures of the teeth. The soft tissues and alveolar bone which support the teeth (periodontium) may become infected by agents which enter at the free margin of the gingivae. Local factors, such as dental calculus, food impaction, and traumatic occlusion, when left uncorrected, will contribute substantially to the destruction of the dental ligament. The overlying infection, which may be primary or secondary, can certainly further this degenerative process which eventually leads to the formation of deep pockets of infection around the teeth. If the infection and irritation remain untreated, suppuration and even periodontal abscess may develop. Underlying systemic disease, particularly diabetes mellitus, may markedly accelerate the degenerative process. The over-all result of this syndrome is that concentrations of pathogenic organisms are present in an area of degenerating tissue. During the trauma of dental procedures, mastication, or brushing of the teeth, bacteria may invade the blood stream from these infected areas in the periodontium.

#### **Dental aspects of specific cardiac diseases**

*Congenital heart disease.* Extraction of infected teeth may be followed by intense bacteremia.<sup>2-4</sup> The risk of development of subacute bacterial endocarditis after extraction is greater in patients with congenital heart disease than it is in patients with normal hearts, not only because of the cardiac defect itself but also, in some cases, because of changes in the periodontal structure associated with congenital heart disease.<sup>5</sup> Among the various types of congenital cardiac defects the potential for the development of subacute bacterial endocarditis is highest in ventricular septal defect and patent ductus arteriosus.

Bacterial endocarditis has also been

observed to follow simple dental manipulations, such as the filling or cleaning of teeth.<sup>6</sup> Most periodontal procedures have been shown to result in bacteremia, the degree of which is related to the intensity of the trauma.<sup>7</sup>

Subacute bacterial endocarditis may occur without extraction or therapeutic dental manipulation in patients with congenital heart disease who have periodontal infection and disease. Although it is difficult to establish that the infected teeth are a source of the bacteremia, it is known that *Streptococcus viridans* is a common cause of chronic pulpitis. Indeed, positive blood cultures have been reported after brushing of the teeth<sup>8</sup> or after the chewing of a resistant mass.<sup>9</sup>

Patients with cyanotic congenital heart disease frequently have changes in the periodontal tissues which predispose to poor oral hygiene and chronic periodontal infection.<sup>5</sup> The most characteristic changes in the periodontal tissues consist of dilatation of the gingival capillaries, which results in edema of the gums and decreased resistance to infection. The dilatation of the gingival capillaries is thought to be a result of increased salivary kallikrein. Frequent infections of the upper respiratory tract, loss of lip seal, and mouth breathing expose the periodontal tissues to bacterial attack. In the presence of lowered resistance of the periodontal tissue, even normal oral flora may establish infection.

In patients with coarctation of the aorta the mandibular arteries as well as the arteries leading to the individual teeth may be enlarged. Tooth extraction in such patients may result in excessive bleeding.

**Rheumatic heart disease.** Rheumatic valvulitis and scarring of the cardiac valves predispose these structures to infection with bacterial organisms, especially *Streptococcus viridans*. The same relationships between infected teeth and subacute bacterial endocarditis as noted above for patients with congenital heart disease apply to patients with rheumatic heart disease.

**Arteriosclerotic heart disease.** Dental care in patients with arteriosclerotic heart disease presents special problems. Such patients are in the older age groups and may

require extensive dental therapy. The pain, anxiety, and fear associated with dental procedures may be deleterious to patients with coronary sclerosis and ischemic heart disease. Tachycardia, angina pectoris, and even myocardial infarction may follow even mild emotional stimuli.<sup>10</sup> Therefore, good oral hygiene is important to patients with arteriosclerotic heart disease. Poor teeth or poorly fitted dentures may result in dietary inadequacies and vitamin deficiency, particularly in older patients. The inadequate dietary pattern may lead to depression and other psychological disturbances in old people. Infected teeth or periodontitis has been implicated in the development of suppurative arthritis, uveitis, iritis, neuritis, fibrositis, cholecystitis, thrombophlebitis, pyelonephritis, cavernous sinus thrombosis, and even in some cardiac arrhythmias. Thus, despite the potential hazards of dental therapy to patients with arteriosclerotic heart disease, in the interest of total care of the patient, such persons should be urged to seek and continue with adequate dental care.

Patients with arteriosclerotic heart disease who have had a previous myocardial infarct may be receiving anticoagulants. Although isolated instances of excessive bleeding after tooth extraction in patients receiving anticoagulants have been reported,<sup>11</sup> there seems to be little risk of bleeding after tooth extraction in patients whose prothrombin time is allowed to decrease to the lower limits of the recommended therapeutic range.<sup>12</sup> It is the responsibility of both the physician and the dentist to be certain that the prothrombin time is not excessively prolonged, and that the determination of prothrombin levels is obtained accurately. Furthermore, after extractions, the dentist or oral surgeon must take steps to encourage local clotting. Before recommending a reduction of the prothrombin time to normal in preparation for tooth extraction, the physician should consider the risks associated with interruption of prolonged anticoagulant therapy and the rebound phenomenon.<sup>13,14</sup>

Patients with arteriosclerotic heart disease may be receiving digitalis, quinidine, or procaine amide. Any of these drugs may lower the threshold of the vomiting reflex,

and care must be taken not to stimulate this reflex during dental manipulation.

Although local anesthesia is generally used when anesthesia is required, extensive dental procedures or control of difficult patients may necessitate the use of a general anesthetic agent. Because of their effect on myocardial function, the use of anesthetic agents, especially general anesthetic agents, in patients with serious cardiac disease involves a certain degree of risk.<sup>15</sup> It is not the purpose of this paper to discuss the merits of any one anesthetic agent in patients with cardiac disease. However, in order for the anesthetist to choose the most ideal anesthesia for a particular patient, he must be fully aware of the nature and extent of the patient's cardiac disease. Thus, there must be free communication between the dentist, oral surgeon, anesthetist, and cardiologist.

*Hypertensive cardiovascular disease.* Dental therapy in patients with hypertensive cardiovascular disease is relatively safe. However, as in patients with arteriosclerotic heart disease, fear, pain, and anxiety may result in detrimental cardiovascular reactions. In this regard, some forms of hypertension have a strong psychoneurogenic component.<sup>16</sup> It is not inconceivable that in some patients with hypertension the expectation of a visit to the dentist may act as a conditional stimulus which results in further elevation of the arterial blood pressure. This phenomenon is well known to physicians, as is the fact that in some patients the arterial blood pressure recorded in the physician's office may be considerably higher than blood pressures recorded in the patient's home.<sup>17</sup>

Despite elevated arterial blood pressure, hemorrhage due to tooth extraction is not a hazard in patients with hypertension. However, the possibility of an untoward cardiovascular reaction to the inadvertent intravascular injection of anesthetic agents which contain epinephrine must always be considered in patients with high blood pressure. Furthermore, nitrous-oxide anesthesia may result in an acute rise in arterial blood pressure. Many of the commonly used antihypertensive drugs potentiate the barbiturates used for preoperative or postoperative medication. Furthermore, hypotensive crisis may be pre-

cipitated during general anesthesia in patients taking rauwolfia preparations.

### **Role of the cardiologist in dental management**

As has been indicated briefly, dental procedures in patients with arteriosclerotic heart disease present a small but definite risk. On the other hand, poor dental health may result in secondary systemic disease which may be fatal in the presence of the cardiac disease. The situation is complicated by the fact that both dental and cardiac diseases increase with age. Much of the difficulty could be avoided by early institution of dental care in cardiac patients. The cardiologist must not assume that the patient is receiving adequate dental care. When the cardiologist sees a patient with early arteriosclerotic, hypertensive, or valvular heart disease, he recognizes the fact that, despite his best efforts, the disease will usually progress. He must also recognize that existent dental disease will also progress. Therefore, he should take steps immediately to make sure that the patient's oral hygiene and dental health are in the best possible state at all times. Necessary extractions, periodontal therapy, and replacement of lost tooth structures should be performed as soon as possible after the diagnosis of heart disease is established.

The cardiologist should not rely on his own examination of the teeth to determine whether dental care is indicated. Indeed, periapical infection may be present in the absence of objective or subjective signs of tooth infection. If dental problems are allowed to accumulate in patients with cardiac disease, eventually the dentist or oral surgeon will be faced with a patient who is in need of extensive dental care but who has poor cardiac reserve. Treatment of such poor-risk patients is rarely satisfactory. It is often necessary to make therapeutic compromises, and in some instances the treatment of choice may be no treatment at all. In addition, whatever procedures are performed are undertaken at increased risk.

The cardiologist should consider the fact that with the progression of cardiovascular disease the patient may become debilitated and bedridden, or a cerebrovascular acci-

dent may place him in a wheel chair. Under such circumstances it may be extremely difficult, if not practically impossible, to provide adequate dental care. Another reason for instituting early dental care in patients with cardiac disease is that at some time the patient may become obtunded or comatose secondary to myocardial infarction, cerebrovascular accident, or narcotics used in therapy. Foci of infection in the periodontal tissues may discharge purulent material which, in turn, may be aspirated into the lungs to produce pulmonary infections and decrease the chances of recovery from the primary disease.

The importance of early and complete dental care should be carefully explained to the patient. The patient should be adequately informed that the risk of dental procedures increases with time, whereas early therapy carries no risk. The patient should also be reminded of the fact that he is better prepared to finance dental care while he is working than after he has retired or has become too ill to work and his income has decreased. Furthermore, the total cost of dental care will most likely be greater if the teeth are neglected and the dental diseases allowed to become extensive.

If dental procedures do become necessary in patients with severe coronary arteriosclerosis and ischemic heart disease, certain precautions should be considered. It may be advisable to extract only one or two teeth at a time. However, the hazard of frequent dental manipulations of short duration should be weighed against the hazard of more prolonged manipulation with fewer visits. It must always be remembered that certain patients cannot tolerate prolonged dental therapy. The amount of dental manipulations which the patient with severe cardiac disease can safely tolerate should be decided by both the dentist and the physician in consultation. In patients with frequent episodes of angina pectoris, nitroglycerin should be placed under the tongue before pain develops. If a particularly difficult extraction is expected, mild sedation or a narcotic should be administered. As little epinephrine as necessary should be used in the local anesthesia. It has been

recommended that no more than 10 c.c. of 1:50,000 epinephrine be used at any one time in persons with cardiac disease.<sup>17</sup> (This volume is rarely approached in current dental practice.) At all times the patient should be reassured and handled gingerly and patiently, so as to allay fear and anxiety as much as possible. Dosages of cardiac drugs, such as digitalis, quinidine, and procaine amide, should be carefully regulated prior to dental therapy, in order to avoid the side effects of these drugs during dental procedures. In patients receiving anticoagulants, prothrombin time should be allowed to decrease to the lower limits of the therapeutic range.

Hypertensive patients taking rauwolfia preparations should not be given a general anesthetic agent. After rauwolfia therapy is discontinued, it is necessary to wait at least 2 weeks before general anesthesia can be considered to be safe.

In patients with congenital and rheumatic heart disease the cardiologist should again be certain that the patient has the best possible oral hygiene. If tooth extraction becomes necessary in patients with congenital or rheumatic heart disease, parenteral penicillin should be administered at the time of the extraction and for a few days thereafter. If the patient is sensitive to penicillin, erythromycin should be employed. Oral penicillin should be used only when the complete cooperation of the patient is fully assured. In patients with rheumatic heart disease receiving prophylactic penicillin therapy it is important to recognize the fact that the dosages of penicillin employed for prophylaxis against Group-A beta hemolytic streptococci are inadequate to prevent bacterial endocarditis. Therefore, even in patients receiving prophylactic penicillin therapy, additional penicillin should be administered in preparation for dental procedures, in order to insure high concentrations of penicillin in the blood.

The patient with congenital or rheumatic heart disease should be prepared for periodontal procedures and other procedures traumatic to the soft tissues in the same manner as for tooth extractions. Furthermore, the trauma associated with periodontal therapy should be kept to a minimum.

Physicians have always been interested in unusual oral manifestations of systemic disease. However, there has been a lack of interest in the ordinary problems of oral hygiene and continued dental care. Most physicians perform only the most cursory examination of the teeth, and medical schools provide no instruction to students concerning problems of oral hygiene and dental health. The prevalent attitude of leaving the problem of oral hygiene to the patient may be detrimental to the patient's health and may ultimately result in an increase in the risk and extent of dental procedures. The physician should obtain a dental consultation in the same manner and with the same exchange of information and thought as he does when he consults physicians in other specialties.

Rapid advances in both medical and dental therapy have made communication between physicians and dentists, in the form of joint conferences and the like, not only highly desirable but necessary. Because of the increased aging population of this country, dentists and oral surgeons will treat an increasing number of patients with cardiovascular disease. The cardiologist must be acquainted with the nature of the various dental procedures if he is to provide his patient with the best treatment and advice. It is the cardiologist who is best able to evaluate the reserve of the cardiac patient, and it is he who should advise the dentist of which procedures can be performed safely in a particular patient. Unless the cardiologist has some knowledge of the various dental procedures, he is in no position to evaluate the ability of the patient to tolerate dental therapy. On the other hand, the experiences of dentists and oral surgeons with cardiac patients should guide the cardiologist in determining whether a particular procedure is safe for his patient. Unfortunately, the cardiologist has little opportunity to learn of the experiences of dentists with cardiac patients. Joint conferences between dentists and physicians would help to provide the cardiologist with such information. Because of mutual problems, dentists may find it advisable to join the American Heart Association.

### Summary

Few people possess and maintain excellent oral hygiene at all times. Thus, it is to be expected that most patients with heart disease have unmet dental needs. In such patients, dental care should be obtained as early as possible. The patient should not be permitted to wait until the cardiac disease has become so serious that dental procedures which would have been innocuous earlier have become hazardous. The cardiologist should insist that the patient with heart disease maintain an excellent state of oral hygiene and dental health. The cardiologist knows the natural history of cardiac disease. He knows, for example, that a patient with coronary artery disease may develop a myocardial infarct at any time. If good dental care is obtained before the development of the myocardial infarct, continued maintenance of dental health should not be difficult. However, if dental problems are allowed to accumulate, restoration of dental health may be impossible. Most dental diseases are curable and should be attended to early when the cardiologist and dentist can elect the proper time and procedures rather than later when they are compelled to institute compromise therapy under adverse medical and dental circumstances and when the dental disease is irreversible.

### REFERENCES

1. Bernier, J. L.: *The management of oral disease*, St. Louis, 1955, The C. V. Mosby Co., p. 154.
2. Becart, A.: Endocarditis following tooth extraction in individuals with valvular disease, *La Clinique* **323**:187, 1939.
3. Reimann, H. A., and Havens, W. P.: Focal infection and systemic disease, *J.A.M.A.* **114**:1, 1940.
4. Middleton, W. S., and Burke, M.: Streptococcus viridans endocarditis lenta, *Am. J. M. Sc.* **198**:301, 1939.
5. Gould, M. S. E., and Picton, D. C. A.: The gingival condition of congenitally cyanotic individuals, *Brit. Dent. J.* **109**:96, 1960.
6. Harvey, P. W., and Capone, M. A.: Bacterial endocarditis related to cleaning and filling of teeth, *Am. J. Cardiol.* **7**:793, 1961.
7. Bender, I. B., Seltzer, S., Meloff, G., and Pressmann, R. S.: Conditions affecting sensitivity techniques for detection of dental bacteremia, *J. Dent. Res.* **40**:951, 1961.
8. Cobe, W.: Transient bacteremia, *J. Oral Surg.* **7**:609, 1954.

9. Murry, M., and Moosnick, F.: Incidence of bacteremia in patients with dental disease, *J. Lab. & Clin. Med.* **26**:801, 1961.
10. Burch, G., and Ray, T.: Cardiovascular system as the effector organ in psychosomatic phenomena, *J.A.M.A.* **136**:1011, 1948.
11. Ziffer, A. M., and others: Profound bleeding after dental extractions during Dicumarol therapy, *New England J. Med.* **256**:351, 1957.
12. Behrman, S. J., and Wright, I. S.: Dental surgery during continuous anticoagulant therapy, *J.A.M.A.* **175**:483, 1961.
13. Sise, H. S., Moschos, C. B., Gauthier, J., and Becker, R.: The risk of interrupting long-term anticoagulant treatment. A rebound hypercoagulable state following hemorrhage, *Circulation* **24**:1137, 1961.
14. Pollard, J. W., Hamilton, M. J., Christensen, N. A., and Achor, R. W. P.: Problems associated with long-term anticoagulant therapy, *Circulation* **25**:311, 1962.
15. Etsten, B., and Li, T. H.: Effects of anesthesia upon the heart, *Am. J. Cardiol.* **6**:706, 1960.
16. Burch, G. E., and DePasquale, N. P.: The value of home recordings of blood pressure in the management of patients with arterial hypertension, *Am. J. M. Sc.* **240**:273, 1960.
17. Chamberlin, F. C.: Management of medical-dental problems in patients with cardiovascular diseases, *Mod. Concepts Cardiovas. Dis.* **30**:697, 1961.