THE BACTERIOLOGY OF PERIDENTAL TISSUES RADIOGRAPHICALLY SUGGESTING INFECTION *

C. COLEMAN BERWICK

From the George William Hooper Foundation for Medical Research and the University of California Hospital, San Francisco, Calif.

The medical and dental literature for a number of years has been filled with reports and bacteriologic data concerning chronic alveolar infections. A critical review of the wealth of material reveals one oustanding feature, namely, that no single report is based on a uniform and reliable bacteriologic technic. This applies especially to the method of obtaining cultures. Moreover, the reports indicate a lack of standardized operative technic and some form of statement which would prove that carefully conceived series of controls have been carried out. It is not unlikely that the cultures obtained and described at some length in certain publications were merely contaminations from the oral flora.

For this reason I have undertaken to investigate the bacteriology of chronic alveolar infections as evidenced by shadow changes in the radiogram; to determine the relationship of the cultures obtained to the bacteria of the oral cavity; to ascertain, if possible, the relationship of chronic alveolar infections to systemic disease.

Method of Study.—In a previous article I [1] reported a method of sterilizing the oral mucosa which proved satisfactory not only from the laboratory point of view, but also from the clinical aspect. The cultures were made from tissues dissected from jaws showing definite radiographic changes. The material was obtained as follows: The teeth were first brushed with an alkaline tooth powder and then the mouth was rinsed with an alkaline lotion. The alkaline reaction of the tooth preparation intensifies the bacteriostatic action of the dye. The gums and mucous membrane of the buccal surfaces were painted with a solution containing 1% each of brilliant green and crystal violet, dissolved in 50% alcohol. Churchman has shown that it is possible to inhibit the growth of gram-positive cocci in dilution of gentian violet up to 1: 5,000,000 in alkaline solution. Hence, in every instance care was taken to avoid a transfer of dye into the culture medium with

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[1] Jour. Dental Research, 1920, 2, p. 21.

the swab. The solution was applied after packing the area off with sterile gauze or cotton rolls. The dye was allowed to penetrate the tissue two and one half minutes. The gum was then incised and a flap of gum and periostaeum laid back with a periosteal elevator. The buccal plate was then entered with a chisel and with a clean chisel or rongeur forceps a piece of tissue at least 4-5 mm. in diameter was removed aseptically. This was then placed in a culture tube containing 1% glucose-veal-broth and taken immediately to the laboratory. The tissue was macerated with sterile sand broth according to the method described by Rosenow. The tissue pulp was enriched in glucose-blood agar and in glucose-veal-broth P_H 7.4, to which were added 10% defibrinated blood. The tube in which the tissue was taken to the laboratory was also incubated as a control.

TABLE 1

GENERAL SUMMARY

Type of Local Lesion	Hemolytic Streptococci		Non-Hemolytic Streptococci	Staphylococcus, Pure	Streptococci With Staphylococcus	Other Organisms	Sterile	Total Number Cultivated	Age of Patients, Years
	Pure	Mixed							
Sclerosis.....	..	..	2	..	1	..	..	3	25-43
Necrosis.....	1	1	8	5	14	..	3	32	32-65
Granuloma....	..	1	8	2	4	..	..	15	18-71
Cyst.....	..	..	..	..	3	2 unclassified anaerobes	4	9	38-64
Pericementitis*	..	..	4	1	5	..	2	12	24-62
Total.....	1	2	22	8	27	2	9	71	

* I have used the term pericementitis to cover the terms alveolitis and periodontitis as used by McCormack.

Swabs were made from the surface of the gum after the application of the dye just before the surface was incised. They were washed out in glucose-blood-agar and the latter poured into plates. The washed swab was placed in glucose-veal-broth and incubated as usual. Invariably these control cultures were found to be sterile after 48 hours of incubation. Occasionally control cultures were also made of areas appearing normal in the radiogram.

The bacteria isolated by the method described in the foregoing were identified, and, as far as the streptococci were concerned, they were classified according to the method of Holman.[2] Later, with the appearance of Brown's monograph,[3] they were differentiated first by

[2] Jour. Med. Research, 1916, 24, p. 377.

[3] Monographs, Rockefeller Institute for Medical Research, 1919.

hemolysis and then with 1% mannite, lactose, salicin, raffinose, inulin and sucrose, in beef serum with Andrade's indicator.

Results.—The cultures were obtained from jaws which demonstrated radiographically certain distinct changes. These have been illustrated by McCormack,[4] and in this paper the tentative classification given by him has been followed. It should be said in this connection that the bacteriologic study was primarily undertaken to elucidate definitely the meaning of some of the radiographic changes demonstrated and discussed by McCormack. It is quite evident that the bacteriologic data failed on some occasions to confirm the original radiographic interpretation.

TABLE 2

CASES WITH SYSTEMIC DISTURBANCES

Case	Age	Disease	Number of Teeth Extracted	Postoperative Condition	Cultures Obtained
1	60	Atrophic arthritis	1	Not improved after 24 months	Hemolytic streptococcus
2	62	Neuritis	2	Improved after 25 months	Staph. albus Strep. salivarius
3	27	Hypertrophic arthritis	5	Very slightly improved after 22 months	Staph. albus Strep. nonhemolyticus I
4	60	Arthritis deformans	6	Not improved after 22 months	Staph. albus
5	33	Neuritis	10	Very slightly improved after 23 months	Streptococcus alpha 2.1 Streptococcus beta 8.5
6	40	Occipital headaches	11	Not improved after 24 months	Staph. albus Strep. salivarius
7	62	Atrophic arthritis	2	Not improved after 20 months	Staph. albus Streptococcus alpha 1.1 Streptococcus beta 2.1
8	45	"Run-down"	2	Improved after 23 months	Staph. albus Streptococcus alpha 4.5
9	32	Acute arthritis	7	Worse after 24 months	Staph. albus Streptococcus alpha 2.1
10	37	Hypertrophic arthritis	2	Not improved after 16 months	Staph. albus Streptococcus alpha 1.1

Table 1 shows the results of our bacteriologic study classified according to the radiographic and pathologic picture. In all there were 71 cultures taken. Of the total number of cultures obtained, we find only 3 hemolytic streptococci and of these 2 were found in large necrotic areas whereas 1 was isolated from a granuloma. At the same time we note that there are in all 22 pure cultures of nonhemolytic streptococci, and 8 pure cultures of staphylococci. A large number of our cultures showed that the infection was a mixed one and that often there were 2 or more different strains of streptococci in the material used for culture.

[4] Jour. Dental Research, 1920, 2, p. 467.

Two of the organisms we obtained from a large cyst were anaerobes and further classification of these bacteria was not possible. Originally the organisms were obligatory anaerobes but with replanting they became facultative anaerobes.

Nine specimens of tissue taken for culture remained sterile, 3 of these coming from necrotic areas, 4 from cysts and 2 from areas of pericementitis.

In addition to this group, 3 other specimens showing apparently normal bone regeneration following extraction were cultivated. All gave sterile cultures.

There were other cases besides those operated on for the removal of local changes, which deserve more detailed analysis (table 2).

TABLE 3

DATA CLASSIFIED ACCORDING TO THE TOOTH INVOLVED IN THE INFECTION

Tooth		Strepto-coccus	Staphylo-coccus	Mixed Infection	Sterile	Total
Bicuspid	Upper	6	4	8	3	21
	Lower	2	2	2	1	7
First molar	Upper	4	..	4	1	9
	Lower	6	..	2	..	8
Second molar	Upper	..	..	4	2	6
	Lower	1	1	..	..	2
Cuspid	Upper	1	1	1	1	4
	Lower	..	..	..	..	0
Incisor	Upper	..	1	1	..	2
	Lower	..	..	..	..	0
Third molar	Upper	1	..	..	..	1
	Lower	..	..	1	1	2

The cases shown in table 2 are those that had been thoroughly examined by competent physicians, and primary causes as well as sources of infection other than dental were eliminated. After removal of the dental infection, a sufficient period of time was given in each case for the symptoms to improve or the changes to decrease. The shortest period of time allotted was 16 months and the longest 25 months.

Only two patients improved definitely, whereas two improved slightly, one was made worse and the rest were unaffected. An examination of the cultures from these cases showed that there were three hemolytic streptococci, one in pure culture and two mixed with other organisms; one pure culture of staphylococcus was obtained in a particularly bad case of arthritis deformans which was not improved; the predominating type of organism here also is the nonhemolytic streptococcus.

Table 3 shows that the upper bicuspid area gave over 33% of the cultures and that the upper and lower bicuspid areas together gave 45% of the total.

The reason for this predominance of bicuspid involvement is perhaps evident when one considers the great variation in the position, size and shape of the pulp chamber and the pulp caval of the bicuspids, especially the superior. Hopewell-Smith [5] and Marshall [6] give the variation from the normal at about 50% in regard to the upper bicuspid, whereas the variation from the normal of the other teeth is much less.

There appears to be no existing relationship between the type of infecting organism and the tooth concerned.

COMMENTS

This investigation shows that 9 cases of 71 gave sterile cultures. Three of these were from large necrotic areas, four from cysts of the jaw, and two from alveoli which showed definite thickening in the radiogram and in the pathologic examination. This definitely proves that cultures can be taken in the buccal cavity uncontaminated by the oral flora. It also shows that all changes in the jaw as evidenced by radiographic findings are not infected. Thoma [7] "believes that all teeth which give roentgen evidence of bone involvement are infected." Our evidence certainly does not bear out this statement. For over 10% of our cases proved sterile although there certainly was radiographic evidence of apparent boney change about the teeth in question.

The examination of the cultures we obtained shows that they correspond to a great extent to the cultures of organisms of the buccal flora (Meyer [8]). Arnold [9] also finds that the "hemolytic and nonhemolytic streptococci found in normal and pathological throats were of the same varieties, when classified according to Holman's sugar fermentation tests."

Under ordinary conditions these may be innocuous, but, due either to a temporary increase in virulence of the organism or to a local lowering of resistance, the bacteria may have gained a foothold on the tissue and there produced their local effects. The lesions produced by these organisms, when situated deep in the jaw, appear to clear up spontaneously in a few cases only, but appear to remain locally until removed by the dentist.

[5] American Textbook of Operative Dentistry, 1920, p. 83.
[6] Operative Dentistry, 1921, p. 14.
[7] Boston Med. and Surg. Jour., 1921, 184, p. 434.
[8] Jour. Nat. Dental Society, 1917, 4, p. 966.
[9] Jour. Lab. and Clin. Med., 1921, 6, p. 312.

That the majority of the organisms situated here are capable of producing pathologic processes elsewhere in the body appears from our data at least to be improbable. However, further investigation is being carried out to ascertain this point.

The cases showing hemolytic streptococci are three in number, one in pure culture and two in mixed growths. The virulence of hemolytic strains of streptococci have long been said by a few to be greater than the majority of the other types of this organism. In examining table 2, which contains the group of cases showing the so-called systemic disturbances, we find that the predominating type of streptococcus is the nonhemolytic, and in 80% of these cases, it was found in mixed culture, either with another type of streptococcus or with staphylococci. In one of these cases a pure culture of staphylococcus was obtained. It is true, however, that all of the hemolytic cocci we obtained were found in this group of cultures. It is not unlikely that a larger series of cultures may show different results.

The eradication of these local dental infections, if they are related to processes elsewhere in the body, should produce some indication of reparatory change in the latter, provided, of course, that sufficient time be given and the damage done is not irreparable. Of the three cases furnishing hemolytic streptococci in their dental tissues, only one showed a slight improvement in the general condition.

These facts may possibly be explained as follows: The patients had other foci from which bacteria may have originated and which act as a source from which reinfection may take place. There are permanent changes in the body and even with the removal of the cause, the damage already done cannot be repaired. The dental focus may have no relation to the systemic disorders since time enough was allowed in each of the instances cited to allow the condition to improve following the removal of the infection by radical measures. However, careful physical examinations were made in each of the cases in table 2. Special care was exercised to search for foci of infection other than dental and to rule out any other pathologic condition likely to produce the condition under observation. In each of these instances the only definitely demonstrable anatomic changes which remained were in the mandible or maxilla.

It must be remembered that extensive hypertrophic changes in the osseous system cannot be greatly affected by the removal of the cause. The progress of the infection may be altered to some extent but without effect on the existing process.

From our series it appears that there is no definite relationship between dental infections and the symptoms complained of by the patient. The histories are not as complete as one desires and a larger series of cases is therefore being investigated along this particular line.

CONCLUSION

In a series of 71 cultures no type of organism was found to be characteristic for any radiographic change which had taken place in the maxilla or mandible. Contrary to expectation, it was noted that 10% of the cases were sterile. It is not possible to ascertain from the radiogram the existence of an infection in any case. The bacteria isolated from areas showing radiographic change correspond to a great extent to those found in the oral cavity. It is not possible to state from the results that there is any definite relationship existing between dental infection and systemic disorder in more than a small percentage of suspected cases.