

THE
AMERICAN JOURNAL
OF THE MEDICAL SCIENCES

SEPTEMBER, 1912

ORIGINAL ARTICLES

**A STUDY OF THE ENDOCARDIAL LESIONS OF SUBACUTE
BACTERIAL ENDOCARDITIS, WITH PARTICULAR
REFERENCE TO HEALING OR HEALED
LESIONS; WITH CLINICAL NOTES.**

By E. LIBMAN, M.D.,

PROFESSOR OF CLINICAL MEDICINE, COLUMBIA UNIVERSITY, NEW YORK; ASSOCIATE ATTENDING
PHYSICIAN AND ASSOCIATE PATHOLOGIST, MOUNT SINAI HOSPITAL, NEW YORK.

DURING the last ten years I have been enabled to study an unusually large number of cases of subacute bacterial endocarditis. Particularly in the last few years I have become impressed with the great frequency of the condition (in 1911 I saw 27 cases). Altogether I have had the opportunity of studying at least 89 cases. Blood cultures were made in 75 of 78 active cases—by this I mean cases in what I call the bacterial stage. The other 3 cases were typical clinically; 1 passed out of observation and the other 2 died, autopsies not being obtainable.

Organisms were recovered from the blood of 73 of the 75 cultured cases. In 71 cases the cocci characteristic of the disease were obtained,¹ and in 4 the influenza bacillus. The symptoms and lesions found in the latter group were practically the same as those found in the former, except that thus far the glomerular lesions in the coccus cases have not been discovered in the kidneys of the influenzal cases that have come to postmortem examination.

I shall not now discuss the proper classification of the cocci found in this disease, leaving that for another publication. I shall

¹ Libman and Celler, *AMER. JOUR. MED. SCI.*, 1910, cxl, 516, and *Trans. Assoc. Amer. Phys.*, 1910.

simply say here that the cocci we have obtained seem to be identical with those found by other investigators.² Until their exact status is determined we shall refer to them as the "endocarditis cocci" or "coccus." Studies by Rosenow indicate that the organisms are derived from pneumococci, a view also discussed in the paper by Celler and the writer.

There were 2 supposedly active cases in which the blood cultures were negative. In the former five cultures were made in a variety of ways in our laboratory, and one in another, all being negative. This patient died at another hospital, and characteristic lesions were found in the heart, with cocci in the vegetations. These cocci were not studied, but I have no hesitation in putting down the case as one belonging in the group of subacute bacterial endocarditis. In the other case two cultures were made, neither very satisfactory. This case died and there was no autopsy made, but the clinical picture was definite.

The term "subacute bacterial endocarditis" I have adopted instead of the older terms: "chronic ulcerative endocarditis," "chronic malignant endocarditis," "chronic infectious endocarditis," and "endocarditis lenta" (Schottmüller). I call all cases of endocarditis already proved to be due to bacteria (rheumatism is not so proved) "bacterial endocarditis," and divide the cases into "acute," "subacute," and "chronic," according to their clinical course. When the causative organism in a given case is obtained, I insert the name of the organism for the word "bacterial," thus, "acute streptococcus endocarditis," etc. Many of the cases that belong in the group with which we are dealing last only four to six months, and are therefore certainly subacute and chronic. Some may prefer to apply the term "chronic" to the cases that last over one year.

Besides the 77 active cases, we have observed 11 cases, which I believe belong in the group of subacute bacterial endocarditis, but in which the lesions found were in a healing or healed stage, and in which the lesions were found free from pathogenic bacteria. In 10 of the cases, blood cultures were made during life (in a few anaerobically), and no bacteria were found. In 1 case as many as nine cultures were made during a period of ten months, all with negative results.

There are many viewpoints from which such large material as I have at my disposal could be presented. I shall attempt in the present communication to show that the lesions found in the cases of subacute bacterial endocarditis in which the mitral valve is involved are quite characteristic. I hope to demonstrate that there are three stages in many cases of this disease: the bacterial, the

² Libman and Celler, *AMER. JOUR. MED. SCI.*, 1910, cxl, 516, and *TRANS. ASSOC. AMER. PHYS.*, 1910.

bacteria-free healing, and the bacteria-free healed stage. I should also like to point out that at least some of the cases which we have been wont to call "chronic endocarditis with fever" are examples of the healed or healing forms of subacute bacterial endocarditis, for healing from a bacteriological or bacteriological and pathological standpoint does not necessarily mean recovery from a clinical standpoint.³

I shall here present my views as briefly as possible and refer to the literature in so far only as is essential. At another time I hope to cover the subject more fully and to discuss the lesions found in other forms of endocarditis. I shall point out for comparison some of the valvular lesions found in infections by the ordinary streptococci, pneumococci, staphylococci, and the gonococcus.

When the mitral valve is involved in cases of subacute bacterial endocarditis (and it is involved in the larger number of cases) there is a tendency for the vegetations to spread up on the left posterior wall of the auricle more than on the valve itself. Often the chordæ tendinæ attached to the posterior flap are covered to a greater or lesser extent by vegetations. Nearly always the anterior flap is also involved, and here the vegetations tend to grow down over the chordæ tendinæ, the involvement of the latter being often extensive. Not uncommonly the chordæ are ruptured, the torn ends at times being massed together by vegetations at the edge of the flap, or the lower ends may be found lying loose near the papillary muscles. The vegetations are yellowish, greenish, pinkish, or reddish in color, and vary much in size in different cases. As they grow older they become firmer and assume a more grayish color.

When the aortic valves are involved the lesions are not usually characteristic and their extent is most variable. There may be only a small vegetation on one or more of the flaps of the valve. On the other hand, there may be enormous green masses that must block the orifice to a greater or lesser extent. The vegetations have a tendency to extend down over the endocardium at the position of the septum membranaceum and over the ventricular aspect of the aortic flap of the mitral valve and down over the chordæ tendinæ. At times they have a stalactite-like appearance. There may develop an aneurysm of the aortic flap of the mitral valve. Ulceration of the aortic valve at times occurs; ulceration of the mitral flaps is rare.

A study of frequency of involvement of the valves, the left auricle, and the chordæ in the hearts from 34 cases of the disease in which the blood cultures were positive during life was made with the following results:

³ Libman, Proc. New York Path. Soc., December, 1911, xi, 118.

Auricle, mitral valve, and chordæ	17 cases
Auricle, mitral valve, chordæ, and aortic valve	5 "
Auricle and mitral valve	2 "
Mitral valve and chordæ	1 "
Aortic valve only	3 "
Aortic valve, chordæ, and aortic flap of mitral	4 "
Mitral valve, chordæ, and aortic valve	1 "
Auricle, mitral, and aortic valves	1 "
Total	34 cases

The auricle was involved 25 times, the mitral valve 27 times, the chordæ 28 times, and the aortic valve 9 times. The frequency of the involvement of the chordæ and auricle is very striking.

The lesions which we consider so characteristic of this group of cases we have not found in a large series of cases of acute endocarditis (58 in number) due to the streptococcus, pneumococcus, and the staphylococcus. In our own cases of acute gonococcus endocarditis we have not met with similar lesions. But I have, through the kindness of Drs. Asch and Humphries, of the German Hospital, seen one case of gonococcus endocarditis, apparently of only three weeks' duration, in which the lesions resembled those seen in the group of cases under discussion. The symptoms seen in the typical cases of subacute bacterial endocarditis were not present nor were the characteristic glomerular lesions found in the kidneys.

And as, in the group of 34 cases just tabulated above, only 1 was due to the influenza bacillus and the other 33 to the endocarditis coccus, the lesions must be considered characteristic of infection by these cocci. There are occasional notes in the literature on such lesions in cases of bacterial endocarditis, particularly by Osler⁴ and Harbitz.⁵ These will be discussed in the fuller paper which will appear later.

After I had made these observations I found (in 1909) lesions in the heart of a man in whose case a clinical diagnosis of chronic nephritis and uremia had been made, which appeared to me to represent the healed form of the lesions I had previously found in cases of infection by the endocarditis cocci. There were extensive lesions on the wall of the auricle in a state of organization, and the chordæ tendinæ attached to the anterior flap were found torn, thickened, fibrous, and in part calcareous. Bacteria were not present. My opinion that these were the healed lesions of subacute bacterial endocarditis (in all probability due to the cocci) was confirmed recently by Dr. Baehr's⁶ studies of the kidneys in all the material we have in the museum from cases of bacterial infection of the heart valves.

⁴ British Med. Jour., 1885, i, 467, 522, 577, 607; Practitioner, 1893, p. 181; Quart. Jour. Med., ii, 219.

⁵ Om. Endokardit, 1897, Christiania; Deutsch. med. Woch., 1899, xxv, 121.

⁶ Proc. New York Path. Soc., December, 1911, xi, 123; Jour. Exp. Med., 1912, xv, 330.

Dr. Baehr investigated particularly the glomerular lesions described by Loehlein⁷ in cases of endocarditis due to the *Streptococcus viridans* of Schottmüller,⁸ which organism seems to correspond to the cocci found in our subacute cases. Dr. Baehr studied the kidneys of 25 cases of endocarditis due to the endocarditis coccus ("*Streptococcus viridans*" or "*Streptococcus mitis*") which were still in the bacterial stage, and found the lesions described by Loehlein in 23. In 2 other cases, 1 an infection by the influenza bacillus and the other the case of gonococcus infection before mentioned (with rather acute course, but with endocardial lesions like those in the coccus case), the lesions were absent.⁹ In the kidneys of 54 cases of endocarditis due to the ordinary streptococci, staphylococci, the pneumococcus, and the gonococcus no such lesions were found. The lesions must therefore be considered characteristic of infections of the heart valve by the endocarditis coccus.

In the kidneys of the case which I have just mentioned, which I believed at the time the case came to postmortem examination represented a spontaneously healed case (from the bacteriological and pathological standpoints), the characteristic glomerular lesions were found. After observing this case I again looked over my collection of hearts from cases of subacute bacterial endocarditis, and was surprised to find how often there is a tendency to healing of at least part of the lesions. In a number of cases I found that the upper part of the auricular lesion was already organizing or was organized, while other parts of the lesions were active and filled with bacteria. I also found a tendency to calcareous infiltration in chordæ tendineæ which were covered by vegetations. And even in extensive vegetations on the aortic valve, which on the whole appeared to be quite active, marked calcareous deposits could be found. It was of the greatest interest to observe the transitions between the lesions present in active cases and the lesions we were beginning to find in the cases which I believed to represent healed cases of the disease in question. Including the case mentioned above (Case I) we have now studied the lesions in 11 cases in the last-mentioned group.

CASE II.—The clinical diagnosis was chronic endocarditis, chronic nephritis, uremia. In the heart there was an organized lesion of the wall of the left auricle. The chordæ tendineæ were thickened, deformed, some were shortened, some torn. One blood culture was made during life, which gave a negative result. The lesions were bacteria-free; glomerular lesions were found.

CASE III.—A case considered to be possibly a case of subacute bacterial endocarditis in which the bacterial infection was no

⁷ Med. Klin., 1910, xi, 375.

⁸ Münch. med. Woch., 1910, lvii, 017.

⁹ Since Dr. Baehr wrote his paper, Dr. Thalheimer has studied with me the lesions in another subacute case due to the influenza bacillus. The glomerular lesions were not present.

longer present. Death was due to exhaustion from anemia and to an embolic aneurysm of the femoral artery. Three blood cultures were made, with negative result. At autopsy there were characteristic lesions of the left auricle and the chordæ, partly organized. There were few poorly staining cocci in the non-organized part of the lesions; they could not be cultivated. Characteristic glomerular lesions were found.

CASE IV.—The clinical diagnosis was chronic endocarditis and chronic nephritis. Characteristic lesions in healing state were found post mortem, bacteria-free. There was no blood culture during life. Glomerular lesions were found.

CASE V.—This case is of particular interest. I had the opportunity of personally observing this patient last summer, in the service of Dr. J. Rudisch. He was a type of case usually termed "chronic endocarditis, with fever." Certain clinical phenomena led me to believe that the case was one of bacterial endocarditis in which bacteria were no longer present, and that the continuance of the clinical phenomena was due to the fact that there was present a large calcareous mass on the aortic valve from which pieces were continually breaking off, the calcareous mass representing the attempt at healing of a large mass of vegetations. At autopsy the conditions were as suspected during life. There was a large calcareous mass present, and there was some ulceration of the valve flaps. As the lesions on the aortic valve are not characteristic in subacute bacterial endocarditis, as those of the mitral usually are, I could not put this case in the group until Dr. Bachr found typical healed glomerular lesions. Two blood-cultures were made in this case; both remained sterile. The masses on the valve were bacteria-free.

CASES VI and VII.—When I thus found that a case with the clinical picture of "chronic endocarditis with fever" could really be a case of bacteria-free subacute bacterial endocarditis I had the kidneys from two other such cases examined. One case had calcareous masses on the aortic valve, an aneurysm of the mitral valve, embolic aneurysm of the iliac artery, and a branch of a renal artery.¹⁰ A few of the chordæ tendinæ attached to the anterior mitral flap showed organized vegetations. Three blood cultures were negative in this case. The lesions post mortem were free from bacteria, and typical healed glomerular lesions were found by Dr. Baehr. The other case presented at postmortem examination calcareous masses on all three flaps of the aortic valve, with some ulceration of the valve. There was also an aneurysm at the position of the membranous septum. Death was due to cerebral embolism. Three blood cultures in this case

¹⁰ It is interesting to note, in view of the clinical remarks appended, that when I looked up the history of this patient, who was in the hospital seven years ago, the house physician had made a note that there was facial pigmentation and a palpable spleen.

revealed no bacteria. Healed glomerular lesions were easily found. It is of great interest to compare the heart in this case with another in my collection in which there are vegetations on all three flaps of the aortic valve. Although there are cocci present, and they were still to be found in the blood at the time of death, distinct calcareous impregnations are present. It is easy to see that this heart might easily look like the one from the bacteria-free case if the process of calcification were further advanced.

CASE VIII.—This case was suspected of being in the bacteria-free stage of subacute bacterial endocarditis. One blood culture was made, with negative result. There were slight organized lesions of the aortic valve. There was a granular lesion of the left auricle and the chordæ tendineæ showed typical changes, but in an organizing or organized condition (histological studies not complete). There were no bacteria in the lesions.

CASE IX.—This case was also strongly suspected clinically of being one of subacute bacterial endocarditis, that had become bacteria-free. The cause of death appeared to be a cerebral embolism. The autopsy showed a slight healed lesion of the posterior flap of the mitral valve. The chordæ tendineæ attached to this flap showed apparently organized vegetations (histological examination not completed). The changes in the anterior flap were like those seen in active bacterial cases of disease; the chordæ tendineæ were matted together at their attachment to the valve, and some of them were torn across. All these lesions appeared to be organized. There was one finger-like vegetation attached to the cusp, which hung down into the ventricle as far as the insertion of the chordæ into the papillary muscle. This vegetation did not seem to be as old as the others. The aortic flaps showed very small vegetations, and one cusp was slightly ulcerated. Three blood cultures were made, all with negative results. The lesions were found bacteria-free; glomerular lesions were found.

CASE X.—This case was also suspected clinically of being one of the remarkable instances of healing endocarditis when the patient was in the hospital in December, 1911. A blood culture taken at that time showed no growth. He returned in March, 1912, with an embolism (embolic aneurysm?) of the right brachial artery. Two blood cultures were negative. At the autopsy the usual lesions were found that are characteristic of subacute bacterial endocarditis when the mitral valve is attacked. The lesions seemed to be nearly if not entirely organized (examination not finished). There was one unusual lesion, an old ulceration of the posterior flap of the mitral valve. The vegetations were found bacteria-free. The heart blood contained saprophytic bacteria only. Glomerular lesions were easily found.

CASE XI.—This case was observed much longer than any other case in this group. The patient was constantly seen for nearly

ten months, and was several times under observation in the hospital. In all nine blood cultures were made, some being incubated anaërobically (this was also done in several of the other eleven cases now under discussion). Not a single colony of an organism was found. The man died of anemia, exhaustion, and decomposition. At the autopsy there were found extensive deposits of calcareous, fibrous, and thrombotic material on the flaps of the aortic valve. There were perforations of the valves with healed margins; these were clearly due to ulceration. There were also present aneurysms of the sinuses of Valsalva. Spreads of the vegetations proved bacteria-free. Cultures of the heart blood showed the ordinary streptococcus, evidently a terminal or agonal invader. The kidneys showed the typical glomerular lesions all healed.

I wish to digress for a moment here to mention a further finding which to me seems important and to which hitherto no attention has been paid. This patient had the sternal tenderness which I described in an earlier paper¹¹ as being such a frequent, valuable symptom in subacute bacterial endocarditis, and he had it to an unusually marked degree. I had suspected that it was due to active regeneration in the bone marrow, this being an effort at compensation for the marked progressive anemia so common in the disease. There was another possibility to be entertained, although it was less likely—namely, embolic disease of the bone marrow.

When we performed the autopsy in this last case we were able to obtain bone marrow from the tibia, femur, and sternum. In the femur and sternum and in the middle of the tibia the marrow was dark brownish red in color, and very firm. It is now being studied histologically.

We have then before us 11 cases in which we have every reason to believe that we are dealing with cases in which patients who had a subacute bacterial endocarditis overcame the infecting agent without their having been seen at a time when the infection was still active. In 1 poorly staining cocci were still seen in small numbers in part of the lesions. In 7 of the cases the mitral valve was involved in a way seen practically only in subacute bacterial endocarditis. As 95 per cent. of our active cases were found to be due to the endocarditis coccus, it is fair to assume that nearly all of the 7 cases were due to the cocci. Besides which we have further evidence in the presence of the characteristic glomerular lesions in all of them.

One case had a calcareous mass on the aortic valve and involvement of the chordæ tendineæ in characteristic fashion. The latter lesion is in itself suggestive, and besides this typical glomerular lesions were found.

We have left 3 other cases in which only the aortic valve was

¹¹ AMER. JOUR. MED. SCI., 1910, vol. 516.

involved and in which large calcareous lesions were found. In all of these we have the proof afforded by the presence of the glomerular lesions that they were almost surely the result of infections by the endocarditis coccae. And I have pointed out that there are transition stages to these lesions in cases which still have the cocci in the blood during life and in the lesions.

It is of interest to note in the cases with aortic involvement (calcareous masses on the valve) that aneurysms are frequent and that they are of a different type from the bacterial embolic type. One finds aneurysms of the sinuses of Valsalva, the heart wall just below the aortic valve, the aortic flap of the mitral valve, and in the peripheral arteries. All except the last seem to be due to impact by the calcific material on the valve. They are all smooth walled. The peripheral aneurysms seem to be due to the traumatism to the wall inflicted by a piece of lime whipped off from the valve. Some years ago I pointed out that such non-infective embolic aneurysms actually existed.¹²

The question will now be asked, How often does one see a case of subacute bacterial endocarditis in which blood cultures have been positive, become bacteria-free and go on with symptoms due to the changes left in the heart or recover completely? As regards this point, our own experience has been that nearly all the cases in which we found bacteria in the blood and which we could follow went on to a fatal termination, with bacteria still present in the blood. In but few cases did the blood cultures become negative; these patients also soon succumbed. In one case of infection by the influenza bacillus five blood cultures were positive and four later ones were negative. This patient died a couple of months after leaving the hospital, or about four months after the cultures became negative. He left the hospital quite anemic, and died of exhaustion and decompensation. An autopsy was not permitted. Our experience coincides with that of those who have seen large numbers of these cases. The instances of recovery in cases with positive blood cultures will later be cited briefly in the discussion of the literature.

It is curious in view of the facts just stated that there should exist so many cases¹³ which must have had a bacterial infection, have recovered from the infection, and have certain clinical pictures from the changes brought about during the infective period. We must assume that in these cases the period of bacterial infection was very short as compared to the cases which we see with bacteria in the blood or very short and very mild. When one sees cases of

¹² Proc. New York Path. Soc., October, 1905, p. 88.

¹³ I have seen a number of cases besides those mentioned in the text which I believed to be examples of bacteria-free cases. Some have disappeared from observation. A few I am still following. I believe we will be surprised at the number of such cases that exist and have hitherto not been properly interpreted.

the disease with bacteria demonstrable in the blood go about for weeks with hardly any symptoms it is not difficult to believe that some patients with a mild or short infection may not feel sick enough to ask for medical attention or present such mild clinical pictures that they are not put to bed. That the infection in such cases is a shorter one is also suggested by the study of the glomerular lesions. They were found to be much more abundant in cases in which cocci had been found in the blood than in those in which they were never demonstrated. It is not my purpose in this communication to discuss at length the clinical pictures presented by the cases with healing or healed lesions. A sufficient number of cases has not yet been collected to give us a clear idea of the complete course of such cases. It will be important to determine how long people with this condition can live, and whether any of them after the bacterial infection is over can live for many years with no other symptom than those they had from their original valvular lesion before the infection was superimposed. My own data are too few to give any definite facts. But two observations are of some value. One case (Case XI) was observed in a bacteria-free condition almost ten months. In Case X a transfusion prolonged the patient's life. I have another case under clinical observation who has but few symptoms, who is in no worse condition today (perhaps even better) than he was ten months ago.

As far as the data which I have thus far at my command go they indicate that the cases with healing or healed lesions present the following clinical pictures:

1. They go on to have a nephritis and die of uremia.
2. They present the picture corresponding to what we have been wont to call "chronic endocarditis with fever" (that is they have a valvular lesion, more or less fever from time to time, usually low, occasional petechiæ,¹⁴ occasional joint symptoms, and embolisms). Some of these cases closely resemble cases in which bacteria are demonstrable in the blood. The differences will be discussed when I have more material. Some of these patients are pale and some more or less pigmented (see below).
3. Some of these cases present a clinical complex that appears to have been entirely overlooked. The striking feature is a peculiar diffuse brown (sometimes quite dark) color of the face. The rest of the body may show some pigmentation. There is evidence of a valvular lesion, there is more or less anemia, usually a palpable spleen, and usually also tenderness of the lower sternum.¹⁵ The patients feel weak and do not sleep well. Petechiæ occasionally

¹⁴ My investigations go to show that purpuric eruptions occur particularly in the cases with calcific masses in the valves.

¹⁵ This symptom will be more fully discussed in a separate publication, as will also the changes in the urine.

occur. There is temperature from time to time, but usually low. Erythrocytes are found in the urine in some of the cases. The subsequent history of such cases is not yet known; one case died with symptoms of cerebral embolism. I wish particularly to emphasize the curious change in the color of the face. It will, I am sure, be of great importance in the recognition of some of the cases with healing or healed lesions. Since I have observed it in such cases I have looked for it in cases with bacteria in the blood. And now, to my surprise, I find that while the faces of most of the cases are sallow, or of a rather white color, some develop a certain amount of brown or *café-au-lait* color.

4. They may go on with more or less anemia, and suffer from that and from decompensation.

I would like now to note a few of the important symptoms that occur in the bacterial cases and state what my experience is as regards them in the cases in which the infection has been overcome:

1. Fever: This is found in all of the non-bacterial cases that we have observed, but it is a less marked feature and the temperatures are low for much longer periods. In an earlier paper I have drawn attention to the fever which occurs in cases of chronic endocarditis without demonstrative bacteriemia.¹⁶ At that time I made the following remarks: "There are many cases of chronic endocarditis with fever without demonstrative bacteriemia. In some cases causes for the fever may be found elsewhere in the body. If no cause can be found the acute symptoms may be due possibly to organisms not to be cultivated by our present methods. I have suspected that in some cases with irregular fever, at times high, and recurring from time to time, the temperature may be due to the discharge into the blood current of bits of thrombotic masses or old vegetations." Bock¹⁷ has recently shown that fever can be produced experimentally by the injection into the blood stream of bacteria-free, chemically indifferent particles.

2. Splenic Enlargement: This symptom seems to persist in the non-bacterial stage. I have reason to suspect that occasionally when the spleen is very large, the clinical diagnosis may appear to be a splenic disorder plus chronic endocarditis. In the bacterial stage, it is well known that the splenic enlargement may be so marked that such cases have been mistaken for cases of Banti's disease or splenic anemia.

3. Pains: These may be just as severe in the bacteria-free cases; the same holds true of joint pains.

4. Painful Cutaneous Erythematous Nodules: These were not observed in the bacteria-free cases except in one case, in which

¹⁶ Libman, Johns Hopkins Hosp. Bull., 1912, p. 222.

¹⁷ Bock, Arch. exp. Path. u. Pharmacol., Band lxviii, 68, 1.

they were a prominent feature during the early period of the observation.

5. Sternal Tenderness: This symptom, on which I lay much stress, is equally frequently met with in both groups of cases. It even seems to be a more marked symptom in the bacteria-free cases. As I have stated in an earlier publication,¹⁸ sternal tenderness may be found even when the hemoglobin is not markedly reduced.

6. Petecluræ: These occur in the bacteria-free cases, but are not as abundant and do not occur so frequently. Purpuric eruptions seem to be a feature rather of some of the bacteria-free cases.

7. Hematuria: This subject needs further investigation. Erythrocytes were found in the urines of those cases of the bacteria-free groups in which they were carefully looked for. Gross hematuria—that is to say, smoky urine—I remember to have seen only once in the cases in the bacteria-free group, and it occurred in that case only during the early part of the period of observation.

Other symptoms, such as the sweats, the blood changes, the gastrointestinal phenomena, etc., will be discussed when more data are available. The facts that I have given show the close resemblance between many of the features in the two groups of cases. It is important that we can recognize at least some of the bacteria-free cases definitely. It will be of great value to search for such cases and to make studies of the serum in them. Complement fixation investigations carried on in connection with such cases may enable us to determine the exact status of the cases classed as chronic rheumatic endocarditis. We may be able to ascertain whether there exist cases that have had the bacterial infection and have completely recovered, being left with the original valvular lesion due to rheumatism.

It will finally be of interest to glance at the literature on the subject of healing of the lesions of subacute bacterial endocarditis. I shall take up at the present time mainly the experience of authors who have had the advantage of having blood cultures made in their cases. I shall not go into the question of the possibility of the healing of acute endocarditis; Herriek¹⁹ has discussed that subject fully.

Litten,²⁰ Leyden,²¹ Osler,²² and Rosenow²³ do not record any experiences with healed cases. Leyden believed that it was possible for "ulcerative" endocarditis to heal. He evidently had instances of subacute bacterial endocarditis among the cases he studied, but none with healed lesions.

¹⁸ *AMER. JOUR. MED. SCI.*, 1910, cxl, 516.

¹⁹ *Trans. Assoc. Amer. Phys.*, 1902, xvii, 48.

²⁰ *Berlin. klin. Woch.*, 1899, p. 609, 644; *Deutsch. med. Woch.*, 1902, p. 369, 395.

²¹ *Zeitschr. f. klin. Med.*, iv, p. 321.

²² *Jour. Infect. Dis.*, 1909, vi, 249.

²³ *Loc. cit.*

Harbitz,²⁴ in the report of his admirable investigations on endocarditis, discusses lesions that he found in 10 cases that he believes were related to "chronic infectious endocarditis," and in which the lesions were in a healing stage.²⁵ He says that he did not succeed in obtaining bacteria in these lesions, but the anatomical picture, "the extension to the walls of the auricle and ventricle, the excrescences on corresponding parts of two adjacent flaps, the tearing of chordæ tendinæ," etc., was quite characteristic. These cases ran a long course, at times associated with subacute nephritis. In one case of this group in which the cultures at the autopsy were sterile, Peter Holst obtained two weeks before death a "white staphylococcus" in the blood. In a few cases indistinct groups of organisms were found in sections and smears made from vegetations, and the cultures were negative. These observations of Harbitz are the most definite hitherto recorded.

Bartel²⁶ made a study of 22 hearts from cases of endocarditis to determine whether "ulcerative" endocarditis is capable of healing and how often it occurs. His Cases IV and VII resemble much some of the cases I have described. He discusses the possibility of relapses of infection due to bacteria lying dormant in healing or healed lesions, a subject to which I have alluded in an earlier publication,²⁷ and which is worthy of further study.

Lenhartz²⁸ states that none of his cases recovered. One case that left the hospital after the fever had disappeared, and the blood was free from bacteria, died ten months later of cardiac insufficiency. Horder²⁹ saw only one recovery in 150 cases of endocarditis due to all kinds of bacteria. The patient was a boy, aged fifteen years, who had fever for seven weeks. He eventually lost all evidences of cardiac disease. This observation loses in value because no blood cultures were made.

Latham and Hunt³⁰ describe the case of a man who was under observation from August 24, 1909, to November, 1910. They obtained a coccus from the blood, which may very well correspond to the endocarditis coccus, seven times between October and July. There was irregular fever and repeated embolisms. From April on there was gradual improvement. When the patient was seen in November, 1910, the temperature had been normal or subnormal for several months, the pulse rate was 60, and the heart was regular. The mitral systolic and aortic diastolic murmurs persisted. The last three blood cultures were negative. The authors make a note that the polynuclear percentage dropped

²⁴ Loc. cit.

²⁵ I am indebted to Dr. Baehr for drawing my attention to these 10 cases described by Harbitz.

²⁶ Wien. klin. Woch., 1901, p. 1004.

²⁷ Libman, Johns Hopkins Hosp. Bull., 1906, xvii, 223.

²⁸ Die septischen Erkrankungen, Wien, 1904, p. 434.

²⁹ Quart. Jour. Med., ii, 289.

³⁰ Proc. Royal Soc. Med., Clin. Sec., November 11, 1910, p. 14.

from 74 to 54 in the course of the case. I have a number of times seen lymphocytic increase in subacute bacterial endocarditis, in cases with and without bacteria.

They ascribe the recovery to the use of an autogenous vaccine administered by the mouth. As one so often sees spontaneous disappearance of the bacteria, this case may very well have become bacteria-free without the use of the vaccine. Vaccines have been used by many competent observers in these cases without any beneficial effect.

Emerson and Harrison³¹ describe a case supposed to be one of the group under discussion, but it does not seem to me to be a case of subacute bacterial endocarditis.

Schottmüller,³² in 1910, described 5 cases of subacute bacterial endocarditis ("endocarditis lenta"), and stated that 1 was still under observation and was doing well. The other 4 died. He has not reported since that time on the case that he believed was recovering.³³

Jochmann³⁴ has recently reported 7 cases of the disease, 2 of which recovered; 3 of the cases were treated with an autogenous vaccine and with a serum produced by immunizing animals with cultures of the "Streptococcus viridans." Two of the patients so treated died. So that 1 case recovered on the use of specific treatment and 1 without it. It is to be hoped that the subsequent course of these 2 cases will be reported.

Some time ago I came across a reference to a case mentioned by Reiche, of Hamburg, at a meeting. He had a case of subacute bacterial endocarditis of the aortic valve in which the blood cultures became negative after they had shown cocci a number of times. The patient died of an embolic aneurysm of an intrahepatic branch of the hepatic artery which had ruptured into the liver substance and caused a fatal hemorrhage into the peritoneal cavity. The endocardial lesions, Reiche stated, were found healed. It is unfortunate that no further data are given us to bacteriological studies of the involved valve, and no accurate description of its appearance.

It will be noted that the observations on the healing of subacute bacterial endocarditis are rather few in number. From the pathological standpoint those of Harbitz are the most illuminating. From the standpoint of healing in a clinical sense the observations of Latham and Hunt and Reiche and Jochmann are important. It is essential that writers who in future report such cases give subsequent reports on the condition of the patients, with reference to the clinical points I have discussed in the body of this paper.

³¹ Jour. Royal Army Med. Corps, 1910, xv, 588.

³² Münch. med. Woch., 1910, p. 880.

³³ July 31, 1912. Since this paper was written, I have heard from Professor Schottmüller that this case has succumbed.

³⁴ Berlin. klin. Woch., 1912, p. 436.

It seems remarkable that the cases that have spontaneously become bacteria-free have hitherto escaped detection.

I believe I have brought forward sufficient evidence to prove that subacute bacterial endocarditis is a disease in which healing can occur from the bacteriological, pathological, and clinical standpoints, although the evidence of complete recovery from the clinical side is still very meagre.

It is a pleasant duty for me to express my gratitude to Drs. Rudisch, Meyer, Brill, and Manges, the visiting physicians to Mount Sinai Hospital, for their kindness during many years in permitting me to make studies on their cases. The clinical data are mainly derived from the cases in the service of Dr. Rudisch and from cases which a number of physicians permitted me to observe in their practice. I wish to add that it would not have been possible to complete the bacteriological and pathological studies as far as they have been carried without the enthusiastic assistance of the various members of the laboratory staff for the last ten years.

GLOMERULAR LESIONS OF SUBACUTE BACTERIAL ENDOCARDITIS.¹

By GEORGE BAEHR, M.D.,

ASSISTANT IN PATHOLOGY, MOUNT SINAI HOSPITAL, NEW YORK.

In the kidneys of nearly all individuals dying during the course of subacute bacterial endocarditis there exists a pathological lesion which affects one or more loops of a variable proportion of the glomeruli.²

The first to draw attention to this lesion and to connect it with infections of the endocardium by the endocarditis coccus (*Streptococcus viridans*) was Loehlein. In March, 1910, he reported 8 cases of this condition, in all of which loops of some of the glomeruli showed the lesions. Three of these showed organisms in blood cultures taken during life, and in one of these, organisms were cultivated from vegetations post mortem. In one case the lumen of an artery entering an infarcted area was occluded by an embolus which contained numbers of cocci.

Before proceeding to a consideration of the glomerular lesions it is necessary to understand a few of the cultural characteristics of the endocarditis coccus in order to be able to appreciate the mechanism by which the kidney lesions are produced. On the

¹ Read by invitation at the meeting of the Association of American Physicians, May 15, 1912.

² Baehr, Jour. Exp. Med., xv, 330.