CLEVELAND CLINIC QUARTERLY

Volume 38, January 1971
Printed in U.S.A.

Anaerobic bacteria in postmortem blood cultures

Correlation with lesions of the gastrointestinal tract

ARLINGTON G. KUKLINCA, M.D.*

THOMAS L. GAVAN, M.D.
Division of Laboratory Medicine

POSTMORTEM bacteriology has attracted little attention in the literature over the years, and it is an aspect that is one of the most neglected in the specialty of pathology in many institutions. In American and Canadian publications since 1915 we have found only 15 reports[1-15] pertaining specifically to autopsy microbiology. Only one[16] of the current textbooks on microbiology mentions the subject to any great extent. There are several reasons for this lack of attention: the once popular concept of postmortem invasion of the bloodstream by bacteria that populate the gastrointestinal tract;[17] the difficulty of obtaining, at the autopsy table, uncontaminated material for cultures; the fact that tissue is difficult to work with in the microbiology laboratory; and lastly, the difficulties involved in the interpretation of postmortem microbiological studies.

The purpose of this report is to present the results of a study of 237 patients which shows correlation of: symptoms immediately preceding death, postmortem finding of gastrointestinal lesions, and postmortem blood cultures.

Materials and methods

A postmortem blood culture is obtained when feasible, via a right atrial puncture. This is performed by exposing and elevating the heart, drying the immediate area of the heart as well as possible, and sterilizing the juncture of the inferior vena cava and the right atrium by searing with a hot thin spatula. The seared area of the right atrium is then punctured with a sterile needle with attached syringe; approximately 5 ml of blood is obtained, and immediately placed into 30 ml of fresh thioglycollate medium. The blood culture is preferably obtained before any blood vessels are ligated or the viscera manipulated. This method has been advocated by several authors[12, 13] who have had good results. The culture is kept for 10 days and examined for both aerobic and anaerobic organisms.

* *Fellow, Division of Laboratory Medicine.*
Paper presented in part at the 70th Annual Meeting of the American Society for Microbiology, Boston, Massachusetts, April 29, 1970.

Results

Results of blood cultures from 237 autopsies over a nine-month period (April through December 1969) were reviewed. All of the bacteriologic studies were performed by one of us (A.G.K.). The cases were consecutive and not selected. *Table 1* summarizes the culture data. Of the 237 blood cultures, 126 (53 percent) were sterile and only 8 (3 percent) yielded more than two organisms, suggesting a low level of contamination. Anaerobic bacteria were found in 16 (6.8 percent) of the cases: *Clostridium sp.* accounted for 13 (5.5 percent); and *Bacteroides sp.* 3 (1.3 percent).

In reviewing the clinical records of these 16 cases demonstrating anaerobic bacteria in the postmortem blood culture, 15 were found to be associated with lesions of the gastrointestinal tract. *Table 2* shows these conditions to be classified into three major categories: (I) malignant gastrointestinal lesions, (II) hematologic disorders with associated gastrointestinal hemorrhages, and (III) other gastrointestinal lesions. In the one patient in whom an an-

Table 1.—Results of postmortem blood cultures during a nine-month period

Blood culture results	Number (%)
No growth	126 (53)
One organism	82 (35)
Two organisms	21 (9)
More than two organisms	8 (3)
Total	237 (100)
Anaerobic bacteria	
Clostridium sp.	13 (5.5)
Bacteroides sp.	3 (1.3)
Total	16 (6.8)

Table 2.—Clinical conditions associated with isolation of anaerobic bacteria from postmortem blood cultures

Category	Clinical condition	Number of cases	Number with anaerobic bacteria (%)
I	Malignant gastrointestinal lesions	21	4 (19)
II	Hematologic disorders (with gastrointestinal lesions)	10	4 (40)
III	Other gastrointestinal lesions	30	7 (23)
	Total	61	15 (23)
IV	No gastrointestinal lesions	176	1 (0.6)

Table 3.—Anaerobic bacteria in postmortem blood cultures—associated with malignant gastrointestinal lesions (category I)

Clinical data				Anaerobe cultured (associated site)
Age, yr	Sex	Status within 24 hr of death	Diagnosis	
71	M	Fever (104 F), shock; hemoglobin, 11.4 g/100 ml	Gastric carcinoma, with ulcerations	*C. perfringens*
62	M	Fever (103 F), shock; hemoglobin, 9.6 g/100 ml	Gastric carcinoma, with ulcerations	*C. perfringens*
84	F	Temperature 99 F, shock; hemoglobin, 11.0 g/100 ml	Rectal carcinoma, with ulcerations	*B. fragilis*
39	F	Fever (104 F), lethargy; hemoglobin, 5–7 g/100 ml	Rectal carcinoma, with ulcerations	*C. septicum* (in neoplasm)

aerobic bacterium was not associated with a gastrointestinal lesion there was a malignant epithelial neoplasm of the urinary bladder.

Table 3 summarizes the clinical data of patients having malignant gastrointestinal lesions. There were two cases of gastric carcinoma and two cases of rectal carcinoma; all demonstrated various degrees of ulceration. Three of the four patients had clinical septicemia, and the one patient who was afebrile went into sudden shock before death. In one case, *Clostridium septicum* was isolated from the heart blood, and was also cultured from the region of the rectal neoplasm which showed massive necrosis.

The data from the group of patients with hematologic disorders are shown in *Table 4*. There were two cases of acute leukemia, one case of aplastic anemia with thrombocytopenia, and one case of hemorrhagic diathesis, the cause of which was unexplained at the time. All patients demonstrated signs and symptoms of septicemia before death; autopsy showed that all had massive hemorrhagic and ulcerative lesions of the colon.

In regard to the last group of patients, the seven with other gastrointestinal lesions, the data are summarized in *Table 5*. The lesions range from a gallbladder abscess to peritonitis resulting from a ruptured hollow viscus. Of the seven patients, six had clinical signs of septicemia, and six also had various degrees of anemia. From four of the seven patients the same species of anaerobe was cultured from the peritoneum and from the postmortem heart blood.

Comment and conclusion

Since this paper is concerned with results of postmortem blood cultures, two questions immediately arise: Is there visceral bacterial dissemination after death? How valid are the results of postmortem blood culture? As stated earlier, the popular concept, held for many years, was that, soon after

Table 4.—Anaerobic bacteria in postmortem blood cultures—associated with hematologic disorders (category II)

Clinical data				
Age, yr	Sex	Status within 24 hr of death	Diagnosis	Anaerobe cultured
21	M	Fever (102 F), chills, dead on arrival in emergency room	Aplastic anemia, thrombocytopenia, ulcerative lesions of colon	*C. histolyticum*
26	M	Fever (103 F), abdominal pain; hemoglobin, 5.7 g/100 ml	Acute granulocytic leukemia, hemorrhagic and ulcerative lesions of colon	*C. perfringens*
8	M	Fever (103 F), abdominal pain and rigidity; hemoglobin, 11.6 g/100 ml	Acute lymphocytic leukemia, hemorrhagic and ulcerative lesions of colon	*C. perfringens*
42	F	Fever (102 F), nausea, vomiting; hemoglobin, 3.3 g/100 ml, leukocyte count elevated	Hemorrhagic diathesis, hemorrhagic and ulcerative lesions of colon	*C. perfringens*

death, bacteria immediately disseminate throughout the body.[17] Data in several publications[4, 12, 13] established quite clearly that postmortem bacterial invasion does not occur and there is no relationship between positive heart blood cultures and the time that cultures are taken postmortem. However, one report[10] states that there is definite correlation between positive heart blood cultures and the postmortem interval. Among the 16 cases in our series, nonmotile anaerobic bacteria were isolated in 11, and it seems an impossibility for a nonmotile organism to reach the right atrium from such a remote site as the rectum. The biggest variable, however, concerning contamination of autopsy blood cultures is in the technic of the individual autopsy prosector.

In regard to the question of validity of results, *Table 6* summarizes the clinical condition before death of the 15 patients with lesions in the gastrointestinal tract. Signs and symptoms of generalized infection predominate. The two patients who demonstrated hemorrhagic diathesis are interesting because it is a well-known fact that clostridial septicemia can lead to a clinical syndrome of disseminated intravascular coagulation.[18] In several patients, a sudden rapid anemia was also noted, and clostridial septicemia has been known to cause intravascular hemolysis leading to severe anemia over a short period.[19]

In our series of 237 postmortem blood cultures, 15 anaerobic bacteria obtained from heart blood were found to be associated with lesions of the gastrointestinal tract. It is known that anaerobic bacteria are the prominent

Table 5.—Anaerobic bacteria in postmortem blood cultures—associated with other gastrointestinal lesions (category III)

Clinical data			Diagnosis	Anaerobe cultured (associated site)
Age, yr	Sex	Status within 24 hr of death		
103	F	Fever (103 F), abdominal pain and rigidity; hemoglobin, 11.4 g/100 ml	Gallbladder and subphrenic abscesses	*B. fragilis*
14	M	Fever (103 F), abdominal pain, vomiting, melena; hemoglobin, 8.9 g/100 ml	Renal transplant, perforated caecum with peritonitis	*C. perfringens* (peritoneum)
58	F	Fever (101 F), abdominal pain and rigidity; hemoglobin, 8.4 g/100 ml, leukocyte count elevated	Perforated gastric ulcer, postoperative peritonitis	*C. septicum* (peritoneum)
71	F	Fever (102 F), melena; hemoglobin, 11.2 g/100 ml, leukocyte count elevated	Rectal perforation, peritonitis	*C. perfringens* (peritoneum)
19	M	Temperature 96 F, comatose, shock; hemoglobin, 11.2 g/100 ml with sudden drop to 5.4 g/100 ml	Cirrhosis, hemorrhagic colitis, disseminated intravascular coagulation	*C. perfringens*
78	M	Fever (100 F), abdominal pain; hemoglobin, 9.2 g/100 ml, leukocyte count elevated	Mesenteric artery occlusion, colonic necrosis, peritonitis	*C. perfringens* (peritoneum)
77	M	Fever (100 F), abdominal pain; hemoglobin, 14.6 g/100 ml, leukocyte count elevated	Terminal hemorrhagic necrotizing enteropathy	*B. serpens*

flora of the gastrointestinal tract.[16, 19] The association of anaerobic bacteremia and gastrointestinal lesions cannot, however, be explained on the basis of mere numbers alone, and it may be that anaerobes are, for example, more invasive than *Escherichia coli*. This is just conjecture, and would require investigation. In Alpern's[20] study of *Clostridium septicum* positive blood cultures and associated malignancy, no reason was suggested for the correlation.

In all of the patients in our series, an opportune site, whether it was an ulcerating rectal neoplasm or a gangrenous gallbladder, was found which would provide the anaerobe with easy access to the bloodstream. These 15 cases of anaerobic bacteria were encountered in a total of 61 autopsies of patients with some type of gastrointestinal lesion. In only one of the other

Table. 6—Clinical status within 24 hours of death—15 patients with gastrointestinal lesions

Sign-symptom	Number of patients (%)
Fever	13 (87)
Anemia	13 (87)
Abdominal pain	7 (46)
Leukocytosis	5 (33)
Abdominal rigidity	3 (20)
Shock	3 (20)
Melena	2 (13)
Nausea, vomiting	2 (13)
Hemorrhagic diathesis	2 (13)

176 cases in which there were no gastrointestinal lesions, was an anaerobic bacterium isolated. Anaerobic bacteria have been shown by at least two authors and their co-workers[20, 21] to be associated with malignant lesions outside the gastrointestinal tract. The association, in 23 percent of the cases, of anaerobic bacteria in the blood, with lesions of the gastrointestinal tract is considered significant. It is believed that a careful search for anaerobes should be undertaken in patients who demonstrate either septicemia or a sudden change in clinical condition, who have gastrointestinal inflammation, perforation, ulceration, neoplasm, or hemorrhage.

References

1. Canavan, M. M., and Southard, E. E.: The significance of bacteria cultivated from the human cadaver; a second series of one hundred cases of mental disease, with blood and cerebrospinal fluid cultures and clinical histological correlations. J. Med. Res. **31:** 339–365, 1914.
2. Fredette, J. W.: Bacteriemias in the agonal period. J. Lab. Clin. Med. **2:** 180–188, 1916.
3. Richey, DeW. G., and Goehring, C.: Studies on bacteriemias in the agonal period. J. Med. Res. **38:** 421–447, 1918–19.
4. Giordano, A. S., and Barnes, A. R.: Studies in postmortem bacteriology; value and importance of cultures made postmortem. J. Lab. Clin. Med. **7:** 538–546, 1921–22.
5. Hunt, H. F., and others: A bacteriologic study of 567 postmortem examinations. J. Lab. Clin. Med. **14:** 907–912, 1929.
6. Epstein, E. Z., and Kugel, M. A.: The significance of postmortem bacteriological examination, with special reference to streptococci and enterococci. J. Infect. Dis. **44:** 327–334, 1929.
7. Burn, C. G.: Postmortem bacteriology. J. Infect. Dis. **54:** 395–403, 1934.
8. deVries, J. A., and Pritchard, J. E.: The increase in serious staphylococcal infections as shown by post-mortem investigation. Canad. Med. Assn. J. **73:** 827–828, 1955.
9. Kurtin, J. J.: Studies in autopsy bacteriology. Amer. J. Clin. Path. **30:** 239–243, 1958.
10. Carpenter, H. M., and Wilkins, R. M.: Autopsy bacteriology: review of 2,033 cases. Arch. Path. **77:** 73–81, 1964.

11. Wood, W. H.; Oldstone, M., and Schulte, R. B.: A re-evaluation of blood culture as an autopsy procedure. Amer. J. Clin. Path. **43:** 241–247, 1965.

12. Minckler, T. M., and others: Microbiology experience in collection of human tissue. Amer. J. Clin. Path. **45:** 85–92, 1966.

13. deJongh, D. S., and others: Postmortem bacteriology; a practical method for routine use. Amer. J. Clin. Path. **49:** 424–428, 1968.

14. O'Toole, W. F., and others: Studies of postmortem microbiology using sterile autopsy technique. Arch. Path. **80:** 540–547, 1965.

15. Silver, H., and Sonnenwirth, A. C.: A practical and efficacious method for obtaining significant postmortem blood cultures. Amer. J. Clin. Path. **52:** 433–437, 1969.

16. Bailey, W. R., and Scott, E. G.: Diagnostic Microbiology, **3d** ed. St. Louis: C. V. Mosby Co., 1970, p. 70, 109–112.

17. Gradwohl, R. B. H.: Importance de l'examen bactériologique pratiqué sur les cadavres. Ann. de l'Inst. Pasteur **18:** 767–773, 1904.

18. Bachmann, F.: Disseminated intravascular coagulation. D.M.: 1–44 (Dec.) 1969.

19. Goldsand, G., and Braude, A. I.: Anaerobic infections. D.M.: 1–62 (Nov.) 1966.

20. Alpern, R. J., and Dowell, V. R., Jr.: *Clostridium septicum* infections and malignancy. J.A.M.A. **209:** 385–388, 1969.

21. Sinkovics, J. G., and Smith, J. P.: Septicemia with bacteroides in patients with malignant disease. Cancer **25:** 663–671, 1970.