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## Modern Surgery - Chapter 10. Septicemia and Pyemia

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## X. SEPTICEMIA AND PYEMIA.

**Septicemia**, or sepsis, is a febrile malady due to the introduction into the blood of pyogenic organisms or the products of pyogenic organisms or of saprophytic bacteria. There is no one special causative organism, and any microbe which produces inflammatory and febrile products may cause it. Either streptococci or staphylococci may be present. Pneumococci are a not very unusual cause. Septicemia arises by absorption of septic matter by the lymphatics. Clinically we distinguish two forms of septicemia: (1) sapremia, septic or putrid intoxication; and (2) septic infection, true or progressive septicemia. In these conditions the area of infection is usually discovered by the surgeon; but when it cannot be located, the disease is called by the Germans cryptogenetic septicemia.

**Sapremia, Septic or Putrid Intoxication.**—This condition is due to the absorption of poisonous ptomaines from a putrefying area. The bacteria do not enter the blood, but their toxins do, and, as these toxins are active poisons, the condition is comparable to poisoning by successive alkaloidal injections, the symptoms and prognosis depending upon the dose. Not unusually there is absorption not only of the toxins of saprophytic bacteria, but also the toxins of pyogenic micro-organisms. Even if some of the bacteria enter the blood, they do not multiply in this fluid. Slight symptoms and recovery follow a small dose; grave symptoms and death follow a large one. The poison does not multiply in the blood, and a drop of the blood of a person laboring under putrid intoxication will not produce the disease when introduced into the blood of a well person; in other words, the disease is not infective. Considerable putrid material must be absorbed to cause sapremia. What is known as surgical fever is due to the absorption of a small amount of putrid or fermented wound fluid, and is in reality a mild form of sapremia. If sapremia arises, it does so soon after the infliction of a wound, and after a large rather than small wound, when a considerable amount of wound fluid is pent up under pressure. It may follow labor where putrid fluid is retained in the womb, may follow an injury of or an operation upon a joint, may follow amputation where decomposing blood-clot or wound fluid is pent up within the flaps, or may ensue upon an abdominal operation or injury. In sapremia there always exist a considerable absorbing surface and a large amount of dead matter which has become putrid. Roswell Park\* points out that sapremia arises from putrefaction of a blood-clot or wound fluids which are retained like foreign bodies in the tissues, and does not arise from putrefaction of the tissues themselves. He speaks of the condition as due to the absorption of poison from a "putrid suppository." Sapremia will not occur after granulations form. The term putrefaction is used because this is the usual change, but any fermentative organism may cause the disorder. Sapremia is a malignant form of surgical fever, and its existence means an ill-drained wound, and a fermenting and probably putrid collection of blood-clot or wound fluid.

In sapremia there is congestion of the stomach, intestines, and other abdominal viscera, particularly the kidneys, and also of the brain, and numbers of red blood-cells disintegrate.

\* "Treatise on Surgery by American Authors."



*Symptoms.*—The patient often seems to react incompletely from the injury; he feels miserable, complains of headache, nausea, and pain in the back and limbs; or, he may react and in a day or two develop this condition of malaise. In some cases an aseptic fever is directly succeeded by sapremia. In most cases of sapremia, between twenty-four hours and two or three days after labor, after an injury, or after an operation, there is a chill, or at least a chilly sensation, though in some cases this is wanting. The temperature rapidly rises to 103° F. or even more. There are severe headache, dry and coated tongue, rapid and weak pulse, nausea, and often vomiting, diarrhea, great prostration, restlessness, muscular twitching, and active delirium. The wound is found to be foul, and commonly there is drying up of wound discharge. There is diminution or suppression of urine, and a strong tendency to congestion of various organs. Jaundice is not unusual. Petechial spots are frequently noticed upon the skin. They occur also upon mucous membranes and serous surfaces, and result from the plugging of small vessels with detritus of broken-down red corpuscles and consequent vascular rupture. Great elevation of temperature often precedes death. In some cases the dose of poison is so large that the patient passes into rapid collapse without preliminary fever. Some cases recover if the initial dose is not overwhelming and if additional doses are not absorbed. Many cases die of exhaustion. Some become linked with fatal pyemia or septicemia. Hemoglobin and red blood-corpuscles are rapidly and notably diminished. Distinct leukocytosis exists, except in those cases in which the organism is overwhelmed with the poison and is unable to react. Cover-glass preparations do not show organisms, and cultures from the blood are sterile.

*Treatment.*—The treatment consists in at once draining and asepticizing the putrid area and administering very large doses of alcohol and large medicinal doses of strychnin and digitalis. The patient should be purged and diaphoresis favored. The hot bath is valuable to cause sweating. The action of the kidneys must be maintained if possible. Purgatives, diuretics, and diaphoretics are given to aid in removing the toxin, and stimulants are used to sustain the strength of the patient during the elimination of the poison. Vomiting is allayed by champagne, cracked ice, calomel, cocain, or carbolic acid with bismuth. Food should be administered every three hours. The patient is fed on milk, milk and lime-water, liquid beef-peptonoids, beef-juice, and other concentrated foods. Quinin in stimulant doses is of value. Antipyretics are useless. The use of saline fluid by hypodermoclysis or intravenous infusion dilutes the poison and stimulates the heart, skin, and kidneys to activity. Visceral complications must be watched for and should be promptly treated if discovered. Among the possible visceral complications are nephritis, cholecystitis, enteritis, hepatitis, peritonitis, pleuritis, empyema, bronchopneumonia, pericarditis, and endocarditis. Antistreptococcic serum is useless in sapremia.

**Septic Infection, or True Septicemia.**—This condition is a true infective process. In sapremia the blood contains toxins of putrefactive bacteria, but not the bacteria themselves. In septic infection the blood contains both pyogenic toxins and multiplying pyogenic bacteria. In sapremia the causative condition is putrid material lodged like a foreign body in the tissues. In septic infection the tissues themselves are suppurating, and both bacteria



and toxins are being absorbed by the lymphatics. Of course, septic infection may be associated with septic intoxication or may follow it. In suppurative fever the tissues suppurate, but only the pyogenic toxins are absorbed, and not the pyogenic bacteria. In septic infection both the pyogenic bacteria and toxins enter the blood, and the bacteria multiply in the blood and produce continually increasing amounts of poison. The symptoms of sapremia depend on the dose. In septic infection only a small number of organisms may get into the blood, but they multiply enormously. The pus microbes cause true septicemia, and reach the blood chiefly through the lymphatics, but to some degree by penetrating the walls of vessels. A drop of blood from a man with septic infection will reproduce the disease when injected into the blood of an animal; hence the disease is truly infective. The wound in such cases is often small, but may be large, and is commonly punctured or lacerated, and the disease begins later after the infliction of a wound than does sapremia. No wound may be discoverable, the infection having arisen from an unrecognized focus of suppuration—for instance, gonorrhœa, middle-ear disease, dental caries, tonsillar suppuration, appendicitis, etc. Septicemia in which the initial atrium of infection is not discovered is called cryptogenetic septicemia.

The bacteria which exist in the blood and organs are usually staphylococci or streptococci, often both. Pneumococci or colon bacilli in some cases are causative. The blood is found to have lost much of its coagulating power; it remains fluid for some time after death, quantities of red corpuscles are destroyed, and minute hemorrhages take place in the brain, mucous membranes, skin, serous membranes, muscles, and various viscera. There may be inflammation of synovial and serous membranes. There is congestion of the gastro-intestinal tube and of the abdominal viscera. The lymph-glands are larger than normal and the spleen is notably enlarged. The wound contains numbers of bacteria.

*Symptoms.*—The type of this condition is met with in puerperal septicemia or in an infected wound. When septicemia arises from an infected wound, red lines due to lymphangitis are usually seen about it, and there is enlargement of related lymphatic glands. In some cases, however, the wound and the parts about it look normal. The post-operative rise may continue for an undue time and septicemia develop. Septicemia may arise during the existence or after the abatement of sapremia, or may arise when the aseptic fever has passed away and when there has been no putrid intoxication. It begins in from four to seven days after labor or an injury, usually with a chill, which is followed by fever, at first moderate, but soon becoming high. In some cases there is a chilly sensation, but no distinct chill. There is always great prostration even before the chill. The fever presents morning remissions and evening exacerbations, and may occasionally show an intermission. When the remission begins there is a copious sweat. As the case progresses the temperature may fluctuate, and it often rises very high before death. The pulse is small, weak, very frequent, and compressible. The tongue is dry and brown, with a red tip. Sordes gather on the teeth and gums. Vomiting is frequent, and, as a rule, there is diarrhea. Low delirium alternates with stupor, and coma is usual before death. The great prostration is a noticeable and characteristic feature of the sufferer from septicemia. There are *sub-*



*sultus tendinum* and *carphologia*. Toward the end the face often becomes Hippocratic. Visceral congestions occur. The spleen is enlarged, ecchymoses and petechiæ are noted, urinary secretion becomes scanty or is suppressed, and the wound becomes dry and brown. Blood-examination detects a rapid and great diminution in red corpuscles and hemoglobin. The anemia is in many cases profound. There is marked leukocytosis except when the system is overwhelmed by the poison. Cover-glass preparations made from blood may show bacteria, but often fail to do so. Cultures from the blood are sterile in most cases, but not in all. A negative finding does not disprove the existence of septic infection; a positive finding is of conclusive diagnostic value.

The *prognosis* is bad, and in some malignant cases death occurs within twenty-four hours, but mild cases often recover. Welch points out that finding the staphylococcus pyogenes albus in the blood is not particularly ominous, but the presence of other pyogenic cocci is exceedingly threatening (Dennis's "System of Surgery"). Endocarditis, pericarditis, peritonitis, pleuritis, bronchopneumonia, empyema, nephritis, arthritis, cholecystitis, hepatitis, meningitis, and pyelitis are among the complications which may arise.

*Treatment*.—The treatment is the same as for septic intoxication. Anti-streptococcic serum is employed by some surgeons, but the value of this method is as yet doubtful. It does not do any harm. It may do good. It is proper to use it, but not to the exclusion of other remedies. The usual dose is 10 c.c. injected into the abdominal wall. It can be repeated two, three, or even six times a day, and can be used for a number of days. Washing the blood by the intravenous infusion of salt solution often produces distinct improvement, which, unfortunately, is usually temporary. Dr. C. C. Barrows commends formalin used intravenously. The strength of the solution is 1 part of formalin to 5000 parts of salt solution. The dose is 500 c.c. I have had no experience with formalin in septicemia.

**Pyemia.**—Pyemia is a condition in which metastatic abscesses arise as a result of the existence of septic thrombophlebitis, the disease being characterized by fever of an intermittent type and by recurring chills. It is not actually due to free pus in the blood, but to the passage into the blood of clots filled with toxins or infected by streptococci or staphylococci, or both. After a wound is inflicted blood clots in the divided veins. If suppuration occurs, the clots may become filled with the toxins of pyogenic bacteria or be invaded by the bacteria themselves. Thus it becomes evident that pyemia may develop with septicemia. It may also develop when there is suppuration in a wound, but not septicemia, no lymphatic absorption of bacteria or toxins having occurred. A suppurating focus about a vein may cause thrombophlebitis and clot-formation even when no wound exists. This is seen in thrombophlebitis of the lateral sinus secondary to suppuration of the middle ear.

A vessel thrombus runs up in the lumen of a vein, and the apex of the clot softens, a portion of it is broken off by the blood-stream and carried as an embolus into the circulation. Many of these poisonous emboli enter into the blood and lodge in some vessels which are too small to transmit them, and at their points of lodgment form embolic, secondary, or metastatic abscesses.

If the embolus contains only pyogenic toxins the danger is infinitely less than if it contains bacteria. The secondary abscess if caused by a clot containing only toxins may not lead to further dissemination of disease. If the embolus contains bacteria, thrombophlebitis occurs about it, and new infected emboli form and are sent throughout the system. Wounds of the superficial parts and bones produce pyemic infarctions and metastatic abscesses of the lungs. When these infarctions break into fragments particles may return to the heart and lodge, or may be sent out through the arterial system to form other foci in distant organs. Infected areas connected with the portal circulation (intestinal injuries or suppurating piles) may produce abscess of the liver. Wounds of bones which open the medullary cavity or diploic structure are particularly apt to be followed by pyemia, and the disease may follow labor, phlegmonous erysipelas, and other conditions. Malignant endocarditis is called "arterial pyemia," and is due to endocardial embolic infection. In this disorder infected emboli lodge in the kidneys, the spleen, the alimentary tract, the brain, or the skin (Osler). Idiopathic pyemia is a misnomer. Some primary focus of infection must exist, as was pointed out when discussing septicemia.

**Symptoms.**—The wound often becomes dry and brown, and sometimes also offensive. A severe and prolonged chill or a succession of chills ushers in the disease; high fever follows, and drenching sweats occur. The chills recur every other day, every day, or oftener. During the sweat the temperature falls and may become nearly normal, normal, or actually subnormal. The temperature often oscillates violently. The general symptoms of vomiting, wasting, etc., resemble those of septicemia. In some cases the mind remains clear, in many the delirium is purely nocturnal. The skin frequently becomes jaundiced, and a profound adynamic state is rapidly established. The blood changes are like those of septicemia. The spleen is enlarged. The lodgment of emboli produces symptoms whose nature depends upon the organ involved. Lodgment in the lungs causes shortness of breath and cough, with slight physical signs. Lodgment in the pleura or pericardium gives pronounced physical evidence. Lodgment in the spleen produces severe pain and great enlargement. The parotid gland not unusually suppurates.

In a suspected case of pyemia always examine an existing wound, and if there is no wound, remember that the infection may arise from gonorrhoea, osteomyelitis, suppuration in the middle ear, appendicitis, dental caries, tonsillar suppuration, abscess of the prostate, etc. Chronic pyemia may last for months; acute pyemia may prove fatal in three days. The chief complications are joint-suppurations, bronchopneumonia, pleuritis, empyema, endocarditis, pericarditis, peritonitis, nephritis, cholecystitis, pyelitis, venous thrombosis, and abscesses.

**Treatment.**—The treatment is the same as for septicemia. Open, drain, and asepticize any wound and any accessible secondary abscess.