Thesis
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Subject:
Actinomyces: The clinical aspects of Actinomycosis illustrating points in diagnosis and treatment.

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Clinical aspects of Actinomyces illustrating points in diagnosis and treatment.

Actinomyces is a specific infectious disease which affects cattle and swine and also man, caused by the Streptothrix Actinomyces (Actinomyces Bevis or Ray Fungus).

A positive diagnosis of Actinomyces can be made only by finding the characteristic "Sulphur Granules" in the pus and the Ray Fungus under the microscope.

In the summer of 1908, in the Bacteriology department of the University of Edinburgh, I worked at, and noted the following characteristics of the Streptothrix Actinomyces:

Microscopic Appearance: A streptothrix i.e. one of the higher forms of fungus, not a bacterium, being between the bacteria and moulds. A streptothrix grows from a true spore which develops into a threadlike mycelium, which branches dichotomously. Several spores may settle down, and the threads growing from them tend to arrange themselves in a radiating manner. The spores are not formed in the substance of the thread, but on special aerial branches bearing chains of gonidia or spores. This spore
spores
then scatter and become new centres of growth. They have a higher resistance than the threads, but e.g. when dried may survive for several years. They are, however, easily killed by moist heat. The mycelial threads are not hollow like those of the cereal moulds. They have an outer sheath and are said to be continuous i.e. not composed of separate cells, but in some conditions they are sometimes found to break up into shorter elements. Sometimes, especially in old cultures and in chronic lesions, the sheath at the ends of the filaments tends to swell up into club-shaped enlargement, which may undergo calcification.

Staining: Retains Gram's method, and stains easily with the ordinary stains: is acid-fast. Club shaped swellings stain yellow with pico-carmine.

Cultivation: grows readily on wheat or potato paste (it is a parasite of certain grains (smut) e.g. wheat and barley). Also grows on agar. Grows best at body temperature but also at somewhat lower temperatures. On surface shows as minute rounded projecting dots, appearing in a few days; these remain discrete and enlarge in size - little raised yellow masses like honey or brown, tough and brittle, and tending to crack in centres. Slightly
Siquefis
gelatin and the growths float in the fluid as little,
hollow, fluffy, yellow balls.
In the tissues. The commonest forms of lesion are 1. Chronic Abscesses
2. Woody Tongue in the ox
3. Suppurative ulcerations of mucous membrane & skin
4. Nodules of tumour-like growth in periostium
   resembling sarcoma which may become fibrous or calcify. According to Frejus:
   "The lodgment of the ray-fungus in the tissue is
   followed by an inflammatory reaction, progressive
   in character, characterized by a cellular infiltration
   sort of necrosis, and the formation at first of
   granulation tissue and later of fully organized
   connective tissue.
   According to Tientil, the cellular hyperplasia,
   not corrosion necrosis, is the first phenomenon.
The fungus develops a mycelium and a fungus pileus
and is soon surrounded by an area of small
round cells, and later, of corporules, giant
and epithelioid cells. In the neighborhood
of the sputa the connective tissue element
proliferates, forming embryonic granulation tissue
with new vessels. The gradual extension of the process
process
by the transportation of mycelial filaments either
by phagocytes or along the lymph channels, with
the attendant cellular infiltrate and granulatative
tissue formation, may result in the formation
of tumour masses resembling neoplasms,
especially the sarcomata. This neoplastic form,
though occasionally seen in man, is more
usually found in horses and cattle, and gives
rise to the so-called "lumpy jaw". The tumour
contains, in addition to the cellular masses,
numerous foci of disintegration, in which
the characteristic granules are observed. In
man the lesion is more inflammatory in its
manifestations: suppuration is a frequent
complication, since tissue-neoform is a more
conspicuous feature than tissue-poliferation.
The disease travels along the connective tissue
planes, producing branching sinusous tracts and
fistulas, lined by granulation tissue upon a
hyperplastic connective tissue base and containing
the typical granules. Suppuration is due to a
secondary infection, since the actinomyces itself
is not a pyogenic organism. This is more
readily understood as the portals of infection
are the mouth, gastro-intestinal, respiratory tract, and skin,
According to Wright the progressive character of the disease might be attributed in some cases to the ever-present source of infection in the buccal cavity and in the gastro-intestinal tract, admitting his assumption that the actinomyces bovis is a regular inhabitant of these cavities. Of all the bones, the inferior maxillary is the most commonly involved. According to Barre'z the bones are never, as Pasteur would have us believe, the seat of a primary lesion. The process is usually a destructive one and is attended with active proliferation from the periodontium and the formation of a new shell of bone, which adds to the size of the tumour. 

Primary actinomycesis of the intestinal tract manifests itself as a superficial invasion of the mucous membrane in the formation of whitish patches (shrun) or in the more diffuse variety by the formation of nodules under the mucosa. These nodules, undergoing degeneration ulcerate and, rapidly extending beyond the original site, invade the peritoneum, retroperitoneal connective tissue and various organs especially the liver. The retroperitoneal infection may travel downward into the pelvis, invading especially the perirectal tissue, or upward through the diaphragm.
diaphragm

into the pleural cavity. As a result of the peritoneal irritation numerous adhesions form which, while preventing a general peritonitis, at the same time might seriously embarrass a surgeon in an attempt to eradicate the disease.

Direct communication may be established at the site of an adhesion between one loop of intestine and another, between the intestines and bladder, and between the intestines and external surface of the body through fistulous openings that in the abdominal wall. Pulmonary actinomycosis is characterized by the development of a broncho-pneumonia about the focus of infection by the dissemination of the fungus and the formation of nodules in the lung, surrounded by new granulation tissue; the contraction attending the organization of the granulation tissue may convert the lung into a functionless connective tissue mass. In most cases the nodules undergo softening and by the destruction of lung tissue, and by secondary infection, abscess cavities form, which contain pus, fatty detritus and fat crystals, blood, and masses of actinomyces. The pleurae, the pericardium, and mediastinum soon become involved.

Metastasis occurs, principally by continuity or, as in
he abdomen by contiguity. Rupture may occur into the blood vessels, usually the vein, and the infection be carried to distant localities such as the skin, bones, muscles, brain, kidneys, or by way of the portal vein into the liver. The portal of entry in some of the cases is hard to determine. This is particularly true of primary lesion of the brain or liver.

Regional dissemination never occurs through the lymphatic channels and if the nodes are enlarged it is an indication of secondary infection (Hagies).

Ecology. The first accurate description of actinomycosis in man was given by James Israelyand subsequently Porfikoff, 1879, insisted upon the disease in man and cattle. Bolliing and Karg, however, studied the lumpy jaw of cattle, 1876, and recognized the characteristic fungus and termed it actinomyces. Johnston was the first to perform inoculation experiments, and succeeded in reproducing the disease from the fungus. Adams in 1884 observed the first case in man in England.
The mode of infection: There is no evidence of direct infection with the flesh or milk of diseased animals. It seems highly probable that it is taken in with the food. Special sites of infection mostly due to swallowing infected barley or wheat:
1. Through buccal mucous membrane, gums, and tonsils
2. From pharynx and oesophagus, infecting mediastinum, lungs, pleura, chest wall
3. From alimentary canal, especially the cecum, may invade peritoneum, glands, etc. and may cause wide spread abscesses
4. Secondary infection, especially of liver and kidney, following primary lesion in cecum, stomach, etc.
5. Direct air passage infection by inhalation, especially affecting part of the trachea and larger bronchi
6. By vagina in rare cases
7. Occasionally through the skin

The secondary spread of the disease is usually by bloodstream.

In cattle the characteristic lesion is the "woody tongue."
Illustrations of the mode of infection by way of the buccal mucous membrane is the following case which occurred in my practice.

Case.

William Oliphant, aged 35, farm servant, married, Emmont Bridge, Perth, Cumberland, came to me in March, 1908, complaining of pain and swelling on the left side of his face, near the angle of the jaw. The swelling had been increasing in size slowly for three weeks. The patient was in the employ of Major Parkin, Allwater. The patient's hygienic conditions at home were good; he had alcoholic tendencies and, on Saturday nights particularly, would return home the worse for drink. He stated he had not had any previous illnesses or accidents of any importance.

For the swelling and pain which he described as being like that of toothache, he had tried various remedies, but got very little relief from them.

On examination, I found him a well-developed and well-nourished man. In the
the mouth the gums were swollen about decayed teeth on the side affected; the tongue and throat were not involved. There was a swelling about the jaw and adjacent tissues. The swelling was of a boggy nature, without glandular enlargement and without much tenderness on pressure. The muscles of mastication were affected, causing the patient pain when opening the mouth. The skin over the swelling was red but fluctuation could not be elicited. After a further period of a week's sedative treatment, without improvement, he was admitted to the Penrice Cottage Hospital. With difficulty now, deep fluctuation was elicited. An incision was made requiring to be as deep as to expose the External Carotid Artery before pus was come upon to the extent of about a drachm. The patient was treated in hospital for ten days during which time the swelling became harder and denser, penetrated more into the cheek, extended to the surrounding tissue reaching below the elavicle. The nature of the swelling now was one of a dense and board-like hardness
and the opening made showed no signs of closing; very little pus discharged through it. I suspected Actinomyces and examined the pus from the discharging sinus in which microscopically the club-shaped bodies were found and diagnosis confirmed. The microscopical evidence was confirmed at the Laboratory of the Royal College of Physicians, St. Thomas' Hospital, as follows:

April 10 '88.

pus

Actinomyces!

16. 4. '88.

Signed: Dr. Ritchie.

There are a great many long positive filaments here and there in small felted masses some branching, some containing coccus-like bodies. They have all the microscopic characters of an Actinomyces.

On the day that the pus was examined for Actinomyces the patient, who was considerably worse after ten days of treatment in hospital,
hospital.

expressed an emphatic desire to be discharged from hospital and have further treatment at home. He returned home on the 9th April where the Potassium Iodide treatment was promptly begun. Up to a hundred grains a day were given for the period of a week at the time, with intervals of a few days. The suppuration areas which caused intense agony and tumours were laid open, and the granulation tissue cut away, the wounds kept open as long as was necessary with Botofront gauge. The pain and tumours, which were excessive for weeks, had to be relieved by full doses of morphia. He had to be constantly watched during sleep there was danger of asphyxiation, for breathing was only possible with the neck in one position. For a week his life was despaired of until the Potassium Iodide began to have marked effect. Then improvement began and continued uninterruptedly. At the end of a month, from the commencement of the administration of Potassium Iodide, the extensive inflammatory condition was checked and the tumours which
which had held his neck like a vice became relieved. There was less of the board-like hardness of the swelling, and the lesions showed signs of healing.

At the end of six weeks, he was able to leave his bedroom and take short walks in the open air. He continued to take Potassium Iodide for nine months in gradually decreasing doses. In December of the same year he was declared cured and returned to his former occupation viz. that of a farm laborer.

A few days ago I had a letter from one of his friends, who said that "he was feeling better than ever and thanked me for saving his life." But for the application of Potassium Iodide, involvement of deeper structures and organs was inevitable, and the result must have been fatal.

Conclusion.

I would offer this sketch, the application in general practice of important scientific discoveries, as a plea for the continued advance of scientific medicine.
References

4. Priest: "Quoted by Snell.
8. Bompich: "Berliner klinische Woch.," May, 1877, s. 146.
Grafs of Actinomyces from Human pus: x 450 (Marwedel).

Actinomyces
Section from human being
K club-shaped bodies
F thread of mycelium
x 800 (Marwedel).
Actinomycosis of the Cheek (Illich).
Actinomycesis (Jacobi).