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CULTURAL STUDIES ON AN INFECTION OF THE SKIN BY *ENDOMYCES ALBICANS*

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Infections by organisms other than the bacteria are by no means uncommon. In many cases, however, no careful study has been made of the infecting agent, and consequently the details of the infection remain unknown. This article is a report of an investigation of a fungus that caused a series of lesions on the index finger of a woman. While this paper is concerned only with the organism which was repeatedly isolated from the discharge, the following anamnesis, which was prepared through the kindness of Dr. A. J. Ochsner, is presented as it may be of some interest.

REPORT OF CASE

History.—Three years ago (February, 1916) the patient first noticed a small pinhead sized grayish-white lesion on the skin of her left index finger just lateral to the root of the finger nail over the distal phalanx. This minute lesion slowly and painlessly enlarged to a diameter of from 5 to 10 mm., and then discharged a yellow matter. At no time was the lesion painful. Within a few weeks other similar miliary abscesses formed on the same finger, always painless and rapidly festering, discharging a purulent material. These lesions followed each other in rapid succession and in crops—at one time the distal phalanx was practically covered by a coalescing mass of the minute miliary abscesses. After attempting to treat the finger herself with little success, she consulted a physician. Hot B. & A. dressings were applied with little benefit and the small lesions recurred quite regularly. Yellow mercuric oxid ointment and incision of the finger together with roentgen-ray treatment effected a disappearance of all lesions for a period of one year. In April, 1919, the small abscesses reappeared. At this time a culture was taken from the pus from one of the lesions and blastomycetes (yeasts) were grown in pure culture on several different occasions. The patient had never noticed any similar lesions elsewhere on her body. She had no other complaint and her general health was excellent.

MICROSCOPIC EXAMINATION OF DISCHARGE

Technic.—The material was taken from the lesions after the surrounding area had been washed and sterilized. An incision was then made into the lesion and the discharge collected on a sterile swab.

This was taken to the laboratory and plated out according to the usual procedures. Glucose agar plates and slants were used for growing the organism. The growth on this medium was white, slimy and quite luxurious, and seemed to differ very little from the growth secured with ordinary yeasts. The fungus grew readily between 18 C. and 38 C. Growth occurred, however, at temperatures below 18 C., but the extent was somewhat in proportion to the temperature.

Form and Size of Cells.—The vegetative cells of this fungus are round, sometimes slightly ovoid, with a granular interior. Some of the cells show the presence of vacuoles and fat globules. Young cells on glucose agar slants are quite regular in size and shape. The size varies between 3.5 and 6.5 microns. The cells from scums are quite different from those taken from glucose agar slants. There is a marked tendency to mycelial structures together with the formation of yeast-like cells (Fig. 1). The cells taken from the sediment at the bottom of culture tubes show a greater number of mycelial threads.

Fig. 1.—Cells from sediment of three month old broth cultures.

although this does not seem to be a constant characteristic. Judging from our cultures there seems to be a great adaptability for the changing of one structure into another. The yeast forms seem to be more common in liquid mediums, while on solid mediums there is a greater tendency to form mycelial threads. The yeast-like structures from glucose agar slants all show the presence of an opaque body. This is about one-thirtieth the size of the entire cell. In the larger cells, especially those which are tending to form mycelial threads, a double wall is visible. There seems to be a marked tendency for the cells to remain attached after having separated by budding.

Numerous observations failed to show the presence of ascospores. The gypsum block was used in an attempt to produce their formation. Although spore formation could not be demonstrated by the usual methods, we are not convinced that this fungus does not form spores.

Growth.—On glucose agar plates, this fungus forms round, slimy, white colonies at room temperature. In old cultures, there was a slight tendency to form a yellowish growth, but this was not constant. There

was no difficulty in getting growth on any of the laboratory mediums, but it was more extensive and appeared most quickly in the presence of glucose.

Giant colonies develop rapidly on glucose agar at 37 C. A white, luxurious growth with raised, wrinkled interiors and flat edges is obtained (Fig. 3). Extending from the raised center are a number of canals or striations which end in one of the spaces between the lobes of the edge.

The development in litmus milk is not rapid. Eventually, the casein, which coagulates without the formation of acid, is slowly digested. This would seem to indicate the presence of a rennin. The change in milk hardly ever appeared before fifteen days at room temperature.

Fig. 2.—Cells from scum of three month old broth cultures.

Gelatin was completely liquefied, showing the presence of an active protease. Nitrates were not reduced.

Fermentation of Sugars.—The fungus is characterized by the absence of gas formation in all of the carbohydrates used as substrates, excepting glucose. On account of the investigations of Mudge¹ (1917) and Hasseltine² (1917), who have shown that sterilization of the higher carbohydrates in the broth is accompanied by hydrolysis to the monosaccharids, the carbohydrates were added to Durham fermentation tubes after they had been sterilized. Subsequent incubation before inoculation was resorted to in order to prove sterility. The inoculated

1. Mudge, C. S.: The Effect of Sterilization upon Sugars in Culture Media. *Bacteriol.* **2**:403, 1917.

2. Hasseltine, H. E.: The Bacteriological Examination of Water. Comparative Studies of Media Used, *Pub. Health Repts.* **32**:1878, 1917.

tubes in duplicate were left at room temperature in the dark for forty-two days, after which there were no evidences whatever of gas formation, with the exception of glucose. All tubes, however, showed the presence of a sediment which, with certain sugars, was quite heavy. The terminal reaction of the cultures was determined, but was not significant. The tubes were exactly neutral to phenolsulphonephthalein at the beginning. Fermentation experiments were carried out on the following carbohydrates: glucose, lactose, sucrose, dextrin, dulcitol, adonitol, galactose, inulin, mannitol, levulose, raffinose, maltose, starch and melizitose.

Fig. 3.—Giant colony of *Endomyces albicans* isolated from the lesions.

The action of this fungus on the glucose in fermentation tubes was interesting. Most of the time there was no formation of gas, especially if the tubes were left at room temperature. Culture tubes of this medium showed no gas even after two months at room temperature. At 37 degrees, however, there occurred very slow, sluggish formation of gas after a week. Sucrose was not inverted nor fermented. In most of the fermentation tubes, the yeast grew as a heavy deposit in the tube.

The organism was slightly pathogenic to guinea-pigs. Injections were made subcutaneously, and after two or three days a swelling developed which finally discharged a little and then healed. The results, however, were not fatal.

Affinity.—A study of the literature indicates that the fungus responsible for this infection has all of the characteristics of *Endomyces albicans*. This yeast is discussed by Guilliermond in his little volume, "Les Levures." *Endomyces albicans* has been characterized by other authors and given other names. Robin, who discovered it, called it *Oidium albicans*, and Audry, *Saccharomyces albicans*, considering it as a typical yeast. Vuillemin³ studied it carefully and classed it as an endomycete. He was able to show the presence in old cultures of resistant units much like chlamydospores. He was also able to show the presence of sacs in old cultures on beets. However, other authors have been unable to find a variety which form spores.

Some have tried to explain this difference in morphology on the basis of the existence of several varieties of *Endomyces albicans*. This idea is somewhat borne out by several investigations.

Beauverie and Lesieur⁴ isolated a variety of this fungus which fermented lactose and formed no ascospores. Castellani⁵ analyzed the publications of many authors and showed that the species *Monilia albicans* is made up of many different varieties. According to Guilliermond, *Endomyces albicans* ferments glucose very feebly. This fact, together with the cultural and morphologic characteristics, indicates with little doubt that this infection was caused by that organism.

SUMMARY AND CONCLUSIONS

This fungus seems to be identical with *Endomyces albicans*. The value of microscopic examinations in lesions such as that described in this article is indicated by this study, since in the beginning they looked much like those caused by staphylococci.⁶

3. Vuillemin: Les formes de champignons du muguet, Rev. mycologique, No. 80, p. 1899.

4. Beauverie, J., and Lesieur, C.: Etude de quelques levures recontres chez l'homme dans certains exsudats pathologiques, J. physiol. & pathol. gen. **14**:983, 1912.

5. Castellani, A.: The Plurality of Species of the So-Called Thrush Fungus (champignon du muguet) of Temperate Climates, Ann. Pasteur Inst. **30**:149, 1916.

6. In addition to the references given, the following articles may be of interest: Ricketts, H. T.: Oidiomycosis (Blastomycosis) of the Skin and Its Fungi, J. Med. Res. **6**:380, 1901; Rajat, H.: Le Champignon du Muguet, Thesis for the Doctorate in Medecine, Lyon quoted from Guilliermond.