

NOTES

Selective Interaction of *Neisseria gonorrhoeae* and *Candida albicans* and Its Possible Role in Clinical Specimens

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A study of 27 clinical specimens from which *Neisseria gonorrhoeae* and *Candida albicans* were isolated simultaneously indicated that 44% of the gonococcal isolates were resistant to inhibition by the *C. albicans* with which they were found and an additional 33% were totally resistant to inhibition by all *C. albicans* tested. All 27 *C. albicans* showed inhibitory activity against standard indicator strains of *N. gonorrhoeae*.

Knowledge of the ecology of the human microflora and of the role some of these organisms play in enhancing or interfering with infection offers new prospects for prevention and treatment of disease, but as yet little is known regarding these phenomena (5, 6). *Neisseria gonorrhoeae*, for example, is an important pathogen isolated from body sites (cervix, throat, and rectum) that normally contains a variety of other microorganisms, but little information is currently available about interactions of *N. gonorrhoeae* with these microorganisms (2, 4).

We have reported (3) the identification of a factor produced by all *Candida albicans* isolates tested which inhibited 60% of the *N. gonorrhoeae* isolates tested. As this pathogen and this yeast may occur together in vivo and are isolated occasionally from the same clinical specimens, it was important to investigate these apparent failures of inhibition. Do all the gonococci isolated with the yeast belong to the resistant group, or are there some *C. albicans* strains that do not produce this factor?

Thirty-four specimens received in our laboratory that were positive for both *N. gonorrhoeae* and yeast were examined. Both the gonococci and the yeast were isolated, purified, and identified by established procedures (1; W. D. Lawton, submitted for publication). In four specimens the yeast was not *C. albicans*. In three other specimens, oxidase-positive gram-negative diplococci were seen but could not be isolated on subculture for confirmation. For the remaining 27 specimens, each *C. albicans* isolate was tested by our cross-streak method (3) against four gonococcal isolates previously found to be susceptible to inhibition by *C. albicans*. All 27 *C. albicans* isolates were shown to

possess inhibitory activity, as evidenced by failure of the gonococci to grow over or near the yeast streak (3).

On the other hand, when each of the 27 *N. gonorrhoeae* isolates was tested against the *C. albicans* with which it had arrived and against five *C. albicans* isolates previously shown to be good factor producers (giving >1.0-cm inhibition), three different groups were observed.

Group 1. Nine *N. gonorrhoeae* isolates (33%) were resistant to all *C. albicans* isolates. This prevalence of resistant strains is similar to the 40% originally reported.

Group 2. Twelve *N. gonorrhoeae* isolates (44%) were resistant to the *C. albicans* with which they arrived but not to the other five isolates. Since the 12 *C. albicans* isolates arriving with this group were shown to produce the inhibitory factor, these results indicate that there are variations in gonocidal efficiency depending on the particular combination of *N. gonorrhoeae* and *C. albicans*. It is possible that not all *Candida* isolates produce the identically same factor, but a more likely explanation is that various isolates produce different amounts of the same factor. Studies to characterize the factor are in progress.

Group 3. Six *N. gonorrhoeae* isolates (22%) were sensitive to all *C. albicans* isolates. This was probably an "escape" group in which the inhibitory level of yeast factor was not attained, possibly because of early isolation or because only a small number of *C. albicans* organisms were present in the original specimens. There was no correlation, however, to the transit time or to the lag period before growth, and it was not possible to correlate these findings to the numbers of *C. albicans* cells in each specimen, as the

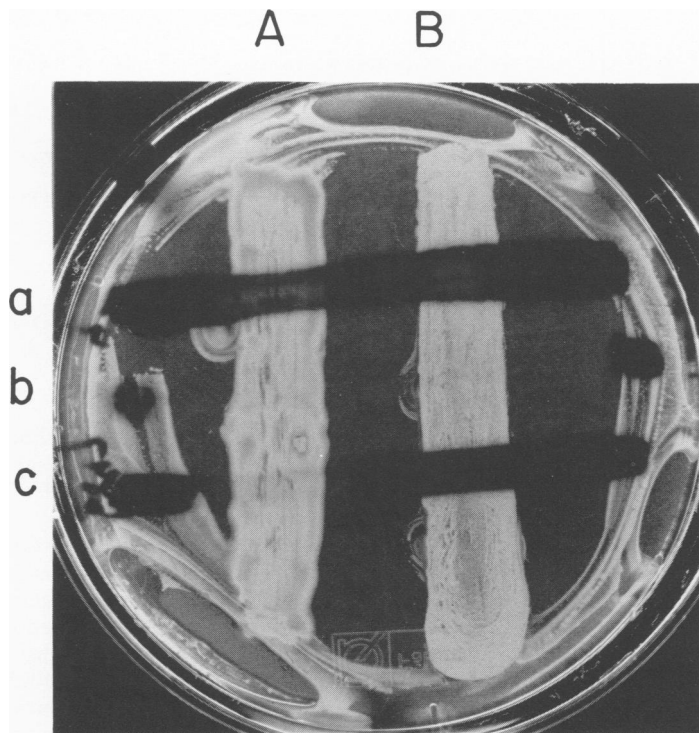


FIG. 1. Varying sensitivity of three *Neisseria gonorrhoeae* isolates to two *Candida albicans* isolates. The *C. albicans* were (A) laboratory strain no. 6897 and (B) isolated from a patient with gonorrhoea. Gonococcal isolate (c) is from the same patient. The *N. gonorrhoeae* were selected to show isolates (a) resistant to all *C. albicans* tested, (b) sensitive to all *C. albicans* tested, and (c) resistant to the *C. albicans* found with it but sensitive to others.

TABLE 1. Cross-streaking results of 27 *Neisseria gonorrhoeae* isolates to their own *Candida albicans* and to 5 "standard" *C. albicans* specimens

Group	No. of <i>N. gonorrhoeae</i> isolates	Results when tested against:	
		Own ^a <i>C. albicans</i>	Standard ^b <i>C. albicans</i>
1	9	Resistant	Resistant
2	12	Resistant	Sensitive
3	6	Sensitive	Sensitive

^a *C. albicans* isolated from the same transport specimen as the gonococcal isolate.

^b Good factor producers, i.e., giving greater than 1.0-cm inhibition from yeast growth on cross-streaking.

results had been recorded qualitatively rather than quantitatively.

These groups are summarized in Table 1, and each is represented in Fig. 1.

These findings do not answer the question of whether a woman carrying *C. albicans* in her genital tract may be more resistant to infection by some types of *N. gonorrhoeae*. They do

suggest, however, that we can be certain of isolating gonococci only from those patients where the gonococci present are resistant to the accompanying *C. albicans*. Moreover, this separation of *N. gonorrhoeae* into at least three biotypes might be a useful epidemiologic tool and is currently being evaluated in our laboratory.

LITERATURE CITED

1. Beneke, E. S., and A. L. Rodgers. 1971. Medical mycology manual, 3rd ed., p. 166. Burgess Publishing Co., Minneapolis.
2. Geizer, E. 1968. Antibacterial substances produced by different bacteria inhibiting the growth of *Neisseria gonorrhoeae*. *J. Hyg. Epidemiol. Microbiol. Immunol.* **12**:241-243.
3. Hipp, S. S., W. D. Lawton, N. C. Chen, and H. A. Gaafar. 1974. Inhibition of *Neisseria gonorrhoeae* by a factor produced by *Candida albicans*. *Appl. Microbiol.* **27**:192-196.
4. Kraus, S. J., and N. Ellison. 1974. Resistance to gonorrhoea possibly mediated by bacterial interference. *Appl. Microbiol.* **27**:1014-1016.
5. Mailback, H. I., W. G. Strauss, and H. R. Shinefield. 1969. Bacterial interference. *Br. J. Dermatol.* **1**:69-76.
6. Rosebury, T., D. Gale, and D. F. Taylor. 1954. An approach to the study of interactive phenomena among microorganisms indigenous to man. *J. Bacteriol.* **67**:134-152.