SURVIVAL OF GONOCOCCI IN URETHRAL SECRETIONS WITH REFERENCE TO THE NONSEXUAL TRANSMISSION OF GONOCOCCAL INFECTION

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GONOCOCCI are assumed to be delicate organisms, but they can survive for at least 24 h in fluid pus at room temperature (Tulloch, 1929), and for 1–2 days in moist smears of pus (Stitt, Clough and Branham, 1948). Cruickshank (1960) and Cruickshank *et al.* (1975) reported that gonococci can survive for 3 days in pus on linen or other fabric. Elmros (1977) recovered gonococci from glass and towelling after 24 h and Elmros and Larsson (1972) found survival periods of 24 h on a towel and 17 h on glass. Berger and Döring (1969) reported survival on glass beads for 3–4 h and on cotton for 7–8 h. However, these researchers made only a few tests on two materials and satisfactory conclusion cannot be drawn from the results.

It has been recognised for many years that gonococci remain alive in moist pus but die rapidly when dried (Finger, Ghon and Schlagenhauser, 1894; Neisser and Scholtz, 1903; Marshall, 1914). Jordan and Burrows (1942) and Bigger (1949) pointed out the significance of the inoculum size; gonococci have survived for several weeks dried in thick layers of pus (Bigger, 1949).

Nonvenereal gonococcal infection may be acquired from contaminated articles (Shore and Winkelstein, 1971; Doyle, 1972). In the past, epidemics of gonococcal vulvovaginitis in children were a serious problem in children's homes and hospitals (Jordan and Burrows, 1942). Thermometers, enema nozzles, examination gloves, nurses' aprons, towels, bed linen and chamber pots have also been implicated as vehicles for infection (Marshall, 1914; Keogh *et al.*, 1916; Willcox, 1964; Grimble, 1969; Schofield, 1974; Catterall, 1975; King and Nicol, 1975).

The present study was undertaken to determine the survival periods of gonococci on a variety of materials that might be contaminated by an infected person. The medicolegal and social implications of the results were also considered.

MATERIALS AND METHODS

Test materials. Two groups of sterile test materials were contaminated with fresh gonococcal pus: (i) *hard substances*—glass microscope slide, plastic petri dish, Cellophane, wooden spatula, white cardboard, white paper; (ii) *soft substances*—plain cotton swab, charcoal-dipped cotton swab, cotton gauze, linen handkerchief, cotton towel, tissue paper, lubricated condom.

Gonococcal pus. Specimens of pus were obtained from male patients. The preliminary diagnosis of gonorrhoea was made on the basis of a gram-stained film of the pus, and primary cultures were made on Thayer-Martin medium (Thayer and Martin, 1966). These cultures were the positive controls; when the cultures were negative the experiments were void.

After "milking" of the patient's urethra, a globule of discharge was seeded directly on to one of the sterile materials. Only one object was contaminated with the secretion of each patient. The test materials were held in disposable foil trays away from radiators, direct sunshine and draughts for periods of 2–96 h. The room temperature was 20–22°C and the relative humidity *c.* 60%.

Recovery of gonococci. After the test period, the exudate deposited on the hard substances was scraped with a sterile, disposable scalpel on to plates of Thayer-Martin medium.

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The exudate deposited on the soft materials was scraped on to one half of a culture plate with a disposable scalpel, and the material was rubbed gently on the other half of each plate. The residue of exudate on the material was washed with 0.5 ml of sterile physiological saline so that the fluid fell on to a second plate and finally the material was placed on the plate. All plates were incubated at 37°C in air + 5% CO₂ for 4 days.

Identification of Neisseria gonorrhoeae. The recovery of *N. gonorrhoeae* on the Thayer-Martin cultures was confirmed by the growth of typical colonies that gave a positive oxidase reaction, a positive indirect fluorescent-antibody test and fermented glucose but not maltose or lactose.

RESULTS

The survival of gonococci on the test objects is shown in the table. Gonococci were recovered from most materials after 24–48 h, and from a few materials after 72–96 h. A large proportion of tests on all materials except the condom gave positive results when tested after 24 h. After 48 h, gonococci were not recovered from tissue paper, linen, cotton towels or pieces of Cellophane, were recovered from < 50% of tests with cotton gauze, cotton swabs, glass slides, wooden spatulae, white cardboard and white paper, and were recovered from 50% of tests with charcoal-dipped cotton swabs and plastic petri dishes. After 72 h, positive results were obtained only from a charcoal-dipped cotton swab, a piece of white cardboard and a wooden spatula, and after 96 h only one positive result was obtained from a piece of white cardboard.

Gonococci survived slightly longer in secretions deposited on hard materials than in secretions on soft materials, but this difference was not significant and the method used for the recovery of gonococci from the soft materials may have subjected the organisms to greater stress.

TABLE
Survival periods of gonococci in urethral secretions

Test material	Number of tests	Results positive/total tests after storage periods of (h)												
		2	4	6	8	10	12	20	24	30	36	48	74	96
White tissue paper	19	...	...	...	...	...	1/1	...	3/8	...	...	0/4	0/5	0/1
Lubricated condom	49	0/3	1/5	1/2	0/3	1/3	0/3	...	0/11	0/1	0/1	0/6	0/8	0/3
Cotton gauze	31	...	...	...	...	...	0/1	0/1	3/6	1/1	...	2/7	0/9	0/6
White linen handkerchief	54	1/1	2/2	1/1	...	...	1/4	2/4	3/12	...	0/3	0/14	0/8	0/5
White cotton towel	40	...	1/1	...	...	...	0/5	2/4	0/6	...	0/1	0/10	0/10	0/3
Cotton swab	36	...	...	...	...	...	1/1	...	3/5	...	0/3	3/10	0/9	0/8
Charcoal-dipped cotton swab	40	...	...	...	...	...	0/1	1/1	3/3	...	3/3	4/8	1/11	0/13
Glass slide	35	...	...	...	...	...	0/1	...	4/9	1/1	2/3	2/8	0/9	0/4
Wooden spatula	43	...	...	...	...	...	...	...	5/10	...	2/4	1/10	2/8	0/11
Cellophane	28	...	...	...	...	...	2/4	...	5/10	...	0/2	0/5	0/3	0/4
Plastic petri dish	26	...	...	...	...	...	1/2	0/1	1/3	...	0/1	3/6	0/6	0/7
White cardboard	31	...	...	...	...	...	...	...	6/7	...	0/3	1/5	1/6	1/10
White paper	47	...	...	...	...	...	1/1	...	3/13	...	1/3	2/8	0/11	0/11

DISCUSSION

The present studies confirm and extend the evidence that gonococci can survive for up to 3 days on some objects; some of the test strains of gonococci survived in exudates for longer periods on a wider variety of materials than has previously been shown. The longer the survival period, the greater is the chance of nonvenereal gonococcal infection from contact with a contaminated article.

The conflicting results of other studies may reflect the different experimental conditions of other groups of workers. Slow drying is less deleterious for gonococci than rapid drying (Tulloch, 1929; Morton, 1977) and although gonococci cannot be recovered from dried saline or broth suspension, survival is enhanced in purulent suspensions (Gilbaugh and Fuchs, 1979).

However, the transmission of gonorrhoea does not depend solely upon a viable inoculum of gonococci. Kellogg *et al.* (1963) produced clinical gonorrhoea in volunteers with large doses of pure cultures of type-1 gonococci, but similar doses of type-4 strains were ineffective, and the inoculum size was unlikely in the natural transmission of the disease. Ward, Watt and Glynn (1970) found that gonococci from exudates were more resistant to the destructive action of antibody than strains from cultures and McEntegart (1975) concluded that there are other virulence and protective factors associated with the transmission of gonorrhoea that are absent from the organism in pure culture, so that infection by pure culture is never as consistently successful as infection by urethral pus from an infected patient.

In urethral exudate some gonococci within polymorphonuclear phagocytes are intact and occasionally appear to be dividing (Ward, Glynn and Watt, 1972; Farzadegan and Roth, 1975; Novotny, Short and Walker, 1975; Ovcvinnikov, Delektorskij and Dmitriev, 1976; Ovcvinnikov and Delektorskij, 1977; Veale *et al.*, 1979); the capacity of gonococci to survive and grow within polymorphs may play a major role in their survival and infectivity and in the pathogenesis of gonorrhoea.

It is generally believed that nonsexual transmission of gonorrhoea is rare. Most doctors do not believe that adults can acquire genital gonorrhoea nonvenereally, although patients occasionally claim to have done so. The present evidence indicates that gonorrhoea might be acquired nonvenereally via fomites by adults, and physicians should consider this possibility because there may be serious social, emotional and medicolegal problems between patients, their consorts and their physicians.

SUMMARY

The survival of gonococci on various materials contaminated with gonococcal pus and stored at room temperature was studied. Gonococci were recovered for up to 3 days from a wide variety of hard and soft materials. It is possible that gonorrhoea is transmitted nonvenereally more often than is usually acknowledged, and these results may have medicolegal and social significance.

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