CLINICAL PATHOLOGY IN GENERAL PRACTICE

TAKING SWABS

BY

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Use of the cotton-wool swab mounted on a wire or wooden applicator for the collection of material for bacteriological examination from various body surfaces and cavities is some 60 years old. Recommended by Councilman in 1893, it was first used in Britain by Hewlett and Nolan (1896) and by Preston (1896) for the isolation of diphtheria bacilli from the throat of affected patients. It has since been widely utilized for the collection of secretions or discharges from the nose, nasopharynx, larynx, trachea, eye, ear, skin, superficial and deep wounds, rectum, vagina, and cervix. The purpose of this article is to discuss the kind of swabs to be used and the best method of collecting material from the sites mentioned.

The Swab

The swab commonly consists of a small pledget of cotton-wool wrapped tightly and smoothly round the roughened end of a wire or wooden applicator in such a

FIG. 1.—Nasopharyngeal swab for use through the mouth.

way that no part of the end of the applicator is left exposed and there is little risk of the swab being pulled off during the collection of the specimen. This latter requirement is particularly important for nasal, cervical, and rectal swabs. The swab should not be bulky, and for pernasal use should be small enough to avoid unnecessary irritation to the nasal mucosa when being passed back to the nasopharynx. Although the use of absorbent cotton-wool is usually recommended, it is probably more advantageous for the survival of bacteria on plain swabs to use non-absorbent wool (Rubbo and Benjamin, 1951). As regards the applicator, wire is more flexible than wood, but the metal should not be too pliable, as aluminium tends to be: "nichrome" wire is now widely used, but stainless-steel wire, which can be hooked at the end to retain the swab, is also favoured. The wooden applicator is recommended for use with the serum swab (see below) to avoid the discoloration which may result from the interaction of the serum with a metal, although this

FIG. 2.—Perianal swab for threadworm ova.

risk should not occur with stainless-steel wire. The applicator is usually pushed into or through a cork at the holder end, and the whole swab is assembled in a test-tube container.

Swabs of special design are used for the collection of material from particular sites. West's swab in a bent glass tube for swabbing the nasopharynx is now an anachronism: instead the ordinary throat swab with a flexible wire holder may be bent to an obtuse angle (about 120 degrees) $\frac{1}{2}$ in. (1.3 cm.) from the tip and used with a tongue depressor to avoid mouth contamination. The swab described by Tarr (1946) for post-nasal culture is illustrated in Fig. 1. For pernasal swabs fine nichrome (s.w.g. 25) or stainless-steel wire with a hooked end is recommended (Cockburn and Holt, 1948). In collecting material from the conjunctiva some ophthalmologists prefer to use the wire loop, which is inoculated directly on to the culture medium, but a fine cotton-wool swab may be used instead. For laryngeal swabs the choice lies between nichrome wire (s.w.g. 16) and stainless steel, which is rather more rigid: the applicator is 9 in. (23 cm.) long and bent at an angle of 120 degrees about 2 in. (5 cm.) from the tip, and is placed in a large test-tube container (8 by 1 in.—20 by 2.5 cm.).

For obtaining faecal material with a swab passed into the rectum and for swabbing the vagina or cervix, the ordinary throat swab with a 6 in. (15 cm.) long applicator is best. A special type of perianal swab is used for collection of roundworm ova. It consists of a 2 cm. square of plain transparent non-moisture-proof "cellophane" wrapped about the tip of a small glass rod and held in place with a rubber band. The holder end of the rod is pushed through a cork stopper and the whole swab placed in a test-tube container (Fig. 2).

The Serum Swab and Bacterial Survival

A major concern in the use of the cotton-wool swab is the period of viability of pathogenic bacteria on the swab between collection of the material and its inoculation on to appropriate culture media. Because of the poor viability of certain bacteria like the gonococcus and the meningococcus material suspected of containing these pathogens is best inoculated on to suitable media as soon as the swab is taken; but this procedure has obvious disadvantages, and various substitute methods for allowing an interval of time between collection and inoculation of these poorly viable bacteria have been recommended. For example, Stuart (1946) found that gonococci could survive for 24 hours or longer if the swab on a wooden applicator is immersed in Brewer's medium before transportation to the laboratory: a somewhat similar procedure was recommended by Saint-Martin (1949), who used Hirschberg's medium as the vehicle. Downie (1940) found that meningococci on nasopharyngeal swabs could be cultured 24 hours after swabbing if the swab were immediately placed in contact with blood agar in the bottom of the container, while Aycock and Mueller (1950) recommended immersion of the swab in horse blood for the same purpose.

The problem of bacterial survival is not confined to the *Neisseria*, since slow-drying is known to be lethal to most bacterial species. The matter has been extensively investigated by Rubbo and Benjamin (1951), who, as a result of their comparative findings with many different pathogens, recommend the use of a serum-coated cotton-wool swab. The swabs are prepared by dipping the cotton-wool swab on a wooden applicator into undiluted ox serum for 10–30

seconds, spreading them out on sheets of blotting paper, drying in an incubator at 37° C. for about half an hour, and finally sterilizing in the autoclave at 15 lb. per sq. in. (1 kg. per cm.²) for 20 minutes. The finished product is a compact honey-coloured pledget, 3–5 mm. in diameter, in which the cotton-wool fibres are firmly bound to each other and to the applicator.

Rubbo and Benjamin found that, with the exception of the *Neisseria*, the serum swabs prolonged survival and gave heavier growths (compared with plain swabs) of some 16 different bacterial pathogens. In addition, they showed that moistened plain swabs but not serum swabs accelerated the death rate of Gram-positive bacteria like *Str. pyogenes* and *C. diphtheriae*, whereas the survival of the Gram-negative intestinal pathogens like the typhoid bacillus and Flexner and Sonne dysentery bacilli was prolonged in the absence of moisture. The deleterious effect of moisture and slow drying on the viability of *Str. pyogenes* and *C. diphtheriae* has a direct application to the moist throat swab, which with plain cotton-wool is unlikely to give reliable results if there is a delay of twenty-four hours between collection and inoculation. For example, in an outbreak of scarlet fever 170 miles from Melbourne the Australian workers found that plain and serum swabs cultured on blood agar twenty-four hours after collection gave respectively 23% and 39% positive isolations of *Str. pyogenes*. Variations in atmospheric temperature (15–24° C.) were unimportant, but

Str. pyogenes survived rather longer on swabs left in the refrigerator (4° C.) than at room temperature, whereas *Sh. flexneri* did not.

The quality and origin of the cotton-wool have little effect on survival time, and cotton-wool does not seem to contain any toxic lipid substance, although there is some evidence that gonococci survive

FIG. 3.—Throat swab with a clear view of the fauces.

better in discharges collected on linen rather than on cotton-wool (see Mackie and McCartney, 1953). If, then, the serum swab is used, and assuming a moderately heavy coating with the suspected pathogen, bacteriological examination of such material usually yields a valid result when cultured within the following time limits:—(1) organisms viable for less than eight hours: gonococci and meningococci (see alternative methods listed above); (2) organisms viable for eight hours: *H. pertussis*, *C. diphtheriae*, *V. cholerae* (moist swab); (3) organisms viable for twenty-four hours: haemolytic streptococci, pneumococci, *Str. viridans*, and *Cl. welchii*; shigellae and salmonellae on moistened swabs; and (4) organisms viable for forty-eight hours; staphylococci, coliform bacilli, proteus, and pyocyanea.

Throat Swabs

The throat swab is used principally to collect material from the faucial area in patients suffering from acute pharyngitis or tonsillitis or suspected Vincent's angina, and in the detection of contact, convalescent, or chronic carriers of haemolytic streptococci or *C. diphtheriae*. The operator must have a clear view of the whole fauces in a good light and see the swab touching the affected surfaces (Fig. 3). The patient should be sitting up or standing with the head tilted back; with children or nervous patients an assistant should support the back of the head with one hand, to prevent sudden or unexpected movement, and hold the patient's hands with the other. If good natural lighting cannot be obtained a hand torch must be used; some tongue depressors

FIG. 4.—Nasopharyngeal swab passed through the nose.

have an illuminated tip which does equally well. It is wise to use a tongue depressor even with patients whose throats can be clearly seen. It should be placed in one movement firmly on the back of the tongue, after which the swab is inserted and rubbed over the faucial area, gently if the throat is acutely inflamed, more vigorously if searching for carriers. In suspected chronic tonsillar carriers or infections the swabbing may be preceded by pressure with the fingers on the tonsils to squeeze out secretion in the tonsillar crypts. When Vincent's angina or moniliasis is suspected two swabs should be taken, as one will be required for the preparation of smears for direct microscopical examination, which, however, has little or no value in other acute throat infections. Throat swabs are preferred to throat washings for the isolation of poliomyelitis virus from the oropharynx.

Nasopharyngeal Swabs

Some pathogenic or potentially pathogenic bacteria that colonize the upper respiratory tract are to be found predominantly in the nasopharynx or post-nasal space. These include the meningococcus and pneumococcus, and in whooping cough *H. pertussis* is most conveniently isolated by nasopharyngeal swabbing. This area may be reached with a swab passed through either the mouth or the nose. The peroral swab with its bent tip is passed to the back of the throat—a tongue depressor is essential—and then slipped up behind the uvula to the post-nasal space. In infants it may be very difficult to pass the swab up behind the uvula, and instead the tip may be directed downwards to the posterior pharyngeal wall. The pernasal swab is passed more or less horizontally along the floor of the nasal passage (Fig. 4), with the patient's head held firmly because of the natural

FIG. 5.—Swabbing anterior nares for staphylococcal carriers.

tendency to withdraw. If contamination with bacteria in the anterior nares is to be avoided, a nasal speculum should be used.

Nasal Swabs

Swabs may be taken from two different sites in the nasal cavity as well as from the post-nasal space. A high proportion of the population carry *Staph. aureus* in the nose, and this organism is found particularly in the vestibule or entrance to the nostrils, where it multiplies on the moist invaginated squamous epithelium. In searching for staphylococcal nasal carriers, therefore, it is sufficient to rub a moistened swab round the vestibule of both nostrils (Fig. 5). If, on the other hand, material is to be examined for infection of the nasal mucosa or associated paranasal sinuses, the swab should be rubbed over the turbinates. Similarly in searching for nasal carriers of pathogens like *Str. pyogenes* or *C. diphtheriae* and in obtaining swabs from young children with suspected pneumococcal respiratory infection the swab should be inserted $\frac{1}{2}$ -1 in. (1 to 2.5 cm.) into the nasal cavity, again using a speculum if contaminants from the vestibule are to be avoided.

Laryngeal Swabs

The laryngeal swab has only recently come into frequent use for obtaining lung secretions in early suspected cases of pulmonary tuberculosis or in convalescing patients who have become sputum-free. With a little experience, at first using a laryngeal mirror, the doctor will find that for this purpose the laryngeal swab has advantages over stomach washings, in that the patient is more willing to co-operate in having repeat swabs taken. The bacteriologist also prefers it because it is easier to handle. It is, however, essential that the swabs should reach the laboratory within a few hours of being taken.

The patient, sitting up and with his head tilted back, is asked to open his mouth widely. The operator, who should wear a mask, catches the tongue in a gauze swab and pulls it forward so that the patient tends to "gag." The laryngeal swab is dipped in sterile water or saline and then with or without the aid of a mirror is passed down into the larynx, when the patient may be asked to cough but usually does so without being asked. Two successive swabs should be taken, placed in the test-tube container, and transported by messenger to the laboratory as quickly as possible.

Eye Swabs

Swabs may be taken from the conjunctival mucosa when it is inflamed or as a preliminary to operations on the eye to exclude the carriage of pathogenic bacteria. The patient is asked to look up. The lower lid is everted and a fine swab is rubbed gently along the conjunctival surface.

Ear Swabs

Infection of the ear may occur in the external meatus or in the middle ear. In otitis externa a fine swab is rubbed gently over the inflamed area. In suppurative otitis media accumulated discharge must first be cleaned away before the swab is taken, preferably through an aural speculum, so that if possible the bead of pus oozing through the perforated membrane is collected.

Skin Swabs

Swabs may be taken from the intact skin in searching for carriers of pathogenic staphylococci among food-handlers in an outbreak of staphylococcal food-poisoning or among hospital staff and patients in outbreaks of staphylococcal infection—for example, wound infection, pemphigus neonatorum, or lactation mastitis. Moistened swabs should be rubbed over the skin of the fingers, back and front, or an area of about 1 sq. in. (6.5 cm.²) on the back of the wrist may be swabbed.

Rectal Swabs

Swabs may be taken from the rectum for the bacteriological diagnosis of infantile gastro-enteritis, bacillary

dysentery, or enteric fever, but in spite of the advantages of the rectal swab in convenience and hygiene of collection it does not allow the full examination for parasites, etc., that is possible with a specimen of faeces. The rectal swab has been used particularly in swabbing groups of young children in day or residential nurseries during outbreaks of Sonne dysentery to find out quickly the incidence of cases and carriers in the group. Whenever it is used, it is important to ensure that, with the patient lying on his side, the swab is pushed well into the rectum and that it is covered with faecal material when withdrawn. The swab must be cultured within a few hours of collection unless some method for keeping it moist is adopted. It is most convenient for collecting specimens from young children; in children over the age of 3 years the doctor should for psychological reasons explain to the patient what he intends to do. It is unnecessary to use a speculum in collecting specimens from children under 5 years of age, but a specially made glass or rubber speculum may be used in older children and adults.

Perianal Swabs

In suspected cases of threadworm infestation a special swab (see p. 1095) may be used to collect scrapings from the anal region, where the ova are frequently found. The edge of the cellophane swab is scraped through the perianal folds and the swab is then transported in the test-tube container to the laboratory, where the cellophane is removed and the swab placed faeces side down in a drop of N/10 sodium hydroxide.

Vaginal or Cervical Swabs

Vaginal discharge may be derived from inflammation of the vagina itself as in trichomonal infection and the vulvo-vaginitis of children, or from the cervix or uterus as in gonococcal and puerperal infections. For the bacteriological examination of most of these infections in adult women the practitioner will find it most practicable to take a high vaginal swab with the patient lying on her side. The external labia and perineum should first be cleansed with warm water, swabbing towards the rectum in one movement. A Cusco bivalve speculum or a Sim duckbill speculum is introduced and an ordinary throat swab is passed into the posterior vaginal fornix. A cervical swab can be taken satisfactorily only with the patient in the lithotomy position, when with a Cusco speculum the cervix is exposed and the swab introduced. In cases of suspected trichomonal infection some of the discharge should be collected with a Pasteur pipette, which is then sealed with plasticine so that the fresh specimen can be examined as a wet film under the microscope. But a swab may be used, provided enough of the discharge can be collected to allow preparation of the wet film.

For the vulvo-vaginitis of childhood the patient should be lying in the dorsal position with the knees drawn up and the thighs separated as far as is possible without hurting the child. Any superficial discharge is removed and the external genitalia are separated with gloved thumb and first finger of the left hand. The swab must be pushed well into the vagina and withdrawn with some discharge on it. The first swab is used to prepare a smear and the second for inoculation on suitable culture media as soon as possible.

REFERENCES

- Aycock, W. L., and Mueller, J. H. (1950). *Bact. Rev.*, **14**, 115.
 Cockburn, W. C., and Holt, H. D. (1948). *Monthly Bull. Minist. Hlth, Lond.*, **7**, 156.
 Downie, A. W. (1940). *Lancet*, **2**, 36.
 Hewlett, R. T., and Nolan, H. (1896). *British Medical Journal*, **1**, 266.
 Mackie, T. J., and McCartney, J. E. (1953). *Handbook of Practical Bacteriology*, 9th ed., p. 371.
 Preston, W. J. D. (1896). *British Medical Journal*, **1**, 1243.
 Rubbo, S. D., and Benjamin, M. (1951). *Ibid.*, **1**, 983.
 Saint-Martin, M. (1949). *Canad. J. publ. Hlth*, **40**, 78.
 Stuart, R. D. (1946). *Glasg. Med. J.*, **27**, 131. (See Browning and Mackie, *Textbook of Bacteriology*, 19th ed. (1949), p. 215.)
 Tarr, H. A. (1946). *Monthly Bull. Minist. Hlth, Lond.*, **5**, 187.

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