July 1, 1959

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ANORECTAL SURGERY

Recent Observations on the Anatomy of the Anal Canal

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THE interest in the detailed anatomy of the anal canal aroused twenty-five years ago by Milligan and Morgan (1934) has been sustained, and indeed of recent years has heightened. Papers written on both sides of the Atlantic have added to our understanding of what is unquestionably a difficult and somewhat variable anatomical territory, and mention may be made of those by Courtney (1950), Uhlenhuth (1953), Ewing (1954), Gorsch (1955), Goligher *et al.* (1955), Morgan and Thompson (1956), Parks (1956, 1958) and Walls (1958). Nor have investigators confined themselves to purely static studies of post-mortem material, for as later references will show the functional anatomy of the region has also received considerable attention.

The Sphincteric Musculature

Pride of place must be given to the external sphincter composed as it is of striped muscle fibres innervated by somatic nerves. As is well known, the response of this muscle even to light touch is brisk, but for a fuller appreciation of its activity in various circumstances recourse may be had to electromyography (Floyd and Walls, 1953). Using surface electrodes placed on the skin overlying the subcutaneous part of the sphincter, it can be shown that during waking hours the external sphincter is always in a tonic state, the degree of which increases considerably with any rise in intra-abdominal pressure. Activities such as straining, coughing or even speaking cause an immediate increase in tone, but should the subject strain as if to defæcate the sphincter relaxes (Figs. 1–3). The question of the nervous pathways involved in sphincteric activity has been the subject of much study and the findings of Garry (1957), Gaston (1948), Goligher and Hughes (1951) and Goligher (1951) should be consulted. The great sensitivity of the lining of the canal from the level of the anal valves downwards is well recognized, and no doubt has some bearing on sphincter control; even so, it does not seem to have attracted a great deal of attention from histologists. However, Duthie and Gairns (1958) have recently made important observations on human material, a number of which my colleague R. P. Gould and I have been able to confirm in our own specimens. In the hairy perianal skin no organized nerve endings were found but, in the subepithelial tissue of the "skin" of the anal canal, endings similar to Krause end-bulbs occurred quite frequently (Fig. 4). It is easy to follow tradition and accept such endings as specialized receptors; however, careful investigation of the innervation of the cornea has led Oppenheimer *et al.* (1958) to suggest that such endings represent "stages in cycle of growth and decay in certain peripheral nerve fibres rather than specialized 'sense organs' ". Whatever the truth may be, there is no doubting the richness of innervation of the anal canal "skin" and anal valves. That the latter structures represent the remains of the anal membrane of early fœtal life may or may not be true, but even should the former view prevail it does not necessarily mean they are useless vestiges. It could be that they provide an increased area of sensory surface.

Muscle spindles, these highly organized structures so important in the regulation of the activity of voluntary muscle, are much in the news these days. Following a careful search of the external sphincter a number of structures have been identified by my colleague and myself in routinely stained cross sections of that muscle which bear all the characters of spindles (Fig. 5). To demonstrate their nerve supply it will be necessary to examine suitably impregnated sections of the muscle cut along its length before a fuller histological statement can be made. Even so the time seems ready for further anatomico-physiological investigation in this field.

The Involuntary Muscle of the Anal Canal

Surrounding the canal are the continuations of the circular and longitudinal coats of the bowel. The circular coat is thickened to form the internal sphincter, an involuntary muscle with its fibres arranged in characteristic bundles so disposed that, as seen in transverse section, the upper bundles overlap one another with an inclination downwards towards the lumen. This disposition is modified towards the lower end of the muscle where its bundles lie horizontally and indeed the lowest of its bundles incline somewhat upwards. The internal sphincter is an impressive structure and it is of interest that Goligher (1951) found little if any disturbance following its division.

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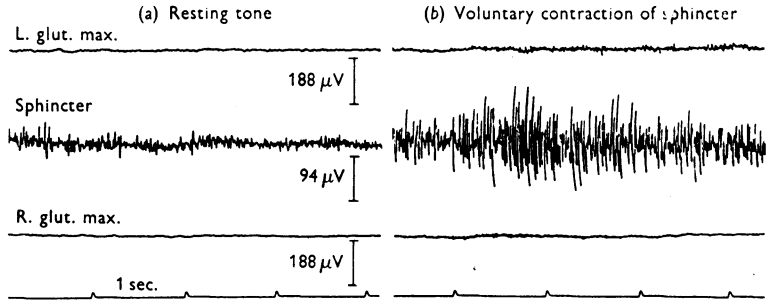

FIG. 1.—Simultaneous electromyograms of external anal sphincter together with both gluteus maximus muscles, subject lying on his left side, showing (*a*) resting tone, (*b*) voluntary contraction of sphincter.

Figs. 1–3 are reproduced from Floyd and Walls (1953) by kind permission.

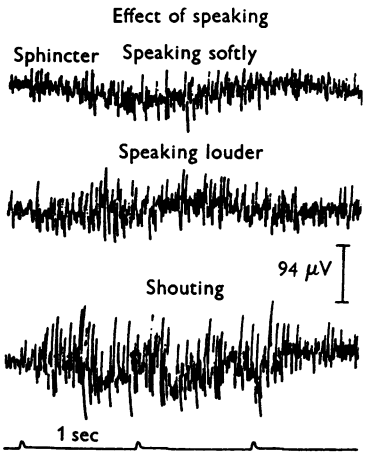

FIG. 2.—Electromyogram of external anal sphincter showing gradation of activity with increase of volume of speaking. Subject lying on couch on his left side.

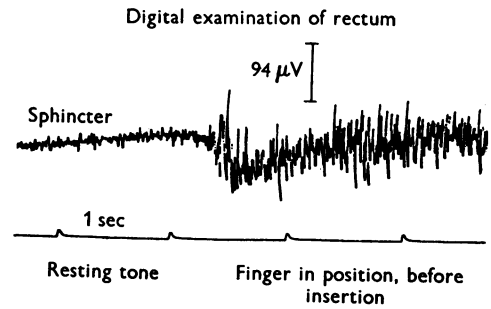

FIG. 3.—Electromyogram of external anal sphincter showing the sensitivity to light pressure with the finger on the anal margin. Subject lying on couch on his left side.

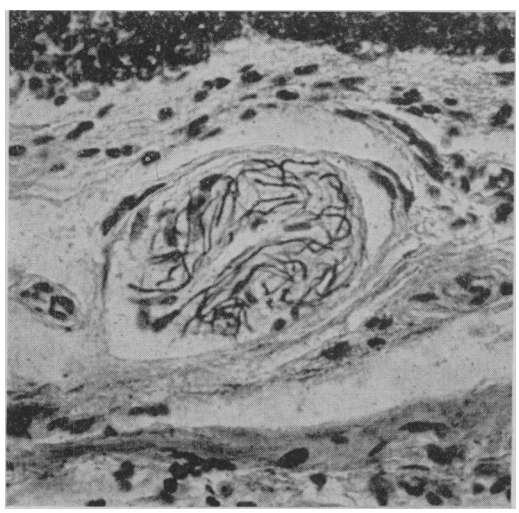

FIG. 4.—Krause end-bulb type ending in the lining of the human anal canal. Bodian's silver protargol method. ×380.

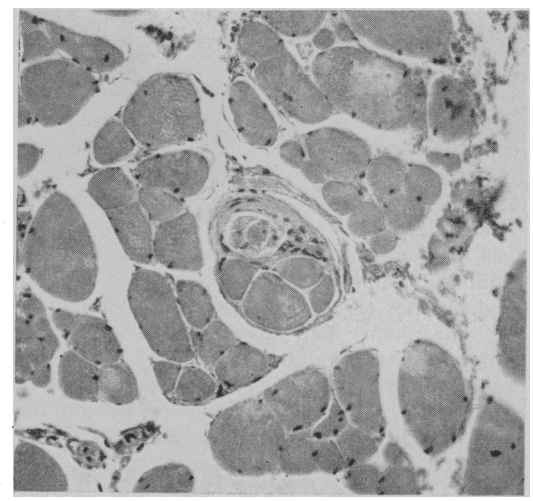

FIG. 5.—Muscle spindle in human external anal sphincter. Hæmatoxylin and eosin. ×170.

The spaces which lie between the bundles of this sphincter are traversed by strands of tissue and blood vessels. A point in dispute is whether fibres from the longitudinal muscle coat pass through the internal sphincter to join the subepithelial tissue of the canal. My observations lead me to think that the sphincter bundles are mainly separated by connective tissue. Here and there slips of the longitudinal muscle can be seen passing for a short distance into the sphincter but they seem to give way quickly to fibrous tissue. With regard to possible pathways for the spread of infection the point does not seem to be material.

Followed downwards the longitudinal muscle coat becomes increasingly fibro-elastic and divides into a number of strands which pass through the subcutaneous portion of the external sphincter to join the skin.

The nature of the subepithelial tissue of the canal has been the subject of much study, and papers by Fine and Lawes (1940), Goligher *et al.* (1955) and Parks (1956, 1958) should be consulted for details. An important conception is that of Parks who by an injection technique has demonstrated that the mucosa is specially well tethered to the internal sphincter in the region of the anal crypts. Parks has named the anchoring tissue the mucosal ligament, and it is interesting that it is concentrated round the anal glands, the small but important structures known also as intramuscular or crypt glands.

The Epithelium of the Anal Canal

Over the years many descriptions have been given of the epithelium lining the last inch or two of the alimentary canal. The matter is one of special importance to the pathologist, faced as he is by the formidable range of tumours which the region may present. Put simply, the situation is that the true skin of the perianal region, with its hairs and sebaceous, sweat and apocrine glands, merges into the modified skin which lines the canal as far as the anal valves. This anal canal "skin" consists of stratified squamous epithelium from which hairs, sebaceous and sweat glands are virtually absent, and in which the pigment content diminishes as the valves are neared.

Some distance above the valves, in my material from 1–9 mm., intestinal mucosa begins. In this zone of variable extent between the valves and the commencement of intestinal mucosa the type of epithelium found varies greatly. In some specimens stratified squamous epithelium alone is found, in others stratified columnar; again, stratified columnar may be found in the crypts only to give way to stratified squamous above; patches of simple columnar epithelium may occur and even transitional epithelium seems on occasion to be present. It is clear that the zone is fickle as regards its epithelium, but being an embryological junctional zone, perhaps this is not to be wondered at. For the pathologists, an awareness of the normal range of variation is of fundamental importance.

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Hæmorrhoidectomy

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"The secret things belong unto the Lord our God: but those things which are revealed belong unto us and to our children for ever that we may do all the words of this law."

"... and ye shall know the Truth and the Truth shall make you free."

WHEN I began surgery there was a confusing choice of operative methods for hæmorrhoids. Perfection of results was prevented by failure of wounds to heal, post-operative external skin tags, and anal stenosis. Indeed stricture at mucosal level or painful and undilatable narrowing at skin level occurred in 10% of cases after the operative methods of that time. In the past the operation for hæmorrhoids was done by instinct and imitation; now it is based on anatomy and physiology.

The operation that holds the floor to-day in this country is that of ligature and excision. 7,400 such operations have been done at St. Mark's Hospital since 1935, an average of 322 each year.