needling of the liver and produced 30 ml. of "anchovy" pus. Some air was returned, and *x*-ray films showed the abscess cavity. He made an uneventful recovery on emetine.

Discussion

Amoebic abscess of the liver is relatively common in this country: apart from the two patients recorded above, I have seen 15 further cases in civilian practice since 1946, 14 of these in Ipswich since 1949. For comparison during the same period I have seen two examples of liver abscess, apparently not amoebic; one contained *Haemophilus influenzae* the other *Staphylococcus aureus*. Of the series of 15 patients all but one were men, all had been in the tropics or subtropics at some time, though in many instances the "incubation period" was long enough to raise doubts whether their infection may not have been indigenous in origin.

Cases of Liver Amoebic Abscess Seen During 1946–60

Sex	Age	Incubation Period	Leucocytosis	Lobe of Liver
M	39	8 years	0	Right
M	38	15 ,,	0	,,
F	53	8 ,,	+	,,
M	52	11 ,,	0	,,
M	39	7 ,,	0	,,
M	33	6 months	+	,,
M	56	20 years	+	,,
M	72	50 ,,	0	,,
M	55	35 ,,	+	,,
M	21	6 months	0	,,
M	35	11 years	+	,,
M	43	7 ,,	+	,,
M	29	2 ,,	0	,,
M	47	25 ,,	+	Left
M	?	10 ,,	+	Right

The Table gives the age of these patients and the time interval since their last residence abroad. In only one case did the abscess present in the left lobe of the liver, and in seven there was absence of leucocytosis—a common feature of the disease, but one to which attention cannot be drawn too often because the diagnosis of hepatic amoebiasis is often ruled out of consideration by doctors without tropical experience, because of a normal white blood count.

There is little doubt that unrecognized amoebiasis exists in Great Britain, both as amoebic dysentery under the guise of ulcerative colitis, of which I have seen six samples, and under the diagnosis of non-specific, or cryptogenic, liver abscess.

When one recalls the attention to detail required in the collection of specimens and in laboratory identification, even in hot climates, it would not be surprising if many vegetative *E. histolytica* or cysts were missed in our colder country, with, for the most part, its inexperience in techniques. But, of course, it is exceptional to find the faeces positive in the hepatic form of the disease.

I believe that amoebiasis is rarely thought of when liver abscess arises in patients who have never been abroad, possibly with tragic results; I therefore recommend a therapeutic trial of emetine and chloroquine as of equal importance to antibiotics in all patients when liver abscess is suspected, and before resort is made to surgical drainage.

Summary

A case of amoebic abscess of the liver is recorded arising indigenously in a boy who had never left this country apart from two holidays in Northern Europe. A second case is described in a man who lived in Northern Europe all his life except for a three-months holiday in Marseilles.

Amoebic liver abscess is not rare in Great Britain, and reference is made to 15 further examples seen between 1946 and 1960, all of whom had lived at some time in accepted endemic areas.

In several of them the incubation period between residence in the tropics and onset was a long one. A trial of emetine and chloroquine, as well as antibiotics, is recommended in hepatic abscess of unknown aetiology before surgical intervention.

Case 2 was under the care of Dr. G. E. Beaumont, and I thank him for permission to publish the clinical details.

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PATHOGENESIS AND TREATMENT OF FISTULA-IN-ANO

BY

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[WITH SPECIAL PLATE]

Descriptions of fistula-in-ano are found in the oldest known medical writings. The condition would appear to have been commoner in ancient and mediaeval times than it is to-day, since it occupies more space in old manuscripts than its present frequency would justify. John of Arderne gave an excellent account of the disease and its treatment in the fourteenth century; his writings have been quoted frequently since the transcription of the manuscripts in the British Museum by D'Arcy Power (1910). From ancient times to the present day, treatment has remained the same—namely, operation in the form of a "lay-open" with knife or cautery or the use of a seton.

Perhaps the most widely held theory concerning the cause of fistula is that infection penetrates the wall of the anal canal through a fissure or other wound and that the infected track, once established, is maintained by faecal contents entering the internal opening. The "lay-open" procedure is based on this concept of aetiology. Any attempt at simple excision of the fistula is doomed to failure, because the surgical wound would also be affected by faecal contamination and would not heal. The only possible treatment, on this view, is to incise the track so that it becomes part of the anal canal. Provided that epithelization occurs from the edges the wound will become a new segment of the anal wall. Should the wound edges close over and heal prematurely the fistula will re-form deep to them.

However, infection rarely crosses the wall of any part of the large bowel spontaneously unless there is a free channel in the form of a diverticulum or ulcer. One of the most cogent arguments against the theory that infection is caused by an anal wound is the extreme

rarity with which haemorrhoidal operations or injections are followed by perianal infection (Eisenhammer, 1958). These wounds become superficially infected only; infection does not penetrate into the perianal tissues. Finally, the view that recurrent faecal soiling is the cause of persistence of a fistula is rendered virtually untenable by the fact that about 50% of cases do not have a clinically detectable internal opening, and any break in the anal mucosa which cannot be seen or probed is unlikely to allow sufficient contamination to perpetuate infection.

The French anatomists Herrmann and Desfosses (1880) first described some small glands which ramify in the internal sphincter ani and the submucosa of the anal canal, finally discharging into the lumen at the muco-cutaneous junction. They suggested that infection in these glands could be a cause of fistula-in-ano. This view has been reiterated on many occasions, notably by Lockhart-Mummery (1929), Gordon-Watson and Dodd (1935), and Hill, Shryock, and ReBell (1943). Tucker and Hellwig (1934) demonstrated infection in and around the glands in cases of fistula, and suggested that the chronicity of the condition is due to the presence of anal-gland epithelium in the part of the track near the internal opening. They pointed out also that infection may destroy part of this epithelium, leaving only remnants behind. Kratzer and Dockerty (1947) examined over 100 anatomical specimens histologically, and though they did not use serial sections they found anal glands in 55% of specimens; in 33% the ducts penetrated the internal sphincter. They noted that the direction of the ducts is downwards and that the epithelium is mucus-secreting. In 10% of their cases the glands were surrounded by lymphocytic deposits. Dunphy (1948) repeated the theory that fistula is due to anal-gland infection, and stressed the importance of its complete extirpation by excising the walls of the track near the internal opening.

Eisenhammer (1956, 1958) goes further than previous writers and ascribes most anal abscesses and fistulae to anal-gland infection in the space between the internal and external sphincters. His views represent a considerable advance in the theory and practice of treatment of these conditions. In particular he suggests that most anal fistulae should be treated by an intra-anal approach; he advises internal sphincterotomy to reveal the intermuscular abscess. Unfortunately, his papers do not contain pathological confirmation of his views.

It may be suggested that, as the "lay-open" type of operation is successful in practice, an attempt to find alternative methods of treatment is misguided zeal. The "lay-open" operation is indeed usually effective and uncomplicated when applied to the common low-level fistula, but it has grave disadvantages when used for the high varieties. In the latter case wounds are produced which may take as long as two months to heal, during which time they have to be carefully dressed to avoid the edges healing over. The nursing care of such cases is tedious and may cause the patient considerable pain. In certain cases the healed wound is scarred and painful. Complicated descriptions in various text-books testify to the great difficulty in treating the fistula whose track passes above all the anal sphincters. In unskilled hands treatment of this last type may lead to very serious consequences indeed; fortunately it is rare.

The unsatisfactory understanding of the pathology of fistula and the need for improvement in operative treatment have led to the present investigation. It must be emphasized that fistula of known pathogenesis such as tuberculosis, Crohn's disease, ulcerative colitis, and penetrating foreign bodies, all of which constitute only a small proportion of cases, are excluded from this study.*

Anatomy

It is first necessary to recapitulate briefly the essential features of the anatomy of the ano-rectal region (Fig. 1). Two sets of viscera, the alimentary and genito-urinary,

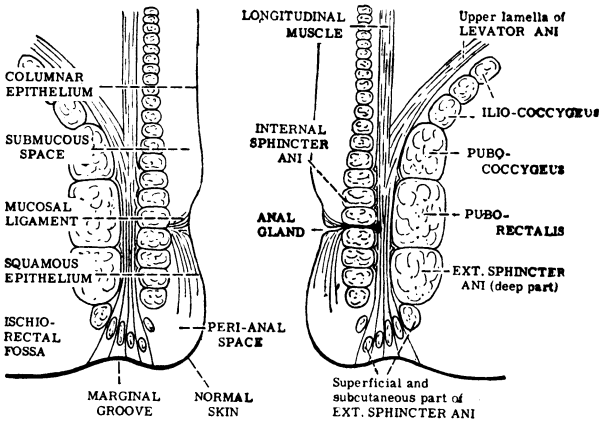

FIG. 1.—Diagrammatic section through the anal canal. The visceral muscles form a tube which is surrounded and controlled by the somatic muscles, the external sphincter, and pubo-rectalis.

pass through the pelvic hiatus (Parks, 1958). Being visceral structures, they contain only smooth muscle in their walls and are innervated by the autonomic system. As they pass through the hiatus, somatic muscles forming part of the muscular diaphragm are specially developed to form sphincters around them. These, which include the pubo-rectalis, not only prevent prolapse through the only weak point of the diaphragm, but enable voluntary control to be established over the visceral exits. In the anal region proper the visceral part consists of mucosa, circular muscle (the internal sphincter), and the longitudinal layer. Surrounding it are the various components of the external sphincter and pubo-rectalis muscles. These somatic muscles form a continuous layer, and the division into separate parts is largely empirical, though sometimes helpful in practice. The anal mechanism may therefore be likened to two tubes one within the other; the visceral tube is surrounded (and controlled) by the somatic one. Fibrous septa occur in the somatic muscles in a haphazard fashion and are unreliable guides to the possible course of fistulous tracks. Between the somatic and visceral components (external and internal sphincters) the longitudinal layer is found; it is a natural plane in which pus can readily spread.

Somatic skin should theoretically cease at the anal margin, but in fact it is found, albeit in modified form, up to a point roughly half-way along the anal canal. Here squamous mucosa changes to columnar, but this often occurs through a zone of transition; the mucosa at this point is variable, but it usually consists of stratified cells with a surface layer which is columnar and mucus-secreting. The anal glands (or ducts) discharge into the zone of transition opening into the base of the anal crypts. Around them the fibromuscular tissue of the submucosa is thickened, and is attached both to mucosa and to the internal sphincter to constitute what I have previously called the "mucosal ligament" (Parks, 1956a). This forms a partial barrier in the

*Also excluded are the very shallow sinuses which are occasionally formed as the result of the healing of the edges of an anal fissure.

submucosa separating the submucous space above (in which internal haemorrhoids are found) from the perianal or marginal space below. Somatic nerves supply the mucosa up to, and including, the zone of transition. Above this point the autonomic system takes over.

Method of Study

The structures in the anal region most likely to serve as channels for the spread of infecting organisms are the anal glands, as only these constitute an open canal between the lumen of the gut and the connective tissue of the sphincter muscles. It was decided, therefore, to make a further, more detailed investigation of their anatomy in normal tissue.

Material for study was obtained at necropsy and also following radical excision of the rectum for carcinoma. Altogether 44 specimens were obtained from patients of varying ages; 13 removed at necropsy consisted of the whole pelvic floor, including bladder and vagina or prostate and urethra. These were reconstituted into as nearly a natural state as possible before fixation and embedding. Sections were prepared in sagittal, coronal, and transverse planes in different specimens. In 31 cases in which only the anal canal itself had been removed the specimen was cut anteriorly in the axis of the bowel lumen and pinned out flat. Sections were cut longitudinally. Specimens from adults (28) were cut into serial sections by a method previously described (Parks, 1956b). This is a thick-section, celloidin method which is the only practicable way of examining serially a large quantity of tissue.

Specimens obtained from stillborn infants (16) or children dying a few days after birth, in which the amount of tissue is small, were prepared with the usual paraffin-embedded serial section technique.* In this way every part of all 44 specimens was examined and a comprehensive picture obtained of the anal canal and the surrounding structures. Details of the results will be published elsewhere; only those particularly pertinent to the aetiology and anatomy of fistula-in-ano will be described here.

Results of Study

Anal glands were found in all specimens. Usually between six and ten glands are found around the anal circumference. Each discharges into an anal crypt, and sometimes two enter the base of one crypt. About half of the total number of crypts in any specimen have no glands entering them.

The anatomy of the glands is variable. They branch immediately into a racemose structure of widely ramifying ducts. The ducts usually end blindly, but in three cases small cystic dilatations of the terminal portion of a duct were found. In one such case the cyst was 0.5 cm. in diameter. Branches of any one gland may extend over an area of about 1 cm. square. The commonest direction of spread is downwards into the submucosa of the perianal space. In no case did branches extend upwards above the level of the anal crypts.

The histology of the glands is of considerable interest. The epithelium lining them is similar to that of the intermediate zone of the anal canal which lies between the true squamous mucosa below the anal crypts and the glandular epithelium of the upper anal canal. The cells are arranged in a stratified and often in a "palisade" fashion. The surface layer consists of elongated columnar cells, the luminal border of which stains strongly with P.A.S. and other mucin stains (Special Plate, Fig. A). They are not usually goblet cells. Their mucin content enables them to be identified even in grossly pathological material when only a remnant of epithelium may be left.

Anal glands would be of academic interest only were it not for the fact that some send branches into the internal sphincter. In two-thirds of the specimens one or more branches entered the sphincter; in one-half, branches crossed the sphincter completely to end in the longitudinal layer. No branch was observed to go beyond the longitudinal layer into the external-sphincter group of muscles. This would be predicted on theoretical grounds, as it will be recalled that the anal mechanism has two parts, visceral and somatic; the two parts are fused together, but do not intermingle, and hence it would not be expected that a visceral structure such as an anal gland would extend into a somatic group of muscles.

Several branches of one anal duct may pierce the internal sphincter at different levels. They plunge radially through, following one of the many intersecting fibrous-tissue septa. Once in the longitudinal layer they usually terminate abruptly, but in one case a duct further divided to form a gland-like structure. This specimen was obtained at operation following a radical excision of the rectum (Fig. 2). The darkly staining area around the terminal ductules is lymphoid tissue; there was no history of perianal infection in this patient.

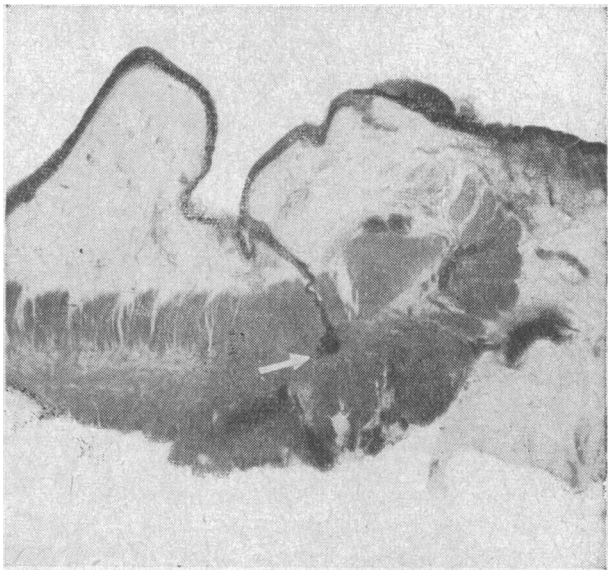

FIG. 2.—Thick section (500 μ) through the anal canal which shows an anal gland (arrowed) penetrating the internal sphincter. It breaks up into short terminal branches in the longitudinal layer; surrounding these is a darkly staining area of lymphoid tissue. (×4.)

The anatomical arrangement is of great practical importance, because it means that the site and extent of an anal gland is predictable. It will be found in the lower half of the anal canal within the submucosa, internal sphincter, and longitudinal layer, but not beyond. It may be that on certain rare occasions congenital abnormalities of development result in a gland extending upwards into the rectal wall or into the somatic muscles; this does not invalidate the practical value of the knowledge of the normal arrangements just described.

*I am indebted to Mr. Ian McColl, who performed this part of the investigation, for permission to use his results in this paper.

Discussion

The facts elucidated in this anatomical study naturally caused speculation as to their practical implications. For reasons previously stated it is hard to believe that the ordinary type of fistula-in-ano is maintained merely by faecal infection of its internal orifice. Anal glands provide free channels for infection to pass from the anal lumen deep into the sphincter muscles. Organisms entering by this route could set up acute inflammation in the longitudinal layer, which might then spread

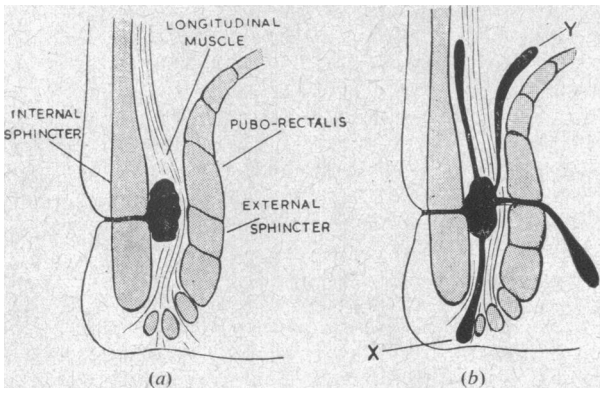

FIG. 3.—Diagrams to illustrate the spread of infection from the primary anal-gland abscess (*a*) into the surrounding tissues (*b*). The commonest course is that marked X, the most rare Y.

secondarily in almost any direction. If spread was downwards in the longitudinal layer an acute perianal abscess would result; if it passed outwards through the somatic muscles it would reach the ischio-rectal space (Fig. 3).

In the course of time such an abscess would subside. It is quite likely that the anal glands, in common with many other glandular organs, can become the seat of chronic infection. Bacteria can reside and multiply in a gland which either is cystic or has an obstructed lumen. Being deep to the internal sphincter, the abscess will not readily discharge itself into the anal canal; the circular-muscle coat of the bowel seems to be an effective barrier to infection. Once a chronic abscess has formed in this site infected material will continue to seep through any channel to the exterior. In fact, a fistula-in-ano is virtually a sinus secondary to a diseased anal gland, though the minute duct opening into an anal crypt makes it technically a fistula. This would fit in with the practical observation that about half the cases of anal fistula do not have a clinically detectable internal opening; in the remainder the overt internal opening is due to rupture of the intermuscular abscess through the internal sphincter into the anal canal. On this theory, then, fistula-in-ano is a granulation-tissue track which is kept open by an "infecting source"—that is, an abscess, deep to the internal sphincter, around a diseased anal gland. Knowing the anatomical site of the "infecting source," it should be possible to remove it and thereby allow the secondary track to heal. It must be emphasized at this point that the origin of a fistula is the abscess in the longitudinal layer; all other tracks and ramifications are secondary to this.

Operative Treatment

Thirty-eight patients with fistula-in-ano have been treated on the basis of the assumptions of the preceding paragraph. The crux of the operation is the removal of the "infecting source"—the infected anal gland and its surrounding abscess which lies deep to the internal sphincter in the mid-portion of the anal canal. The abscess is most easily approached and excised through the anal lumen. This procedure is usually supplemented by excising as much of the subsidiary track to the exterior as possible.

The first step is to identify the internal opening of the fistula, because it overlies the "infecting source." In about half the cases it is readily identified by probing the external opening. In the other half, however, no obvious breach in the anal mucosa can be discovered, though the probe can often be inserted to a point just under the mucosa. In doubtful cases it is helpful to insert some pale-blue dye (a strong dye will discolour the tissues) into the external opening and observe the appropriate region through an anal speculum. The dye will seep through the minute and otherwise invisible orifice of the duct in the base of a crypt.

The essential part of the operation is performed through a special anal speculum (Parks, 1956b). The aim is to remove a segment of the internal sphincter in which, and deep to which, the gland is situated (Fig. 4). It is not necessary to excise any of the external sphincter, because it is known from anatomical studies that glandular tissue does not extend into it. It is, therefore, important to be able to identify the internal from the external sphincters *in situ*. This is not usually difficult in the normal person, because the visceral internal sphincter is white, whereas the somatic external-sphincter fibres are reddish-brown. The area of operation is lightly infiltrated with adrenaline in saline (1 part of adrenaline in 100,000 parts of saline) to decrease

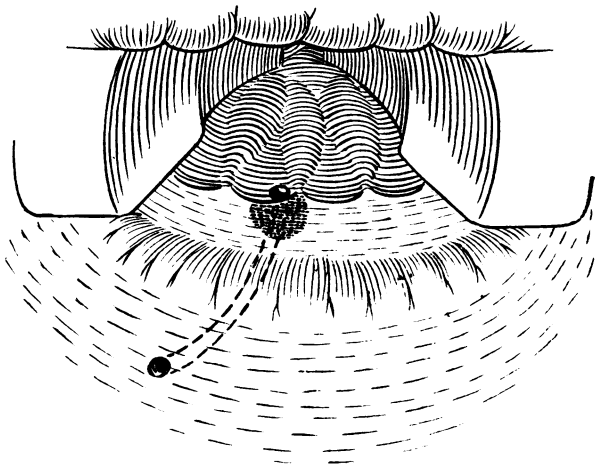

FIG. 4.—Exposure of the internal region of the fistula by means of an anal speculum. The abscess of origin lies deep to the internal sphincter.

capillary bleeding. This prevents the internal sphincter from becoming blood-stained and facilitates the differentiation between the two types of muscle.

An incision is made in the mucosa of the anal canal for about 0.5 cm. above and to the sides of the gland of origin (Fig. 5); it is continued downwards to complete an ellipse, the lowest part of which is at the anal margin. In this way an oval area is incised surrounding the internal opening of the fistula. The lower border of the internal sphincter is next identified in the floor of the wound (Fig. 5). A segment of it is excised corresponding to the overlying mucosal incision; it is dissected off the external sphincter, a manœuvre which is easy to perform until the intersphincteric abscess is approached. Here the two muscle groups are adherent

with inflammatory fibrous tissue and must be separated by cutting between them with scissors (Fig. 6). The intersphincteric abscess, which may have the typical appearance of an infected cyst, is lifted off the external sphincters with the excised segment of internal sphincter. In doing so the operator may discover the origin of a secondary track leading to the skin of the perineum (Fig. 7). The accessible part of this is curetted. The anal wound created by removing a segment of the internal sphincter is then carefully examined for any further subsidiary tracts. The commonest site to find one is in the longitudinal layer extending upwards deep to the circular muscle of the upper part of the anal canal. Such a track is excised or merely curetted.

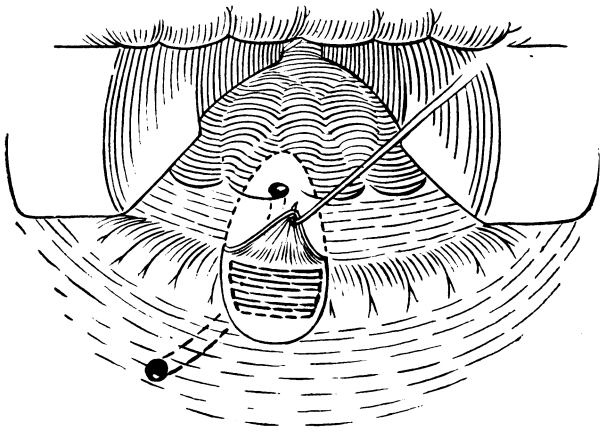

FIG. 5.—An oval incision is made around the internal opening and the lower border of the internal sphincter identified.

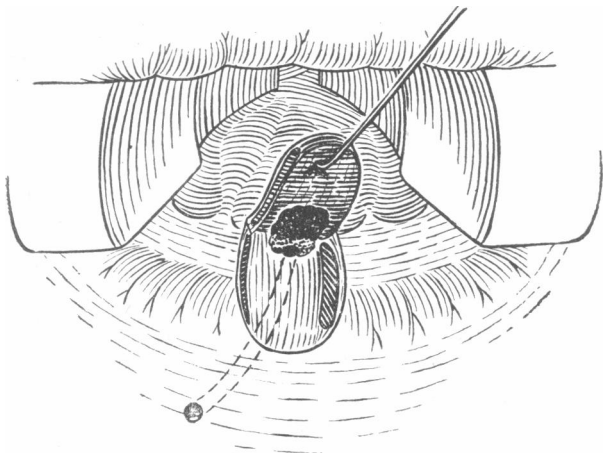

FIG. 6.—A segment of the external sphincter is incised corresponding to the mucosal incision. As it is dissected off the longitudinal layer the abscess of origin is discovered.

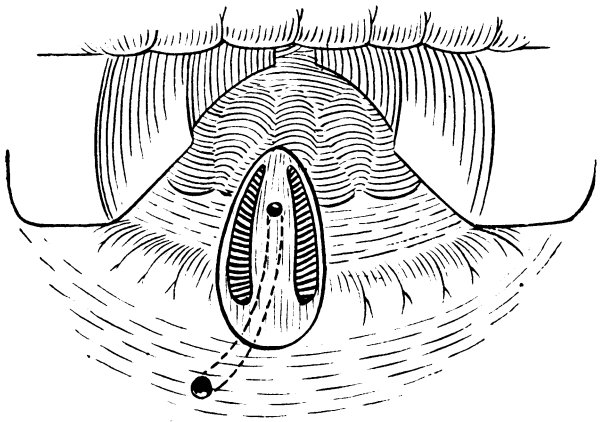

FIG. 7.—A segment of internal sphincter together with the abscess has been excised. A secondary track leading through the external sphincter to the skin is revealed.

Attention is now given to the part of the track which passes from the external sphincter muscle to the perineal skin. After making an incision in the skin around the external opening, this is simply cored out as far as the external sphincters (Fig 8). Here the dissection meets the anal wound, so that the fistulous track and surrounding fibrous tissue becomes free and is removed. It may be thought that this procedure creates a fistula far larger than the one present before operation. A large wound communicating between the anal canal and the perineum is indeed formed (Fig. 9*c*), but this surgically made track closes rapidly and is usually completely healed in four to six weeks. In the past attempts have been made to "core out" fistulae, but the majority have failed though some have been successful. The present procedure is a "core-out" supplemented by an intra-anal operation designed to eradicate the source of infection. Failure in the past was probably due in part to imperfect anatomical knowledge and in part to inadequate instruments to perform intra-anal operations.

The intra-anal exposure has the further advantage that blind tracks penetrating the external sphincter or ramifying high in the intersphincteric layer can be directly observed and explored. Eisenhammer (1958) also advocates an intra-anal approach, but recommends sphincterotomy for the treatment of low anal fistula. Though this may cure a proportion of cases, there will certainly be recurrence if the intersphincteric abscess,

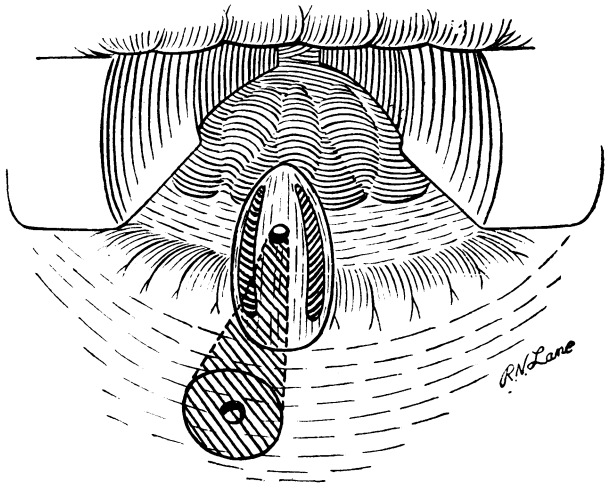

FIG. 8.—The external part of the track is cored out as far as the external sphincter.

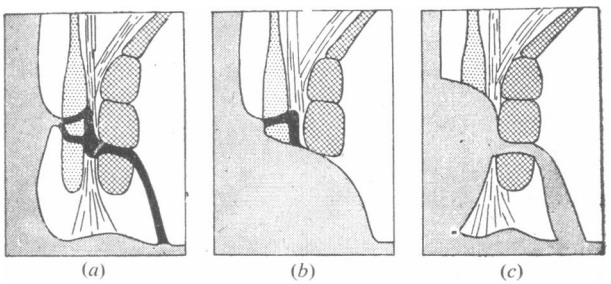

FIG. 9.—Sagittal sections of the anal canal to illustrate the origin and course of fistula-in-ano (*a*), together with the effects of operation (*b* and *c*). (*b*) Illustrates the results of "lay-open" and shows how part of the abscess of origin may be left behind. (*c*) Is the effect of the procedure described, and demonstrates how the external sphincter is conserved in its entirety. The upper one-third of the internal sphincter is also retained.

lined by anal-gland epithelium, is not thoroughly excised. In contrast, the procedure herein described is a partial internal sphincter*ectomy* of the abscess-bearing muscle. Fig. 9 illustrates (*a*) the origin and track of a mid-anal fistula, together with the result of treatment by (*b*) " lay-open " and (*c*) the operation described. Note that in (*b*) part of the abscess of origin may be left behind. It is important to leave at least the upper one-third of the internal sphincter intact; if all of it is divided the patient may become incontinent of flatus and fluid faeces.

If the external opening is close to the anal margin (a low-level fistula) the anal wound will encircle both internal and external openings and the operation will be similar to a " lay-open." When the external opening is situated in the skin over the ischio-rectal fossa, however, the two wounds are separated by a bridge of skin and external sphincter (Fig. 9*c*). The great virtue of the present procedure is that all the external sphincter is preserved. The higher the fistula, therefore, the more advantageous is this method, because with the " lay-open " technique the external sphincter is divided as high as the penetrating track.

Following the " lay-open " type of operation it is necessary to prevent the mucosal edges joining as a bridge over the wound, because this will cause the fistula to form again. The classical reason given for this is that any track with an internal opening in the anal canal will form a fistula. If the views presented here are correct, the efficacy of a " lay-open " is due to the fact that the anal-gland epithelium lining the fistula is made to form part of the wall of the anal canal. If the mucosal edges join over the incised track the fistula recurs, because this gland epithelium is still present and will line the new track as it did the old. By means of the technique described above, all anal-gland epithelium is removed, and hence the wound edges can unite without forming a recurrent fistula. No packing, irrigation, or other wound treatment is required; only an external dressing is needed until the serous discharge has ceased. As a result there is a considerable economy of nursing-staff time and the patient is saved the discomfort associated with the after-care of " lay-open " wounds.

Results of Operation

All wounds healed per primum. In those instances in which a skin or muscle bridge was left crossing the excised track of the fistula healing was equally uncomplicated.

In the past detailed descriptions of fistulous tracks were given, as it was believed that only by laying these open was it possible to eradicate the disease. The conclusion drawn from this study is that complete extirpation of the intersphincteric abscess of origin is the crucial factor for cure. It is possible that in certain cases a track may be connected with a secondary deeply seated, poorly drained abscess which will itself perpetuate infection. Clearly, treatment must be aimed at establishing proper drainage of this in addition to excising the primary abscess.

Pathology

One of the reasons for performing the operation as described above was to obtain the tissue around the " infecting source " and subject it to serial sectioning in an attempt to find anal-gland epithelium. This has been reported from time to time in the past (for example, by Gordon-Watson and Dodd), but it is not commonly found and is regarded as an unusual occurrence. Perhaps this is because in a " lay-open " only the external part of the track is likely to be removed and examined histologically.

Material from 30 consecutive cases obtained in this way was cut into serial sections. There were 16 low anal fistulae, but in 14 cases the track passed through the main part of the external sphincter. Two specimens were from children of 3 and 10 months of age respectively. In these 30 specimens stratified mucus-secreting columnar epithelium characteristic of anal-gland mucosa was found in all but two; there was some variation in amount and distribution. The cases can be grouped into five main categories: (1) there was gross cystic dilatation of an anal gland; (2) part of the inter-sphincteric abscess was lined by anal-gland epithelium; (3) part of the track was lined by anal-gland epithelium; (4) an anal gland was present but was not apparently part of the fistulous track; and (5) no anal-gland epithelium was discovered.

Those in the first category (8 cases) are the most interesting and probably provide the clue to the origin of fistula. At operation a cystic cavity containing pus and mucus is found deep to the internal sphincter in the lower half of the anal canal (Special Plate, Fig. B). This may communicate with the anal canal through an opening up to 2 mm. in diameter. Vegetable matter was present in two of the cysts (Special Plate, Fig. C), suggesting that faecal material was able to enter the ducts of these particular cases. Frequently, however, the duct passing through the internal sphincter which joins the cyst to the bowel lumen is minute and may be free from evidence of infection.

In the second and third groups (13 cases) there was a varying quantity of anal-gland epithelium lining the intersphincteric abscess or part of the fistulous track (Special Plate, Figs. D and E). In these cases also the origin of the disease is manifestly an infected anal gland, so that in this series 70% of cases were proved to have this aetiology. It would seem highly probable from the examination of the histological sections that infection started as in Group 1 with an infected cyst, but that part of the lining wall of the cyst has been destroyed in the course of the disease. In many cases the outline of the cavity closely resembles that of a cyst wall, but is covered with granulation tissue. Sometimes only a fragment of epithelium is found, and for this reason serial sections are essential if anal-gland mucosa is to be detected. In a few specimens this was discovered in only one or two sections of all that were cut. It is possible that in the cases where no epithelium was found at all, either it had been destroyed altogether or islets of tissue were missed despite diligent searching.

The reason why many have been sceptical about the theory that fistula was due to diseased anal glands is that these structures are so minute and insignificant when seen in normal tissue. Examination of the specimens described suggests an explanation of the problem. It is probable that the glands are abnormal before gross infection starts; they are not minute structures, but have attained diameters of up to 1 cm. as the result of cystic dilatation. The cause of this change, which was clinically obvious in eight cases of this series, could be either acquired duct obstruction or congenital abnormality. In 22 cases (73%) the abscess of origin was in either the anterior or the posterior commissure of the anal canal. Anal glands are distributed equally around the circumference, and it is unlikely that a congenital

change would be liable to occur more in one site than another. These two positions are the common sites in which anal fissure is found. It seems likely, therefore, that duct obstruction arises as a result of inflammation, the commonest cause being fissure. If this is true, it is odd that fistula is not a commoner complication of haemorrhoidectomy. Cystic anal glands are occasionally found in normal tissue; three were discovered in specimens examined during the anatomical part of this investigation, one of them being in a child of 4 years. It is interesting that fistula in young children does not select the anterior and posterior positions; it is equally distributed around the anal verge (Venturo, 1953). This suggests that the cause in children is a congenital abnormality of the anal glands.

In six cases extensive deposits of lymphoid tissue were found around the anal glands (Special Plate, Fig. F). Though these deposits are sometimes found in sections of normal anal tissue, their occurrence in such a proportion of cases of fistula (20%) makes it necessary to link them with the inflammatory process. Either they are caused by prolonged infection, or infection is more prone to occur in glands surrounded by lymphoid tissue in this way. In certain cases lymphoid follicles were present which closely resemble those found in the submucosa of the appendix. It is possible that the initial lesions of tuberculosis and Crohn's disease affecting the anal canal occur in them.

Conclusion

In this unselected series of 30 consecutive cases of anal fistula 21 (70%) were manifestly caused by infected anal glands. In 7 cases (Group 4) the histological evidence also suggests a similar origin of the disease, bringing the total which may be ascribed to this aetiology to 90%. It is submitted that this investigation provides conclusive proof for the view that infection in anal glands is the usual cause of the common type of fistula.

Summary

Forty-four complete specimens of the anal canal have been subjected to a serial section technique. Anal glands were found in all cases. In half of them branches of the glands crossed the internal sphincter completely to end in the longitudinal layer. The epithelium lining them is characteristic. It resembles squamous mucosa in that it is stratified, but also alimentary mucosa by virtue of its superficial layer of mucus-secreting cells.

The results of this investigation suggest that fistula-in-ano is caused by infected anal glands in over 90% of cases. It is unlikely that the disease starts in a normal anal gland. It is suggested that cystic dilatation is a necessary precursor to infection.

All the lesions healed uneventfully following the operative procedure described, the essential feature of which is excision of the intersphincteric abscess of origin. The operation may be difficult if much fibrous tissue has been deposited in the sphincter muscles; the features distinguishing between smooth and striated muscle are destroyed by repeated infection. A detailed knowledge of the muscles of the anal canal is necessary to avoid extensive muscle division in these circumstances.

In cases of low-anal intersphincteric fistulae this procedure is similar to a "lay-open," but is more radical. For higher fistulae, however, it has the great advantage that no part of the external sphincter is sacrificed, thus ensuring that full continence is retained and large, deforming wounds are avoided.

I would express my gratitude to Mr. H. J. B. Atkins, in whose department at Guy's Hospital the anatomical study was carried out; also to Mr. F. R. Nicholls, Mr. Soodeen, and Mr. Yap for technical assistance. I am deeply indebted to Dr. Basil Morson, Director of the Research Department, St. Mark's Hospital, for help in the interpretation of pathological material and for his constant encouragement and advice.

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CONTROL OF RESPIRATORY INFECTIONS IN CHILDREN BY TETRACYCLINE

BY

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The object of this investigation was to determine whether a therapeutic dosage of tetracycline for two days at the very start of an upper respiratory infection would prevent the development of bronchitis or disabling chesty colds in young children. The idea was inspired by the work of Ritchie (1958) on the prevention of colds in adults.

Plan of Investigation

It was necessary for there to be a past history of frequent colds going on to the chest, severe enough to put the child to bed or prevent attendance at school. Children aged 2 to 12 years inclusive were chosen. The information recorded about each child included the sex, age, father's occupation, the total number of children under 15 in each family, the number of rooms in the house and the number of occupants, and whether the child had its own bedroom. Physical and radiographic examination of each child excluded other pulmonary disease, including obvious chronic bronchospasm. Children were referred to the ear, nose, and throat department for attention if necessary.

It was carefully explained to each mother that immediately an infection was suspected a course of six doses of medicine as prescribed should be given over a period of two days, at approximately six-hourly intervals. If the infection was suspected late in the day the second dose of the course should be given to the child during the early part of the night. A suitable card was given to the mother on which she could record the time the infection started and the time at which each dose was given. Morning and evening temperatures

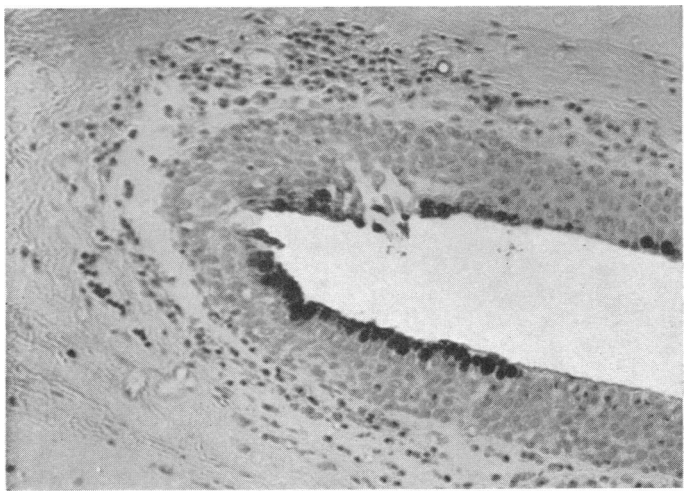

FIG. A.—Section of normal anal duct. The epithelium is stratified and the columnar cells of the surface layer contain mucin (black). Stained with haematoxylin and alcian blue. (×150.)

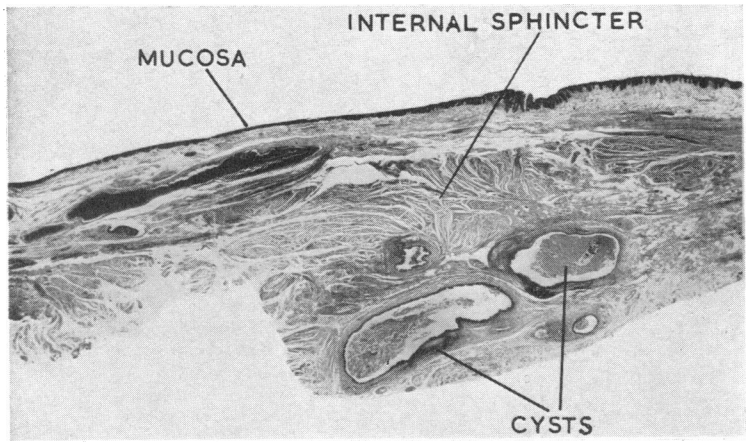

FIG. B.—Section of fistula specimen. There are two large cystic cavities deep to the internal sphincter which are filled with pus. (×4.)

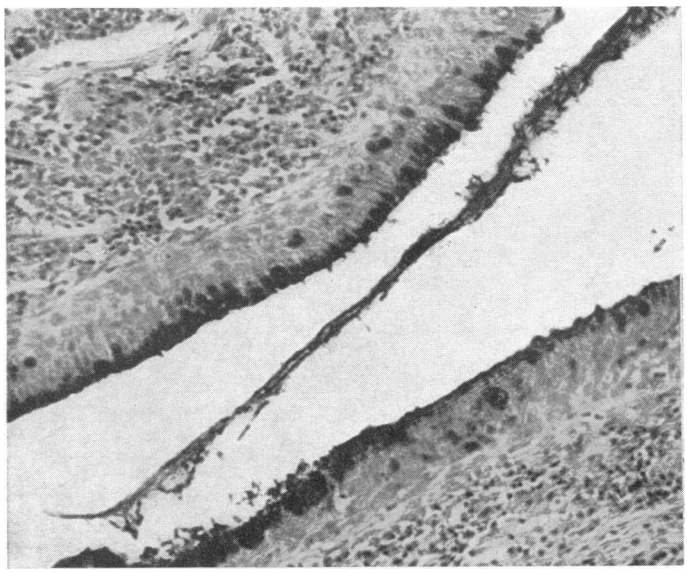

FIG. E.—Photomicrograph of fistula stained with haematoxylin and alcian blue The black globules are mucus, which is mostly concentrated in the surface cells. Some free mucus is present in the lumen. (×180.)

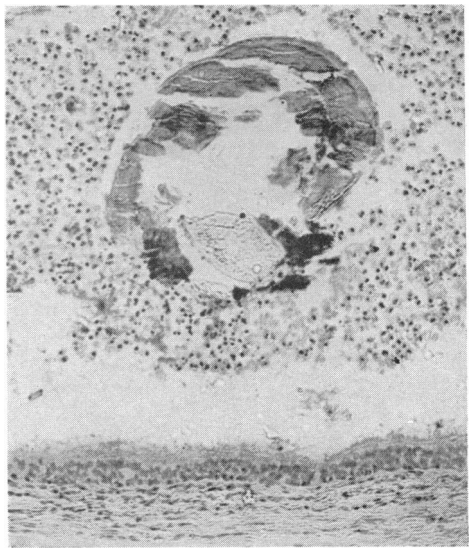

FIG. C.—Vegetable material in an infected, cystic anal gland. (×120.)

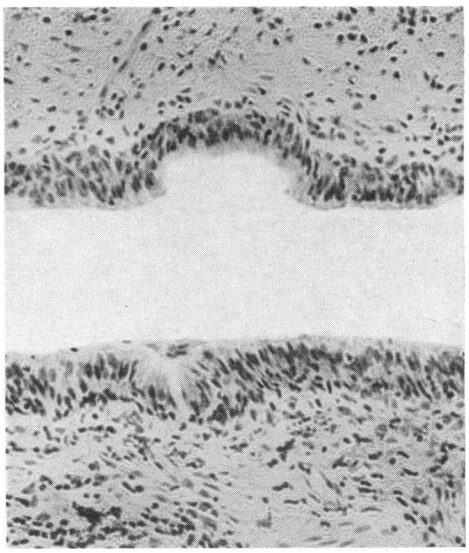

FIG. D.—High-power photomicrograph of a fistulous track. The lumen is lined by stratified epithelium with a columnar-celled surface layer. There is a suggestion of a "palisade" effect. (×150.)

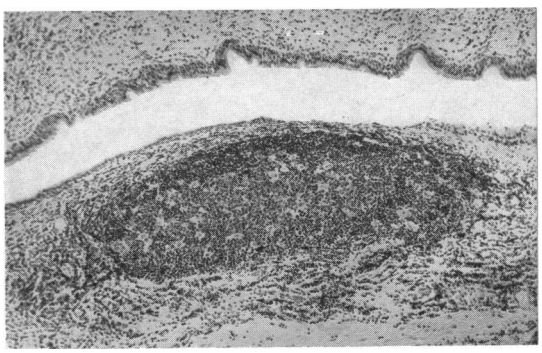

FIG. F.—Fistula with typical anal-gland epithelium. There is a large lymph follicle immediately adjacent to it. (×70.)