NON-SURGICAL DRAINAGE OF THE GALL-BLADDER.

By T. JOEKES, M.B. (Leiden), M.R.C.S. (Eng.).

Introduction.

For a long time it has been realised that the value of an examination of duodenal fluid for the early or more complete diagnosis of duodenal or biliary disease might rank equally with that of the analysis of the gastric contents in affections of the stomach.

Early attempts at Duodenal Drainage. In 1889 Boas succeeded in massaging the duodenal fluid back into the stomach, whence he recovered it by the stomach tube. In 1904, Boldyreff observed that the introduction of butter oil, etc.; had the effect of opening the pylorus and causing a regurgitation of the contents of the duodenum into the stomach. This discovery led Volhardt to administer a "test meal" of 200 c.c. of olive oil on a fasting stomach, recovering it half to one hour later. The fluid thus obtained consisted of duodenal fluid, olive oil and gastric juice. This mixture, on standing, separated into three layers according to their specific gravities. The duodenal fluid thus obtained could then be examined cytologically, chemically and bacteriologically. These early attempts to examine duodenal contents, although very crude, gave valuable information, as for instance the discovery that in the normal healthy state this fluid did not contain any micro-organisms, and that in cases of cholecystitis, Coliform bacilli, Streptococci or Staphylococci could be identified.

The present Technique. After having tried several other unsuccessful methods, Einhorn in 1909, introduced the duodenal tube made of rubber with perforated metal olive attached to its end. This procedure has been further elaborated and perfected by Vincent Lyon in 1919, whose method is still employed at the present time. An important improvement was the construction of a duodenal tube of rubber impregnated with lead, affording the opportunity, at any given moment, to determine the exact position of the tube by "screening" the patient. In one's early experience of duodenal drainages uncertainty is felt as to what is happening during the passage of the tube, and I am greatly indebted to Dr. Gilbert Scott for allowing me to screen all my early patients. The cause of delay or difficulty can then be traced, whether through twisting of the tube in the stomach as the result of a patient having swallowed it too quickly or because the olive had passed the pylorus, or because the tube was retained in the upper half of the stomach through some temporary spasm of the gastric muscles. In one case it was seen that the tube had completely knotted itself.

Once one has been able actually to visualise all these possible difficulties it is quite easy to master the technique of duodenal drainage:

The instruments required for a duodenal drainage are:—

1. Sterilised Ryle's tube or a lead impregnated tube with a metal olive attached at one end. These tubes are marked at 12, 22 and 30 inches from the olive, indicating respectively the distances of the cardia, the greater curvature and the middle part of the duodenum, from the lips of an average subject.
2. A graduated syringe with a capacity of at least 50-60 c.cs. with a rubber tube attached to its nozzle.
3. A four-inch long glass tube to connect the two rubber tubes and to serve as a "window" when withdrawing the liquid from the stomach or duodenum.
4. Three or four sterile bottles for the collection of the specimens.

Preparation of the Patient

The best time for this investigation is in the early morning after the patient has had at least a twelve hour fast, when the stomach and the whole biliary system will be in a resting state, i.e. the stomach will usually not contain a great deal of either mucus or acid, and the bile ducts, and particularly the gall-bladder, will be filled to a much greater extent than during the active state of digestion.

The patient should therefore be instructed to take an ordinary meal, not later than between 7 and 8 p.m. on the previous night. This, I think, is preferable to a small meal, as in the former case one gets a better impression of the functioning of the stomach, for after a small meal the stomach should be quite empty next morning whereas after an ordinary meal one may still find some food remains, which would provide very valuable information. No food should subsequently be allowed and preferably no drink although a cup of weak tea is permissible.

Some authorities have stressed the importance of the patient's mouth being thoroughly rinsed with some astringent solution and forbidden the swallowing of saliva either before or during the drainage, but as the procedure may last as long as two to three-and-a-half hours, it is practically impossible for the patient to obey any such exhortation at all. Moreover as the stomach is, in any case, thoroughly washed out and cleaned before the tube is allowed to enter the duodenum it would seem unnecessary to take this precaution except in cases with bad pyorrhoea.

A most important part of the technique is the "mental" preparation of the patient. Even quite intelligent people, when they come for their first drainage—hitherto an unheard of procedure—not unnaturally, ask the most fantastic and absurd questions as to the possible dangers which may befall them "with that awful thing inside me." Unless one is able to put their minds completely at ease, to convince them that there is no danger whatsoever, and that the only difficulty for them is to swallow the metal olive, failure is inevitable, for even if one is successful in persuading the patient to swallow the tube, it will not reach the duodenum on account of the pyloric spasm which is nearly always present when the patient is nervous and excited.

Swallowing the Tube and Gastric Lavage. For the insertion of the tube the patient should sit upright. The end of the tube carrying the olive is placed as far back as possible on the middle of the tongue, while the patient is instructed to take regular deep breaths. In most cases it is sufficient to lubricate the tube with glycerine or even to dip it in ordinary water, but in sensitive subjects it may be necessary to paint the throat with 10 per cent. cocaine. The patient should now try to swallow the olive, a procedure greatly facilitated by a little sip of water. A distinct tug informs us that the olive has been successfully swallowed and the tube is now slowly pushed in further, while the patient alternately swallows and opens his mouth to breathe. During this process of advancing the tube notice should be taken if the passage is easy or if some obstruction occurs in the oesophagus or at the cardia. The tube is pushed in to the second mark, at which level the olive will lie at the bottom of the greater curvature. The fasting gastric residuum is now extracted by syphoning or by gentle aspiration with a syringe, in the latter case taking care not to exert too great a suction to avoid injury to the mucous membrane of the stomach. In this paper we are mainly concerned with the examination of the contents of the duodenum and the biliary tract, but even so it is well to note whether the gastric residuum contains food residue, an excess of mucus, blood, bile, etc.

The stomach is now thoroughly washed clean of all mucus by repeated irrigation with clean water at body temperature, running 4-5 oz. through the tube into the stomach and withdrawing it. This process should be repeated until the water is returned quite clear. In cases where there is a good deal of thick mucus in the stomach which does not pass easily through the tube, it is advisable first to run in 4-5 oz. of 1% Sod. Bicarb. sufficiently often to dissolve the mucus and then to continue with ordinary water.

The Passage into the Duodenum. When the stage is reached that the water returned from the stomach is quite clean, the patient lies down with the upper part of the body slightly elevated and turns well on the right side. Some authorities advise running another 4 oz. of water into the stomach at this stage and clamping the tube at the third mark to prevent the water returning, and then instructing the patient to swallow the tube very slowly, taking at least twenty minutes to swallow the additional 8 ins.

If, after twenty to thirty minutes, one finds that the tube has not entered the duodenum it must be pulled out again as far as the second mark and again slowly reswallowed. It has been my experience however, that, in the majority of cases, when the tube is in the duodenum and the patient has swallowed it up to the third mark, the olive has advanced well into the third part of the duodenum or even into the jejunum. Since I have had the opportunity to observe on the screen what actually happens, the explanation is quite simple. So long as the tube is in the stomach it lies along the greater curvature, but soon after the tube has passed into the duodenum it is pulled up along the lesser curvature so that the distance from the lips to the pylorus is considerably shortened.

As, in a number of people, the tube will reach the correct place in the duodenum, i.e., opposite the papilla of Vater, with the second mark still at the lips, I wait five to ten minutes before making the patient very slowly swallow the tube further without clamping the tube at all. As soon as the recovered fluid becomes yellow, swallowing should cease.

Localising the end of the Tube. The next step is to find out whether the tube is now in the right position. The most accurate method is, of course, by screening but as in many cases this is not possible, the best test for general use is to inject 30-40 c.cs. of air with a syringe and at the same time listen with the stethoscope over the epigastrium. If the tube is still in the stomach the bubbling sound can be heard over a considerable area with the maximum intensity to the left of the midline; whereas if the tip of the tube is in the second part of the duodenum, the sound is sharply localised with its maximum intensity in the right hypochondrium.

Collection of Specimens. With the tube in position we start collecting the duodenal fluid in a sterile bottle. If this fluid contains a good deal of mucus suggesting the presence of duodenitis, the duodenum should be washed out with water a few times before proceeding to the next step, which is to stimulate the gall-bladder to evacuate its contents by introducing 50-60 c.cs. of 25% magnesium sulphate into the duodenum. One should carefully watch through the "window" the fluid which is now recovered by syphoning. As soon as the fluid becomes dark yellow it is collected in a sterile bottle and whenever its appearance subsequently alters, it should be collected in a separate bottle. The first portion of dark bile which appears after the administration of the magnesium sulphate is derived from the large bile ducts, whereas the subsequent, still darker, specimen comes

from the gall-bladder. Even if a satisfactory supply of gall-bladder bile has been obtained, it is advisable to give the patient a second dose of magnesium sulphate (30-40 c.cs.) with a view to emptying the gall-bladder completely.

Sometimes, however, there is only a small flow of bile after the first dose of magnesium sulphate and the patient may complain of a sharp pain in the gall-bladder region. On examination one finds marked tenderness and the gall-bladder, which could not previously be palpated, can now easily be felt. In such cases I have found it useful to introduce a second dose of 50 c.cs. of magnesium sulphate which has been warmed to slightly over body temperature, and as soon as any fluid at all returns, to apply gentle pressure over the gall-bladder, when, often, there will suddenly appear a good flow of very dark bile and the patient will remark that he feels much easier. This can be repeated a third and a fourth time, running in not more than 30 and 20 c.cs. of magnesium sulphate respectively.

Occasionally one finds that even after repeated introductions of magnesium sulphate practically no gall-bladder bile is obtained or that marked abdominal pain and prolonged diarrhoea result. In such cases 1 oz. of olive oil, warmed to body temperature, should be given, which in most cases is an effective stimulant. The olive oil has the advantage over magnesium sulphate of not mixing with the bile so that it can be pipetted off and pure bile be used for the required examinations. Its great disadvantage is the difficulty of cleaning the tubes afterwards, particularly the lead-rubber ones, as these cannot be boiled. Some authorities advocate the use of a solution of 10-20 per cent. peptone instead of the magnesium sulphate but in my experience peptone is by no means so effective.

In some cases too it will be noticed during the collection of the different specimens that the bile suddenly becomes very turbid and assumes a dirty yellow colour. This is due to spurts of acid gastric juice passing from the stomach into the duodenum and mixing with the bile. This naturally happens more frequently in people suffering from hyperacidity, a not infrequent complication of cholecystitis. In a few cases it has even happened that there was such a continuous outpouring of acid from the stomach that no acid-free bile could be collected. In the latter type of case the drainage will have to be repeated after the patient has been given belladonna for a few days.

At the end of the drainage, i.e., when no more gall-bladder bile is obtained—liver bile can practically be collected *ad infinitum*—200-300 c.cs. of 1 in 3,000 solution of potassium permanganate should be instilled into the duodenum before withdrawing the tube, because one has to remember that in draining cases of cholecystitis, highly infected material may have entered the duodenum, not all of which has been aspirated. By virtue of this amount of potassium permanganate solution and the magnesium sulphate left behind, a thorough clean-out is effected very soon after the drainage.

Finally, the patient sits up for the withdrawal of the tube, which is done by gentle and even pulling.

In the great majority of cases the patients are now quite ready for a good meal and can go about their usual business, although occasionally a few hours' rest is advisable.

Examination of Specimens. The specimens should be examined as soon as possible after collection as the cells are liable to disintegrate very quickly.

First of all they should be examined macroscopically for the presence of mucous flakes. A few small flakes may be found even from a normal duodenum or gall-bladder but the presence of many flakes would indicate some "catarrhal" condition.

The next step is to centrifugalise the specimens and note the amount of deposit obtained, which may vary from a thin layer to a quarter or a third of the whole specimen. Fluid collected from a normal, healthy duodenum contains a few small flakes of oval or cuboidal cells and no micro-organisms or only a few scattered ones. Some authorities state that normally as well as in cases of cholecystitis where the sphincter of Oddi has not been affected, the duodenal fluid should be quite colourless or slightly opalescent, but should not contain bile. In all cases I have drained thus far, with one exception to which I will refer later, the duodenal fluid contained bile in varying degrees. In cases of duodenitis one finds numerous mucous flakes, pus cells according to the severity of the inflammation, sometimes a few red blood cells and numerous micro-organisms, which are often found lying aggregated into big groups. In order of frequency the micro-organisms found in duodenitis were streptococci, coliform bacilli staphylococci and micrococcus catarrhalis. In a few cases cysts of *Lamblia intestinalis* were found and in one case typhoid bacilli, which probably came from the gall-bladder as the bile contained them in great numbers.

In two cases a good deal of fresh blood was found, one of which proved to be a duodenal ulcer; the other, carcinoma of the papilla of Vater.

Normal *gall-bladder bile* contains a few desquamated bile-stained columnar epithelial cells, fatty acid crystals in moderate numbers, occasionally a few cholesterol crystals, but no pus cells or micro-organisms. In a case of cholecystitis this bile contains numerous epithelial cells and fatty acid crystals, pus cells and micro-organisms in varying degree, as well as some red blood cells; cholesterol crystals in larger numbers strongly suggest the presence of gall-stones. Up to the present I have never found large numbers of these crystals in the gall-bladder bile in cases without gall-stones and vice versa.

Sometime ago a girl of 26 complained of symptoms which were very suggestive of cholelithiasis. The gall-bladder bile collected by drainage was quite normal and did not contain any crystals. At a subsequent cholecystographic examination however, a large rounded shadow was found in the fundus of the gall-bladder which was diagnosed as a large solitary stone and cholecystectomy was performed. The gall-bladder was then found to be perfectly normal except for the presence of a congenital valve stretching across the whole lumen of the gall-bladder leaving only a small communicating opening between the fundus and the rest of the lumen. The large shadow had evidently been produced by the dye which had entered into the smaller lumen but had not been evacuated as rapidly as that from the rest of the gall-bladder. In another patient a diagnosis of cholecystitis was made after drainage and the presence of only very few crystals suggested, in this case too, that she had no gall-stones, although two doubtful, but suspicious shadows were seen in the X-ray. As the patient was very persistent in her assertion that, in certain positions, she could make the stones "click" and this always produced a sharp pain, her gall-bladder was removed but was found to contain no stones at all.

The micro-organisms most frequently found in cholecystitis are again streptococci, bacillus coli communis and staphylococci. Typhoid bacilli were found twice and *Lamblia intestinalis* in half-a-dozen cases, in one of which the gall-bladder

PLATE 1.

Dr. T. Joekes

- - - - -

Duodenal Drainage.

FIG. I.—Illustration of a radiopaque duodenal tube engaging the pylorus.

FIG. II.—This shows the tube in the correct position having passed through the pylorus and now lying in the duodenum. Some air and opaque emulsion has been injected to outline the walls.

bile contained them in enormous numbers. This latter case was the more interesting because he had never been abroad except for two days spent in Portugal during a cruise. Great difficulty was experienced in ridding the patient of his infection, but by frequently draining his gall-bladder, the administration of high doses of hexamine and weekly intravenous injections of neo-kharsivan, we succeeded in considerably reducing the numbers of *Lamblia*. Unfortunately this patient had to go abroad before he was quite clear of his infection. An interesting observation was that within two minutes of his being injected intravenously arsenic could be found in the drainage fluid.

After the microscopical examination, *cultures* are made of the centrifuged deposit. It is a common experience that whereas the staphylococci, *B. coli* communis and typhoid bacilli seldom give rise to any difficulty, one frequently fails to obtain a culture of the streptococci. It is very difficult to explain this because even in cases where one finds numerous streptococci in the bile, no matter whether the cultures are made at the time of collection, i.e. during the drainage, or from the centrifuged deposit, whether fluid or solid media are used, whether the cultures are aerobic or anaerobic, quite frequently no growth is obtained. To make matters still more incomprehensible, having failed to cultivate the streptococci from a patient, one may, at a subsequent drainage—although using exactly the same methods as before—suddenly obtain quite a good growth.

Lastly the specimens can be examined for the presence of different enzymes, but this lies outside the scope of the present paper.

1. Duodenal Drainage as a Diagnostic Measure.

X-ray examination informs us as to the shape, size and position of the gall-bladder, whether it fills and empties in the normal time and, in suitable cases, discloses the presence of stones. Where no gall-bladder shadow is seen after administration of the dye, the only information obtained is that the cystic duct is blocked but not whether this blockage is due to mucus, debris or stone. A properly conducted drainage can usually elicit all these data. Even in cases where X-ray examination has revealed normal filling and emptying time, it can often be proved by drainage that the patient has a mild degree of chronic inflammation of the gall-bladder.

2. As a Therapeutic Measure.

Results obtained in cases of sub-acute and chronic cholecystitis and duodenitis by repeated drainages in addition to the treatment with diet and drugs, leave no doubt that this method has very high therapeutic value. I have found it a good general working rule, in such cases, to perform the drainage at weekly intervals and where one has been able to obtain a culture, to give the patients an injection of an autogenous vaccine the day before the drainage so as to empty the gall-bladder during the reaction.

On the days between the drainages the patient should empty the gall-bladder by taking either olive oil (1-2 tablespoonfuls), magnesium sulphate or epsom salts (1-2 teaspoonfuls in half a tumbler of warm water), or Agocholine (a combination of magnesium sulphate and peptone) 1-2 teaspoonfuls in warm water first thing in the morning while still in bed, and then to lie for twenty minutes on the right side

so as to ensure that the fluid taken enters the duodenum quickly. Of these substances I have found olive oil the most useful. If the patients object to the taste of the oil, the addition of some orange juice or a few drops of lemon juice will be very helpful. With the magnesium sulphate or epsom salts the dosage should be regulated so that the patient does not have more than one or two good evacuations afterwards.

In patients with "rheumatic" complaints in whom a streptococcal cholecystitis may be considered to be the focus of infection, this treatment has given very satisfactory results in many cases.

In *catarrhal jaundice* a course of three or four drainages at three-day intervals has often considerably shortened the duration of the illness.

The case mentioned above concerned a young man who had been on a shooting expedition to Newfoundland, where he had contracted some intestinal infection, causing diarrhoea for several days. About a week after he recovered from this attack he developed jaundice. When I saw him six weeks later he was deeply jaundiced, his urine was dark mahogany brown, his stools were completely discoloured, denoting a complete blockage of the common bile duct. He came to seek relief of the unbearable itching of which numerous scratches all over his body bore convincing testimony. With the tube in the right position (as verified by screening) not a trace of bile was obtained after repeated applications of magnesium sulphate but all the specimens contained large amounts of mucus. Repeated washings with normal saline and 1 per cent. sod. bicarb. succeeded in removing the mucus and after five hours the fluid contained a slight trace of bile. After another hour a large amount of very dark bile suddenly appeared. Using olive oil the drainage was continued for another three hours so as to ensure a very thorough emptying of the gall-bladder and liver. The patient kept up the drainage by taking olive oil in the morning for the next few days and made an uninterrupted recovery.

Finally, it is hardly necessary to remark that duodenal drainage cannot replace surgery in appropriate cases. In cases of acute cholecystitis with high temperature etc. drainage should not be attempted but in several cases with persisting cholangitis after cholecystectomy or with persisting bile fistula, a course of drainages has often proved very beneficial. In cases of stones in the gall-bladder no good results are to be expected unless the stones be small and not too numerous, although it is impossible even in such cases to be too dogmatic, as is shown by the following example of a patient in whom the presence of numerous stones had been established. As she refused operation a course of drainages was given. After the instillation of warm magnesium sulphate (105°F.) at the first drainage, the patient complained of a very sharp attack of pain, suggesting gall-stone-colic. After the injection of one-sixth of a grain of morphia the drainage was continued in the ordinary way. As several stones could be found in the stool passed afterwards, we were encouraged to persist with this line of treatment, in the course of which 67 stones in all were collected of varying sizes, up to $\frac{1}{4}$ -inch in diameter. Subsequent examinations showed the complete absence of stones in the gall-bladder.