Observations

ON

THE DUODENAL TUBE IN THE DIAGNOSIS AND TREATMENT OF BILIARY DISEASES.

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In 1917 Meltzer¹ reaffirmed his "law of contrary innervation"* and his conviction that disturbance of this law was of great pathological significance. He demonstrated it particularly in regard to the physiological function of the gall bladder in promoting an interrupted flow of bile into the intestine. He further suggested instances where suspension of the physiological process might give rise to pathological sequelae. He drew attention to the musculature of the gall bladder, which on contraction empties this viscus of its fluid contents. The antagonist of this musculature is the circular muscle of Oddi, which is situated at the termination of the common bile duct, thus closing the papilla of Vater at its duodenal entrance. In conformity with the "law of contrary innervation" the muscle of the gall bladder is relaxed and the muscle of Oddi contracted during the storing of bile, while a reverse action takes place when the bile is being poured into the duodenum. The nervous control appears to be equally interesting.

"According to Doyon, stimulation of the peripheral end of the splanchnic nerves causes simultaneously a contraction of the gall bladder and an inhibition of the tonus of Oddi's muscle. The vagus, on the other hand, seems to contain motor fibres for the sphincter of the common duct and inhibitory nerve fibres for the gall bladder. Furthermore, also the afferent innervations show the character of contrary innervation. For instance, stimulation of the central end of the vagus causes simultaneously a contraction of the gall bladder and an inhibition of the sphincter muscle."

There are numerous suggestions in physiological experiments that variations in dietary may influence this co-ordination of gall bladder and sphincter muscular action. Sometimes this influence may be for good and sometimes for evil. Rost first demonstrated the fact that the injection of peptone or albumoses into the duodenum was followed by the prompt discharge of bile into it, and that this was due to a reflex act which caused the simultaneous relaxation of the sphincter of Oddi and the contraction of the gall bladder.

In a footnote to his communication Meltzer records his observation that the application of a 25 per cent. solution of magnesium sulphate "to the mucosa produces a completely local relaxation of the intestinal wall." Such a result is not obtained if the salt passes through the stomach. He therefore makes the suggestion that the local application of a 25 per cent. solution of magnesium sulphate by means of the duodenal tube might relax the sphincter of the common duct and permit the ejection of bile and perhaps even the removal of a calculus of moderate size wedged in the duct in front of the papilla of Vater.

The development of the use of the duodenal tube by Einhorn and other workers stimulated investigation, and many observations were made upon the normal and pathological contents of the duodenum. In particular these observations were directed to the character and digestive power of the pancreatic and hepatic secretions. Attempts to increase the flow of these fluids, except by means of the so-called cholagogues administered by mouth, were not undertaken until Lyon² applied the observations of Meltzer in regard to the local duodenal action of magnesium sulphate on the gall bladder and bile-duct sphincter. Lyon's experiments were entirely successful and established the basis for extended investigation into the contents of the gall bladder in health and disease. He further developed the technique in order that the gall bladder might be evacuated of its fluid contents whenever considered advisable if such evacuation were mechanically possible.

Methods.

The patient should fast for at least six hours before the duodenal tube is introduced. The tube is then passed to the first mark (40 cm.). The stomach contents are then aspirated by means of a glass syringe. If the stomach be normal, they will be found to consist of slightly opaque acid fluid with

flakes of mucus; this is quite typical of the resting gastric juice. It is well to examine this material, when obtained, as to its total acidity, for frequently useful information may thus be obtained. The stomach is then washed out with 30 c.cm. of tepid water, which is introduced by syringe and withdrawn. This repeated process need not be prolonged if the stomach appears normal. The patient is now placed on the right side in the recumbent position. The duodenal tube is then passed to the second mark (55 cm.) and the process of washing and evacuation repeated two or three times. The tube is finally introduced to the third mark (80 cm.), where it is allowed to remain. The patient is kept lying on the right side with the abdomen inclining towards the bed, although it is not found advisable that he should lie too flat on the abdomen. It is important that the patient should be made as comfortable as possible in order that restlessness and fatigue may be avoided. The patient remains in this position for about half an hour, when a small sample of the contents of the gut is removed for examination. If the end of the tube be in the duodenum the fluid withdrawn may be scanty, alkaline or neutral, and sometimes more or less bile-tinged. If it contain free hydrochloric acid (indicated with Congo red paper) it may be presumed that it has not yet passed the pylorus or at the best is just within the duodenum.* Each fifteen minutes following a small sample of the contents is obtained for examination. When these samples are alkaline or neutral and probably slightly bile-stained it may be concluded that the end of the tube is well into the duodenum. This usually takes from three-quarters of an hour to an hour, but sometimes longer. In a certain number of cases it may be impossible to obtain an alkaline or neutral sample. If the resting gastric juice has been examined a high degree of acidity may frequently have been found in such cases. If the final samples remain acid but with a much lower concentration of titratable acid than that of the resting gastric juice it may be presumed after two hours that the tube has reached the duodenum, especially if the fluid be bile-stained. Subsequent events will indicate whether this be so or not.

When it has been decided that the tube is in the duodenum 30 c.cm. of a 25 to 50 per cent. solution of magnesium sulphate is injected through it. This is allowed to remain for five or ten minutes, when a sample may be removed. If the procedure has been successful the fluid will be found to be deeply bile-stained, and if the withdrawal be continued at intervals almost pure bile may be obtained. If diagnosis be the principal point in view the bile may be withdrawn in fractional amounts and placed in numbered test tubes and subsequently examined when the procedure has been completed. If, however, drainage or thorough evacuation of the gall bladder be the primary object, then persistent withdrawal of the bile is not required and the contents (magnesium sulphate and bile) of the duodenum may be allowed to pass down the bowel. In these circumstances care must be taken not to introduce too much magnesium sulphate, as violent purging may then result.

In the practice of a busy practitioner, where a nurse skilled in the procedure is not available, or in the wards of a hospital where a number of patients are treated each day by this method, the steps outlined above may be too time-consuming. The following plan may therefore be adopted. The tube is passed the night before to the 80 cm. mark, a spring clip being attached to the free end in order to prevent leakage, and pinned to the nightdress. The patient is then instructed to sleep on the right side. If there be restlessness and difficulty in sleeping, 1 gram of sodium or potassium bromide, or an equivalent amount of some mild hypnotic in solution, may be introduced into the stomach through the tube, which may be completely emptied by injecting a few cubic centimetres of air. A good night's rest is thus usually obtained. At a convenient hour in the morning a small sample of fluid is withdrawn. Only exceptionally does this fail to give positive evidence of coming from the duodenum. The magnesium sulphate may then be introduced. When it has been determined that the bile is flowing freely the tube may be removed,† and after half an hour the patient may have the breakfast indicated under the circumstances of the condition irrespective of the duodenal tube having been introduced.

* The passage of the tube into the duodenum may be hastened by having the patient drink about 150 c.cm. of hot clear meat soup or milk. The latter is to be preferred as it does not obscure the future colour indications. This drink should be taken before the tube is introduced to the second mark, and therefore the second washing and evacuation of the stomach is omitted.

† It is usually advisable in infected conditions of the biliary tract to lavage the duodenum with a bland aseptic solution before the removal of the tube.

* Sherrington has termed this "reciprocal innervation."

The importance of this direct method of investigating the character and flow of bile can hardly be overestimated in pathological conditions of the liver, the gall bladder, and their ducts.

Abnormalities of the Bile.

Lyon⁸ has drawn attention to the difference in the character of the bile during consecutive periods of the physiological drainage of the bile ducts and gall bladder. The first bile which appears is of a light golden colour and as a rule quite transparent. This is followed by a much larger quantity of darker greenish-yellow bile, which is more concentrated and frequently quite viscid. Finally a small quantity of much paler and thinner bile is obtained. Lyon considers that these three types of bile are at the time of drainage in three more or less separate portions of the biliary tract. The bile in the common duct, and probably the cystic duct (10 to 20 c.cm.), is the first bile to appear. There is then a short transition flow of bile, which rapidly becomes darker until the darker bile is obtained. (This may amount to between 30 and 150 c.cm.) Finally a small amount of light yellow bile is obtained, which flows slowly and steadily. It has been suggested that this bile is identical with that which flows normally from the liver and is stored in the gall bladder, where it becomes concentrated during the periods of physiological biliary stasis. It must always be remembered that normally the bile does not enter the duodenum in a continuous stream but intermittently when the appropriate stimulus is in operation. This stimulus is normally the product of gastric digestion—the acid chyme with proteoses, albumoses, and peptones. As will be mentioned later the character and periodicity of diet may have an important bearing on biliary affections.

A careful macroscopical, microscopical, and, if indicated, chemical examination of the different succeeding and continuous aspirations of bile may give much valuable information as to the site and character of the pathological process. It has been found to be extremely difficult definitely to diagnose abnormal conditions of the lower biliary passages (independent of the gall bladder) by an examination of the first samples of bile obtained. If they are found to be abnormal it cannot be definitely stated that this bile has not been contaminated by the residue from the last expulsion from the gall bladder which may be the site of the pathological condition. This difficulty, however, does not arise if the first portion of the bile be healthy and the second portion (dark green and more viscid) be definitely abnormal, whilst the final portion is again found to be normal. Under such conditions it may be definitely affirmed that the pathological lesion is situated in the gall bladder. Furthermore, if the whole of the bile—even the last portions—be abnormal, it may be inferred that the abnormal process has either arisen in the hepatic duct or above, or that it has extended upwards into these channels. In such cases this may be taken as definite evidence of an extensive cholangitis, and even hepatitis may sometimes be diagnosed. If the first portion only of the bile be abnormal it may be assumed that the lesion is confined to the common duct.

The various indications of abnormal conditions in the biliary passages as indicated by the bile are as follows: Increased viscosity and turbidity, presence of flakes of bile-stained mucus, pus cells, large numbers of degenerated epithelial cells and pathological micro-organisms, such as streptococci, *B. typhosus*, large numbers of *B. coli*.* Small gritty particles of material which may chemically be identified as biliary sand, and even definite gall stones of considerable size, have been obtained. The diagnosis of the local lesion will depend upon the degree and character of the abnormality of the bile. If there be numerous pus cells, with or without numerous micro-organisms, it may be safely inferred that the condition is of an active inflammatory character. This is usually associated with a systematic reaction. A chronic suppurative lesion of the gall bladder may, however, exist without pronounced systematic or local symptoms provided a modicum of biliary drainage be present. Such a degree of drainage, however, may not be sufficient to prevent the development of chronic symptoms of intoxication.

Abnormalities of Biliary Drainage.

Evidence of partial or complete mechanical obstruction due to gall stones, adhesions, neoplasm, and other conditions is frequently found. The causes of pathological stasis or partial

retention are of great importance in the production of immediate symptoms or future complications. But there are other less obvious conditions which are of even greater importance. Meltzer¹ has quite clearly pointed out the pathological sequence of events which may follow upon prolonged biliary stasis. It is recognized that this may occur as a secondary condition consequent upon the impaction of gall stones, inflammatory swelling of the tissues, new growth, or pressure from without the passages. But his claim that primary biliary stasis may in itself lead to certain of these more conspicuous lesions is not commonly appreciated.

It has been demonstrated that the bile in health may contain pathological organisms. That these do not set up pathological processes is due to the fact that the cells of the biliary passages are of normal vitality. In such soil micro-organisms seldom find a favourable habitat for their growth and invasion. If, however, abnormal conditions arise which lower the vitality of the parts, or in any manner improve the habitat of the organisms for their growth, then pathological processes are apt to arise.

As has been stated previously, the evacuation of the gall bladder is an intermittent act depending upon initiation of a definite reflex by suitable stimuli. In order that this physiological function may operate properly two things are necessary—first, a properly balanced nervous path for such a reflex, and secondly, a proper stimulus. This physiological reflex is under the control of the vagi and the splanchnic nerves, and the evidence seems to indicate that the vagus contains motor fibres for the sphincter of the common duct and inhibitory fibres of the gall bladder. Thus it is quite conceivable, and indeed probable, that central impulses are capable of inhibiting or at least rendering more difficult the action of the proper stimulus even if it be normally operative. The emotional and other states which are conducive to the disturbance of many physiological reflexes need not be discussed at present.

The various stimuli which may initiate this reflex are not as yet fully understood, but that they are intimately connected with the processes of normal digestion there is good reason to believe. Bruno has shown that during the fasting stage no bile enters the duodenum, but when the digestive chyme enters the stomach after a meal bile is ejected into the duodenum. Rost has shown that if the gall bladder be absent the bile enters the duodenum in a continuous stream. He has further demonstrated in a healthy dog with the gall bladder in operation that injection of albumoses, peptones, and other products of protein digestion into the duodenum immediately initiates a flow of bile from the papilla of Vater. He has proved that this flow of bile is produced by the reflex act of simultaneous contraction of the gall bladder and relaxation of the sphincter of Oddi. These observations would indicate that the gastric contents furnish the normal stimulus for this reflex. This, however, is not entirely true. Oddi¹⁰ and Archibald⁴ have conclusively demonstrated that high acidity of the duodenal contents stimulates the contraction of the sphincter of Oddi. The resistance which this spasm of the sphincter muscle affords to the flow of bile may be judged from experiments. Archibald found that under fasting conditions 180 to 330 mm. pressure of water forced fluid through the sphincter, but when the duodenal mucous membrane was drenched with 15 per cent. solution of hydrochloric acid it took 330 to 800 mm. pressure of water to produce the same result.

We are therefore faced with certain facts which may indicate how a deleterious action upon the normal physiological flow of bile may be brought about—how, in other words, a biliary stasis may be produced. The question naturally arises, Is such a biliary stasis a harmful condition? As yet sufficient evidence has not been accumulated to answer this question in full, but there is much to indicate that it is a condition which may be fraught with much eventual mischief. It has already been mentioned that normal bile may contain pathological organisms. Much more so is this the case in infectious diseases such as typhoid fever. In ordinary circumstances biliary infections are not common occurrences, probably for the reason that the mucous membranes of the passages are healthy and the flow of bile quite normal. But it is well to recognize the evil influences which biliary stasis has in predisposing to biliary disease. Whether this be by lowering the resistance of the containing structures or in providing a suitable habitat for the growth of pathological micro-organisms, or in both ways, is not as yet clear.

In addition to the pathological processes which may be produced in the biliary system by a disturbance of the reflex

* A small number of these organisms are frequently found in the bile, and may probably be due to the filtration action of the liver on the portal blood.

ejection of bile we have to consider the very important pathological condition which may be initiated in the pancreas. The observation of Opie⁶ that the impaction of a small stone in the ampulla of Vater could give rise to acute haemorrhagic pancreatic necrosis has been repeatedly confirmed. Opie demonstrated that this most serious lesion was consequential upon the regurgitation of bile into the pancreas through the duct of Wirsung. Archibald⁴ has pursued this subject farther, and has shown that such regurgitation of fluid can be accomplished by producing a spasm of the sphincter of Oddi and increasing the intrabiliary pressure. Further, he has demonstrated that acute haemorrhagic necrosis of the pancreas may be produced in this manner.⁶ Whether the pancreatic lesion be acute or chronic depends upon a number of circumstances. But the fact seems now quite evident that biliary stasis is frequently a most important factor in producing these lesions.

Functional Biliary Stasis.

It is not the purpose of this communication to discuss biliary stasis caused by gross mechanical lesions, but to deal chiefly with biliary stasis of a so-called functional character—a stasis which is present before structural changes of an obstructive type are evident. Meltzer has pointed out the possibility that by some strong mental excitement

“tonic contraction of the sphincter of the common duct, at a period assigned for the discharge, does not become relaxed while the gall bladder contracts within the usual normal limits; this would result in abnormal stasis within the biliary ducts which may lead to icterus—*emotional icterus*. Or both the muscle fibres of the gall bladder and of the sphincter are abnormally strongly contracted, which would lead to biliary colic with consecutive jaundice without the presence of catarrhal conditions or of calculi, at least not in the first few attacks of comparatively short duration.”

In addition to the possible action of powerful emotion in producing a functional biliary stasis there must be considered the probable results of a deficiency of the proper stimulus. It has been pointed out that the products of normal gastric protein digestion play a prominent part in supplying such stimulation.* This being the case, it will be readily appreciated how important it may be that a properly balanced diet should contain a certain amount of protein. Meltzer has particularly emphasized the possible dangers in this regard of a purely vegetarian diet. A diet may contain sufficient calories but may not be properly balanced in so far as diet may affect the physiology of digestion and metabolism.

The manner in which the contents of the stomach, apart from the products of digestion, influence the biliary function has already been suggested. If the duodenal contents be kept abnormally acid, the physiological relaxation of Oddi's sphincter will not take place. Thus it will be seen that gastric hyperacidity may possibly exercise an important influence in producing a certain degree of functional biliary stasis.

The association of gastric hyperacidity with biliary lesions in general assumes an additional importance when considered from this point of view. It has been recognized for some time that lesions of the gall bladder are frequently accompanied by signs and symptoms of gastric hyperacidity. It has even been held by some that the hyperacidity has been reflexly produced by the cholelithiasis. Little or no evidence has been advanced in support of this view except the observation that the two conditions are frequently associated. In view of the present experimental observations it would be more consonant with the facts to suggest that biliary stasis and subsequent gall-stone formation might be the result rather than the cause of hyperacidity.

The influence of functional biliary stasis upon the formation of gall stones is probably very important. Two outstanding factors in the production of gall stones are recognized—bacterial invasion and biliary stasis. In regard to the etiology of gall stones, Mayo-Robson⁷ makes the following statement:

“Anything, therefore, which causes stagnation of bile may dispose to gall stones; on the other hand, whatever leads to a regular emptying of the bile passages will tend to clear out such detritus as cast-off cells and incipient collections of cholesterol crystals and mucus, and thus to prevent the formation of gall stones.” Among the remoter causes we must consider age, sex, habits, dress, diet, diathetic conditions, and disease.”

* It is probable that there are other physiological stimulants which as yet have not been demonstrated.

In regard to the diet he makes the following interesting observations:

“If the supply of nitrogen in the food be limited, the bile salts will be diminished and cholesterolin may be precipitated. This may serve to explain the presence of gall stones in gouty persons who on account of the lithic diathesis limit their intake of nitrogen. The larger consumption of farinaceous food in Germany may also serve to explain the greater prevalence of gall stones there than in England, where meat enters more extensively into the dietary. In diabetes, in which nitrogenous food is prescribed, gall stones are rarely found.”

Since Gallippe⁸ in 1886 first demonstrated the presence of bacteria in biliary calculi much attention has been paid to this aspect of the question. The evidence collected goes far to substantiate the view that bacterial infection of the bile passages is the chief cause of the origin of gall stones. As has been pointed out above, the normal bile frequently contains pathological micro-organisms. The numerous routes which have been suggested whereby they may reach the bile need not be discussed in detail. It will be sufficient to mention the two main ones—namely, an ascending infection by way of the bile ducts and infection through the liver from the portal or systemic blood stream. In such circumstances it is not surprising that cholelithiasis is a common condition. In fact it might be expected to be much more frequent than it is. It has already been stated that the two most important factors in preventing the pathological growth of micro-organisms in biliary passages are a healthy mucous membrane and efficient biliary drainage, while biliary stasis in itself may lead to a lowering of the resistance of the biliary mucous membrane. One attack of biliary infection is frequently followed by others. It is quite readily seen how this may be the case when it is realized that biliary inflammation leads to a prolonged partial stasis and the stasis perpetuates the favourable habitat for the growth of micro-organisms. In this manner a vicious circle is established.

It is quite evident from these observations and experimental facts that biliary stasis and any abnormal conditions which tend to promote it or to perpetuate it are probably the most important factors in the etiology of the more common biliary lesions. The initial form of stasis in all these circumstances is most probably of a functional nature resulting either from a spasm of the gall-duct sphincter or prolonged absence of the proper stimulus in sufficient strength.

Treatment of Biliary Lesions.

Apart from its value as a diagnostic measure, the use of the duodenal tube as outlined lends itself to treatment. In conditions where there is biliary stasis independent of complete obstruction it is advisable to promote free and periodical emptying of the gall bladder and passages. This is of particular importance when the stasis is associated with some chronic inflammatory process. If cholelithiasis be present, and there be good reason to avoid an operation if possible, much in the way of amelioration may be expected. This hope is especially warranted when it is realized that in practically every case of cholelithiasis a chronic infection of the biliary passages is present, which infection perpetuates and is perpetuated by biliary stasis in the manner of a vicious circle. The claims of operation *versus* duodenal tube drainage need not be considered. The indications for either therapeutic measure are quite clearly to be distinguished. It may be observed, however, that in the use of the duodenal tube no physiological organization is disturbed in so far as present knowledge goes. In the case of operation this cannot be conceded. After cholecystectomy the rhythmical flow of bile ceases and it dribbles into the duodenum whether necessary or not. This may be harmless, but at any rate is not physiological, and it is possible that the presence of large quantities of bile in the intestines when it is not needed may exert some deleterious influence. Furthermore, it is established that the bile is more concentrated in the gall bladder than in the hepatic ducts, and that bile salts are absorbed from the intestine to be stored again in the gall bladder,* so that an ejection of concentrated bile may take place when necessary. Without the gall bladder none of these physiological processes may be carried out. In the case of cholecystenterostomy not only is the gall bladder physiologically eliminated but an open door for infection from the bowel into all the radicles of the biliary system is permanently established. However, in spite of all these objections, and apart from the risk attending any major operation, it is sometimes imperatively indicated and therefore must be undertaken. But there are many instances in which operation is not

indicated, in fact the risk of the cure may be greater than that of the disease; in addition there are conditions where operation as a therapeutic measure would be useless.

Catarrhal Jaundice.

The prolonged course of catarrhal jaundice is well known, and anything which would shorten it would be welcomed. It is frequently associated with systemic infections or obvious infections of the digestive tract from the teeth to the duodenum. In fact, catarrhal jaundice is a result of an infection of a greater or lesser part of the biliary passages. Therefore there are present in this condition the two fundamental factors, stasis and infection, most liable to promote biliary mischief. The longer the stasis remains in whole or in part the greater will be the liability to future trouble. The indication, therefore, is to re-establish efficient biliary drainage as soon as possible. Lyon⁹ in a series of cases of catarrhal jaundice occurring during an influenza epidemic in the United States navy reduced the average duration of the jaundice by 50 per cent. In those cases treated by the expectant measures the average duration was thirty-five days, while in those cases treated with the duodenal tube the duration was seventeen days.

Cholecystitis and Cholangitis.

The probable vicious circle established by biliary stasis and cholecystitis has already been referred to. The treatment of severe suppurative or gangrenous cholecystitis by operation is well recognized, but there are many degrees of lesser severity in which the use of the duodenal tube is especially indicated. The complete evacuation of the gall bladder at frequent intervals (twenty-four hours) promotes freer drainage and conduces to the more rapid resolution of the morbid condition. It also helps to remove small collections of pus, cholesterin, precipitated bile salts, mucus, and bacteria which are so prone to form the nucleus of a gall stone. The chances of the infection spreading to distant radicles of the biliary tract and into the pancreas are also diminished. Even where surgical drainage of the gall bladder has been instituted it may be demonstrated by the duodenal tube that the infection is persistent, and that much can be done to hasten resolution by duodenal drainage.

Cholelithiasis.

Instances have been reported where small faceted gall stones have been evacuated with the bile on the use of the duodenal tube, but it must be acknowledged that such instances are rare. It is not at all uncommon, however, to find biliary sand, which represents the early stages of the formation of gall stones, in the evacuated bile even where the presence of larger gall stones is not diagnosed nor definitely considered.

There is no reason to believe that through duodenal drainage the ejection of gall stones from the gall bladder can be brought about. Where small stones have been found it may be surmised that they had been lodged in the ampulla of Vater. In so far as cholelithiasis is concerned there is as yet no evidence to indicate that duodenal drainage can replace operative procedure. There is, however, much to recommend the employment of both measures.

Numerous cases of cholelithiasis are met with where an operation would be attended by considerable risk or might be absolutely contraindicated. In these circumstances much relief may be obtained by the use of the duodenal tube. In fact it may be demonstrated that many attacks of so-called gall stones are in reality periods of acute exacerbations of cholecystitis and cholangitis *plus* cholelithiasis. In such cases the periodic use of the duodenal tube may in great part clear up the chronic infection and thus obviate the recurrent attacks of cholecystitis.

The following reports may serve to demonstrate the value of this plan of duodenal drainage of the biliary tract:

CASE I.

J. M., female, aged 30; married, no children. Duration of illness four years. The onset was gradual with pain in the right side of the epigastrium radiating to the right shoulder. The first attack lasted for some hours and was associated with vomiting. Similar attacks occurred during the next three weeks. She was then free of attacks for three and a half years. Eight weeks before coming under observation the attacks of pain with gradual onset recurred, each attack lasting about six hours and occurring every two or three days. Otherwise the patient was free of symptoms. On examination, there was acute tenderness and rigidity over the gall bladder, very slight jaundice and glycosuria with minute traces of bile in the urine. The stools were not clay-coloured.

Treatment with the duodenal tube showed the bile to be viscid, turbid, and of a dark greenish colour. On examination many epithelial cells and leucocytes but no micro-organisms were found. Repeated biliary draining relieved all the symptoms, the bile became quite clear and of light greenish colour, and the glycosuria disappeared.

This appeared to be a case of recurring cholecystitis with biliary stasis and associated glycosuria. It was thought probable that the glycosuria could be accounted for by the secondary pancreatitis resulting from chronic biliary stasis. A year elapsed without return of symptoms. The glycosuria did not return although the patient was on a full diet and had a high carbohydrate tolerance.

CASE II.

C., female, aged 64; married, twenty-one pregnancies. During the last ten years the patient had suffered from periodical attacks of "indigestion and gastric discomfort," which were relieved by vomiting. The pain was never extremely severe, came on gradually, and usually lasted for some days, being felt in the upper right quadrant of the abdomen and radiating to the right shoulder-blade and shoulder. It lasted from seven to ten days and was usually associated with jaundice. There was no history of acute paroxysms of pain such as is usually found in cholelithiasis. On examination there was some tenderness in the right hypochondrium with localized rigidity. The liver was not enlarged. There was slight jaundice and a trace of bile in the urine. The stools were not clay-coloured. The duodenal tube was passed and a large quantity of dark turbid bile was recovered after the injection of magnesium sulphate. This greatly relieved the pain, and after repeating the draining on the next day the symptoms entirely disappeared. This treatment was carried out twice a week, until the bile became a clear golden colour and the patient continued to be completely free from discomfort.

This appeared to be a case of mild cholecystitis with considerable biliary stasis which was relieved by the use of the duodenal tube.

CASE III.

E. C., female, aged 59; married, five children. Two years before coming under observation the patient suffered from a very severe attack of acute pain in the upper right quadrant of the abdomen, which radiated to the right shoulder-blade. During this attack she suffered from jaundice. Since then she has had many mild attacks of pain situated in the same region, the onset of which has been gradual, lasting for a few hours to a few days, but has never been severe enough to prevent her working. On examination there was slight tenderness of the right upper quadrant of the abdomen on deep palpation. Otherwise examination was negative. The duodenal tube was passed, magnesium sulphate injected, and 50 c.cm. of dark viscid bile obtained. No pus cells were found on microscopical examination. This gave the patient considerable relief, and all symptoms disappeared after three such treatments.

It was considered probable that this condition was due to cholelithiasis with associated cholecystitis, and operation was advised. At the operation the gall bladder was found to be fibrosed and thickened; it contained a single stone the size of a walnut. The common bile duct was dilated, but did not contain any stones, and the head of the pancreas was fibrosed.

CASE IV.

E. C., female, aged 78; married, seven children. In 1913 the patient began to suffer from attacks of angina pectoris, which gradually became less severe under treatment. In 1918 she had her first attack of abdominal pain. This was of very acute onset and extremely severe, associated with tenderness and rigidity over the right upper quadrant of the abdomen, radiating to the back and the right shoulder. It was associated with jaundice and clay-coloured stools. These attacks recurred at irregular intervals of a few weeks. Sometimes the onset was very acute and at other times very gradual. The gall bladder was always tender and palpable during the attacks. X-ray examination revealed the presence of a single large stone situated in the gall bladder. The diagnosis of cholelithiasis and acute cholecystitis was made, but for various reasons an operation was considered inadvisable. It was decided to attempt to drain the gall bladder by means of the duodenal tube. This was found to be accomplished with ease, and the patient did not suffer any inconvenience on the introduction of the tube. During the first drainings of the biliary tract dark, turbid, viscid bile was obtained, which contained many leucocytes and bacteria of the *B. coli* group. The biliary drainage was repeated bi-weekly, the bile gradually assuming a lighter colour, being much less viscid and clearer. As the bile improved in appearance the intervals between the biliary drainage were lengthened until it was only necessary to do it once a fortnight. Since then the patient has been completely free from attacks of pain, and can now tell by the onset of symptoms of general depression and abdominal discomfort when a biliary drainage is necessary.

There seems little doubt that this is a case of cholelithiasis with associated cholecystitis, the main symptoms being due to the cholecystitis and spread of the inflammatory condition to the ducts. That biliary stasis contributed to the exacerbation of these symptoms there seems little doubt. The risks

of operation in this case would be considerable owing to the frailty of the patient's general condition and her inability to accomplish much exertion on account of the cardiac condition.

These are but examples of certain classes of cases in which biliary drainage by the duodenal tube has given satisfactory results. There seems to be no doubt that there is a definite field of usefulness for it, and more extended experience will probably give indications for its further development.

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An Address

ON

THE SPREAD, PROBABLE MODE OF INFECTION, AND PROPHYLAXIS OF LEPROSY.*

BY

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FROM the time of Moses the control of leprosy has been one of the most difficult medical problems of world-wide importance. Nor are the reasons far to seek, for although since the discovery of the lepra bacillus the disease is now nearly universally acknowledged to be a communicable one, yet owing to the failure hitherto to cultivate or inoculate the organism with any degree of certainty, we are still very ignorant regarding the precise manner in which the bacillus passes from one case to another; while in the absence of any reliable method of treatment it has hitherto nearly always proved impossible to detect and segregate the early but infective stages of the disease. In view of the increased powers in the latter direction which the recent progress in the treatment of leprosy has placed in our hands, I propose briefly to review the problem in the light of a study I have recently made of the literature, more especially of the last sixty years.

The Spread of Leprosy over the World.

The following is briefly the history of the spread of leprosy over the world. Historical data show it to have been present in Egypt and India about 1400 to 1350 B.C., and in China about 200 B.C., while in Europe it was unknown to Hippocrates 400 B.C.; but Aristotle described it in 345 B.C. as a rare disease, so it was probably introduced by the invasion of Darius, taking some time to spread sufficiently to attract attention. Italy was free until the return of Pompey's soldiers from the East in 62 B.C.; Galen wrote of it in Germany in A.D. 180, and it gradually spread over all Europe by the eighth to the tenth centuries. During and after the crusades it greatly increased in Europe, becoming a scourge in the twelfth and thirteenth centuries, France alone having two thousand leper hospitals and England some two hundred, this being the first great effort to control leprosy by segregation, to which the rapid decline of the disease in the latter part of the fourteenth century is attributed by most authorities, assisted in England by the famine of 1315-16 and the black death of 1349, which are believed to have caused a loss of half the population. Some anticontagionist writers have questioned the prophylactic value of the mediaeval leper hospitals on the ground that the isolation was not sufficiently complete to stamp out a contagious disease, but in view of the prolonged close house contact usually necessary to allow of infection of leprosy, as I shall show presently, they must have been of great use, and it is worthy of note that the disease died down most rapidly in just those countries where segregation was most stringently enforced, while leprosy remains endemic to this day in outlying parts of Europe where these measures were not much used, such as Norway, Spain, Portugal, Greece, Turkey, and parts of Russia.

Very soon after leprosy began to decline in Europe it spread to the West Indies, the northern part of South America, and Mexico, being carried by infected early Portuguese and Spanish invaders, and later also spread widely by negro slaves from Africa, and Chinese and Indian immigrants after the

emancipation of the slaves; and it is interesting to note that all the evidence points to the aboriginal American Indians having been free from leprosy, while those who have always kept aloof from intercourse with Europeans still remain so. Lastly, leprosy spread to Oceania in epidemic form during the second half of last century, becoming prevalent in the Sandwich Islands in 1853, in New Caledonia in 1865—the latter outbreak certainly and the former probably beginning with immigrant Chinamen—while in 1878 the Marquesas Isles were invaded with equally serious effects. Thus the whole history is that of a communicable disease slowly creeping over the world, although it was not until the appalling character of the invasion of the Oceania Islands by leprosy became evident that the then widely held hereditary and non-contagionist doctrines of the origin of the disease were seriously questioned and its communicability gradually became generally recognized, being materially hastened by Hansen's discovery of the lepra bacillus in 1874.

Hereditary Theory of Origin of Leprosy.

Perhaps the most remarkable feature of the history of leprosy is the almost complete replacement of the world-aged contagious theory of its origin by the hereditary theory of its causation during the nineteenth century, largely based on the book of Danielssen and Boeck of 1848, who looked on the occurrence of a second case within four generations of a family—including collateral descent and ascent and irrespective of whether the parent was diseased before or after the birth of a child—as evidence of hereditary causation, and completely ignored the possibility of family or household infection; and even then had to admit some cases to be of spontaneous origin. The absence of hereditary propagation of leprosy in the descendants of Scandinavian lepers living under far more favourable hygienic conditions after migrating to the United States of America; the frequency of infection in leprosy tropical climates of Europeans free from all hereditary taint; the spread of epidemic leprosy in Oceania far too rapidly to be possibly accounted for by heredity; and the rapid loss of sexual powers of adult male lepers and want of development of such powers in adolescent males, had already greatly shaken the hereditary theory before Hansen's discovery finally established the infectivity of the disease, although the precise mode of communicability still remains unsettled and has to be discussed in the light of recorded cases.

The Communicability of Leprosy.

As the result of an analysis of answers to questions sent to a number of medical men in leprosy countries in 1862 the Royal College of Physicians of London reported leprosy "not to be contagious or communicable to healthy persons by proximity or contact with the diseased," and that there was therefore no justification for segregation measures. As the direct result of this opinion the Colonial Office issued orders stopping all action in that direction and urged the repeal of all laws empowering isolation of lepers. Yet Dr. N. C. Macnamara, I.M.S., with great experience of leprosy came to exactly the contrary conclusion from an analysis of the 107 reports from India, constituting a large majority of the total reports received by the College, further opposition to whose view was soon forthcoming from actual workers in the tropics. Thus, Drogant-Landr recorded a number of infections in 1869; all the thirteen doctors reporting to the British Guiana Leprosy Commission of 1875 favoured contagion; W. Munro collected many cases and stated the whole case in favour of contagion in 1877-79; Brosse, with long experience at the Trinidad leper asylum, wrote a book on contagion in 1879, and Hillis of British Guiana, in an important work on leprosy (1881), found evidence of contagion in 67 per cent. of 139 cases without heredity which he closely investigated. In 1876 Hansen refuted the hereditary theory in Norway and supported the communicability of the disease, and in the next decade Vidal, Boeg, Leloir, and Besnier took the same view in France, and, with the exception of the Indian Leprosy Commission of 1891, to which a strong anticontagionist was nominated by the College of Physicians, but whose views were repudiated by the London Leprosy Investigation Committee who appointed them, every important leprosy conference of the last three decades has endorsed the infectiousness of leprosy, which is now generally accepted. Sir Jonathan Hutchinson's view, first put forward in 1863, that leprosy was "fish-eater's gout"—but subsequently repeatedly modified until "commensal communicability," apart altogether from fish diet, was acknowledged—is also a prebacteriological theory of only historical interest.

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