

growth of thin-walled blood-vessels, and this haemangiomas may be an aetiological factor. Progress of the condition is slow and variable; it commonly stops after a time but occasionally ends fatally.

1. Annotation (1956): Lancet, 1, 93.
2. Krikler, D. M. (1955): S. Afr. Med. J., 29, 1050.
3. Gorham, L. W., Wright, A. W., Shultz, H. H. and Maxon, F. C. jun. (1954): Amer. J. Med., 17, 674

## SURGERY OF THE GALL-BLADDER AND THE COMMON BILE-DUCT\*

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### I. SURGERY OF THE GALL-BLADDER

The surgical treatment of diseases of the gall-bladder consists largely of the treatment of stones and their complications. There is a voluminous literature on gallstones, but its analysis would serve little purpose in this paper. It is of greater value to analyse one's own experience, to discuss how we can diagnose lesions of the biliary tract earlier, with greater accuracy, and how we can treat our patients more efficiently and with greater safety.

Cholecystectomy is one of the commonest of abdominal operations, usually associated with low mortality and morbidity; but this very fact has led to the mistaken view that it is also a simple operation. This light-hearted attitude is to be deplored for, not only may removal of the gall-bladder be an extremely difficult and dangerous operation, but it may be attended with the most serious accidents, such as damage to the common bile-duct.

I present for analysis a consecutive series of 250 cases (260 operations) of surgery of the biliary tract in private practice. This figure could have been more than doubled if one had included free cases operated on in hospital but, because clerking facilities are limited hospital cases are largely lost to follow-up. But although the analysis is confined to the more limited series the opinions expressed in this paper are based on the total experience.

This series of 250, being consecutive cases, is of more value than a selected group of cases of, say, calculous disease only, as it shows a fair cross-section of the type of biliary surgery which may be encountered in practice.

Table I shows an analysis of the type of biliary surgery performed in this series.

TABLE I

Cholecystectomy .. .. .	230
Cholecystostomy .. .. .	10
Stricture of common duct .. .. .	3
Cholecysto-jejunostomy .. .. .	2
Cystic duct, remnant excision .. .. .	4
Secondary choledochostomy .. .. .	4
Laparotomy, infective hepatitis .. .. .	3
Carcinoma of gall-bladder, biopsy .. .. .	1
Gallstone ileus .. .. .	1
Sphincterotomy .. .. .	2
Total operations .. .. .	260

\* Papers presented at the South African Medical Congress, Pretoria, 1955.

Fig. 1 indicates the age incidence in 230 cases of cholecystectomy. There were 160 females and 70 males. In both sexes the highest incidence occurred in the 5th decade.

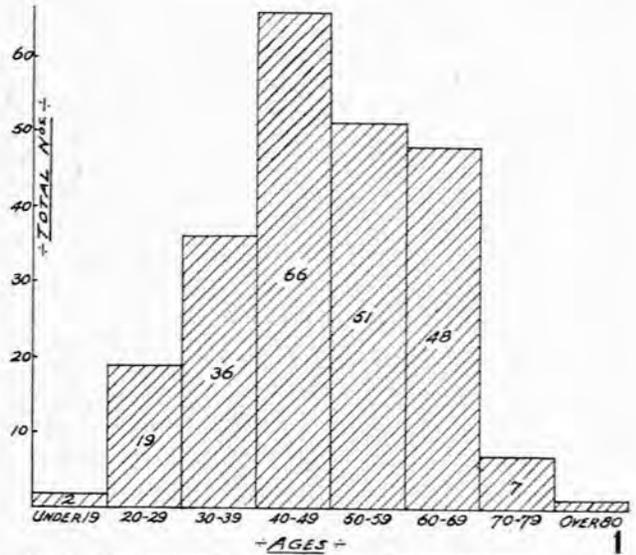


Fig. 1. Age incidence in 230 cases of cholecystectomy.

Table II shows an important analysis of the presence or absence of stones in the common bile-duct. This aspect of surgery of the biliary tract is discussed in Part II. The table indicates that, in all cases of cholecystectomy, it was considered necessary to explore the common duct in 29.1% of cases, that stones were present in 14.8% of all cases, and that, of all common ducts opened, stones were present in 50.7%.

TABLE II. STONES IN THE COMMON DUCT

Cases	Common duct opened		Stones present		Common duct opened, found to contain stones
	No.	%	No.	%	
230	67	29.1%	34	14.8%	50.7%

Table III analyses mortality rate. In cholecystectomy only, the mortality was nil. Where the common duct was explored, the mortality rate was 8.9%, making an average mortality rate in all cases of cholecystectomy,

with or without exploration of the common duct, of 2.6%.

TABLE III. OPERATIVE DEATHS (DEATHS DURING STAY IN HOSPITAL)

	Cases	Deaths	Percentage Mortality
Cholecystectomy only	163	0	0%
Cholecystectomy and/or Cholelechochostomy	67	6	8.9%
Miscellaneous	20	3	15%
Total	250	9	3.6%

The high mortality rate of 8.9% in exploration of the common duct needs explanation, and details of the 6 deaths are given:

One was a case of carcinoma of the common duct, with long-standing jaundice. He died in hepatic coma 2 days after operation.

One case with hypertension died of cerebral haemorrhage 10 days after operation.

Two cases of impacted stone with 3 weeks' neglected jaundice died in hepatic coma a few days after operation. (One was a robust young parson, who had been under treatment by quacks and faith-healers for severe and deepening jaundice before coming to operation.)

One case of cholecystectomy and removal of stone in the common duct was a frail old man who burst his abdomen on the 10th day and died soon after re-suture.

One case was a frail old lady of 83, who died after difficult transduodenal removal of impacted stone.

The 3 deaths in the series of 20 cases of miscellaneous conditions were a case of carcinoma of the gall-bladder, a case of carcinoma of the stomach associated with acute cholecystitis in a man of 81, and a case of stricture of the common duct.

The mortality rate in the entire series of 250 cases (260 operations) was 3.6%.

#### FOLLOW-UP AND RESULTS

In this country it is hardly practicable for all patients to report personally for follow-up examination. Accordingly, follow-up by letter is resorted to. I believe this to have been valuable in the present investigation, for the patient is aware of his (or her) symptoms, and can state accurately whether pre-operative symptoms have gone, are still present, or have become aggravated. The patients were asked to reply to the following 4 simple questions:

1. Have you been quite well since the operation?
2. Have you had trouble with the bile passages?
3. Have you had a further operation for this trouble?
4. Any further comments?

If a patient reported further severe trouble, a personal letter was sent asking for details. In some cases further investigation was arranged.

Of the 250 cases, 229 were traced (a 92% follow-up). Ten cases had died since their discharge from hospital, from coronary thrombosis (5 cases), carcinoma of the pancreas (3 cases), aplastic anaemia (1 case) and periarthritis nodosa (1 case).

What we were interested in was the results of cholecystectomy. It is to be noted that, of the 230 cholecystectomies, in 35 (15%) the gall-bladder did not contain stones. In some cases operated on, the gall-bladder wall was found to be opaque and thickened, inflam-

mation or cholesterosis being present but no calculi; in the absence of other pathology, the gall-bladder was removed. In a few cases, one was left with the real problem of a patient with classical biliary colic, in whom no pathology could be found on laparotomy. Should a normal-looking gall-bladder be removed? We have left the gall-bladder in some such cases, and the patient's pain has continued. In others we have removed the gall-bladder, and some patients have been relieved and others not.

Table IV indicates the results of cholecystectomy. (Note: 'Mild trouble' means insignificant and mild symptoms described as 'windy', 'have to take salts', 'dyspepsia', 'have to watch my diet', etc. 'Severe trouble' means severe and incapacitating symptoms, such as attacks of pain, and cases where the pre-operative symptoms are unchanged.)

TABLE IV. RESULTS OF CHOLECYSTECTOMY (Average follow-up interval 3.5 years)

Cases	Deaths	Survivors traced	Further trouble	
			No further trouble	Mild Severe
230	8	196 (85%)	127 (65%)	44 (22%) 25 (13.7%)

It is noteworthy that in 13.7% of cases the patient had little or no relief from the operation.

Table V shows the results of cholecystectomy in cases with stones and without stones respectively. It is significant that, if 'mild' and 'severe' troubles are combined, more than 50% of cases of cholecystectomy without stones had further symptoms after operation.

TABLE V. RESULTS OF CHOLECYSTECTOMY

Cases	No further trouble	Further trouble	
		Mild	Severe
G.B. contains stones	167 (67.6%)	33 (19%)	21 (12.5%)
G.B. does not contain stones	29 (48%)	11 (38%)	4 (13.7%)

Consideration of Table V brings us again to the problem of the patient with 'biliary colic', with the abdomen opened, no stones discovered, and the gall-bladder looking normal. It is our duty to search thoroughly for other pathology before removing a non-calculous gall-bladder. We believe that the state of the sphincter of Oddi should not be overlooked, for a 'fibrotic' state may be present. It is in this very type of case of persistent pain following removal of a non-calculous gall-bladder, that subsequent sphincterotomy has given good results.

Table VI shows results compared in cases where the common duct was or was not explored.

TABLE VI. RESULTS OF CHOLECYSTECTOMY

Cases	No further trouble	Further trouble	
		Mild	Severe
Common duct not explored	145 (63.4%)	32 (22%)	21 (14.4%)
Common duct explored	51 (68.6%)	12 (23.5%)	4 (7.8%)

Significant trouble was experienced in twice as many cases where the common duct was not explored as in those where it was opened. This may indicate, of course, that stones in the common duct may have been overlooked in the first group of cases, and that we should extend our indications for exploring the duct. This has been difficult to establish, but it is possible that stones are present in the common duct in 4 of the 25 cases who experienced 'severe trouble' post-operatively. These may have been present at the time of the cholecystectomy, or they may have developed subsequently.

Consideration of the 25 cases with 'severe trouble', reveals the following (Table VII).

TABLE VII

	Cases
Common-duct stone probable *	4
Duodenal ulcer or gastric ulcer	2
Chronic relapsing pancreatitis	1
Probable chronic relapsing pancreatitis	2
Plummer-Vinson syndrome	1
Investigated with Biligrafin and barium meal—negative findings	3
Re-operated, sphincterotomy	1
Associated gastrectomy at primary operation †	2
One attack of pain without jaundice 5 years after primary operation	1
Attacks of 'fainting'	1
Unexplained and not investigated	7
Total	25

\* In none of these cases was the common duct explored at the primary operation.

† Could account for symptoms.

Consideration of the 25 cases who did poorly after operation therefore reveals that at least 13 cases suffered from pathological conditions more or less unassociated with the original trouble or the operation. The case in which sphincterotomy was performed was completely relieved by this operation. In the 4 cases suspected of having common-duct stones, the duct was not explored originally because there appeared to be no indication for the procedure. Together with the 7 unexamined cases, there therefore remain 11 cases who may be said not to have benefited from their cholecystectomy.

#### GENERAL DISCUSSION

##### 1. Procedure

Our procedure at an operation for cholecystectomy is as follows:

A high, substantial, right paramedian, muscle-displacing incision is made. This is adequate for all types of biliary surgery, provided it extends really high, right up to the costo-xiphoid junction. The abdominal wall is treated with the greatest gentleness, and a self-retaining retractor is never used; nor is a 'gall-bladder rest' or a sandbag behind the patient ever used.

A thorough and systematic examination is made of all abdominal and pelvic organs, including structures such as the oesophageal hiatus. (This procedure is indeed followed at every laparotomy, except in the presence of acute suppurative conditions.) If any additional pathological condition is found, it is usually dealt with at the same operation if the patient's condition allows. Gastrectomy, splenectomy, hiatus hernia,

may all be done at the same time. The appendix is removed as a routine measure, unless it is completely inaccessible.

The peritoneum to the right of the duodenum is incised, and the duodenum, together with the head of the pancreas, is mobilized, so that the common duct and the pancreas can be properly palpated between the fingers and thumb.

Cholecystectomy is proceeded with in the usual manner from the neck upwards, after completely identifying the bile-ducts and the hepatic and cystic arteries. If there is even the slightest doubt about the anatomy around this area, the gall-bladder is removed from the fundus downwards. The cystic artery is ligated and divided, and care is taken to remove the entire cystic duct. The cystic duct is left if it would appear hazardous to proceed with its identification and removal; such cases are exceptional.

There is no opportunity in this paper to discuss the hazards and difficulties of this operation. It can be the easiest and quite the most difficult of abdominal operations. One should be acutely aware of the anatomical abnormalities of the region, the operation should proceed with the greatest care and without hurry, and no structure should be divided or ligated unless it has been absolutely identified.

At the conclusion of the operation, the gall-bladder bed is re-peritonealized, and the peritoneum is reconstructed over the common duct. A soft rubber drain of the Penrose type is used in all cases, and is brought up between the two lobes of the liver, through the upper part of the wound.

##### 2. Acute Cholecystitis

Each case of acute cholecystitis is assessed individually and treated by antibiotics and replacement of fluid and electrolytes; and cholecystectomy is performed as soon as the general condition of the patient allows, usually within 1-3 days. In the aged, the acutely ill and the toxic patient, however, we still perform a cholecystostomy as a primary operation, frequently under local analgesia.

##### 3. 'Silent Stones'

Whenever a gall-stone is discovered, either during routine radiological investigation, or at laparotomy for other diseases, cholecystectomy is advised, either at the time or subsequently.

##### 4. 'Post-Cholecystectomy Syndrome'

There is no opportunity to discuss this aspect in detail. We believe that in all cases of post-cholecystectomy pain an organic cause must be sought, and in the majority of cases it will be found. 'Biliary dyskinesia' is a questionable diagnosis, attributed to functional spasm of the sphincter of Oddi. The following causes of post-cholecystectomy pain must be carefully considered:

1. *Errors in diagnosis.* Hiatus hernia, chronic pancreatitis, right kidney disease, duodenal ulcer, and coronary disease, should all be excluded pre-operatively, and also at laparotomy. We have found that posterior penetrating duodenal ulcer in women may give rise to intermittent attacks of pain, quite unlike the usual ulcer

history. It is also well to bear in mind that, should one operate for gall-bladder pathology and find none, a posterior duodenal ulcer may not easily be seen or felt unless one deliberately enters the lesser sac through one of the omenta, to examine the posterior aspect of the first part of the duodenum.

It should be stressed that a careful clinical evaluation of the patient is most important, with laboratory and X-ray studies as secondary aids in diagnosis.

2. *Errors in surgical technique.* It is a fault to leave the cystic duct behind. It is even worse to leave a portion of the gall-bladder behind unless its mucosa is destroyed. Such remnants, with or without stone, may give rise to quite marked symptoms, often entirely relieved by subsequent removal. Failure to remove stones from the common duct is often the cause of persistent symptoms, as is failure to perform a sphincterotomy when the sphincter is fibrotic and cannot be dilated.

The most serious error in technique is trauma to the common duct, and post-operative symptoms and signs are proportional to the extent of the damage.

3. *Residual disease.* Residual common-duct stones as well as untreated peptic ulcer, hiatus hernia, or chronic pancreatitis, may cause persistent symptoms after cholecystectomy. In the series of cases reported here, a most careful search was made for other conditions at the time of the cholecystectomy, and they were dealt with if discovered; yet 13.7% of the cases suffered from what may be classified as severe or significant 'post-cholecystectomy syndrome'. In one case pancreatitis was present at the time of the operation, and the patient has continued to have symptoms. In 2 cases peptic ulcer developed which was not present at the primary operation. In at least 11 other cases there were severe symptoms, usually consisting of the

same attacks as before the cholecystectomy. In the absence of jaundice, common-duct stones are unlikely but cannot be excluded. Fibrosis or spasm of the sphincter of Oddi is a possibility.

One should consider, in the first place, extending the indications for exploring the common duct at cholecystectomy, so as to minimize the risk of leaving common-duct stones behind; and, secondly, investigating the state of the sphincter of Oddi more frequently and thoroughly, so that a sphincterotomy may, if necessary, be performed at the primary operation.

#### SUMMARY

1. A consecutive series of 250 cases (260 operations) of biliary-tract surgery in private practice is analysed. Emphasis is laid on the incidence of common-duct stones.
2. A complete follow-up study was undertaken, and the results of cholecystectomy are analysed.
3. The procedure of cholecystectomy is discussed.
4. 'Post-cholecystectomy syndrome' is discussed briefly.

#### SAMEVATTING

1. 'n Aaneenlopende reeks van 250 gevalle van operasies aan die galweë word (260 operasies) ontleed, met spesiale verwysing na stene in die ductus choledochus.
2. Die gevalle van cholelitië word ontleed en die resultate, verkry van 'n opvolgstudie, word uiteengesit.
3. Die operasie van galblaasverwydering word bespreek.
4. 'Na-cholelitië sindroom' word bespreek.

## II. SURGERY OF THE COMMON BILE-DUCT

The commonest condition of the common bile-duct which merits discussion is stones. We have to make a pre-operative diagnosis of stones in the common duct if at all possible. If stones are suspected, or if they have to be excluded, we should know how to search for them at operation. We should recognize certain indications for incising and exploring the common duct and, once the duct has been opened, we should know exactly what to do and how to avoid missing stones.

The very fact that there is a voluminous literature on the question of stones in the common duct overlooked at the time of cholecystectomy indicates the great importance of the problem; any procedure or technique, however trivial it may seem, for detecting and removing common-duct stones, should be familiar to the surgeon.

#### CLINICAL DIAGNOSIS

*Stone v. Compression.* The typical clinical picture of attacks of biliary colic, followed by shorter or longer periods of jaundice, in the case of stone, is well known. The more cases one sees, however, the more atypical syndromes are seen. There is no doubt that a case of insidious onset of painless jaundice, gradually deepening,

may be due to an impacted stone. On the other hand, we have had cases of intermittent attacks of jaundice, sometimes accompanied by pain, proved at operation to be due to carcinoma of the pancreas, or chronic pancreatitis. It is well to remember that the great majority of cases of pancreas carcinoma have pain.

In our experience, Courvoisier's law has been so often proved wrong that it is of no practical importance, and could practically be disregarded in the differential diagnosis of jaundice.

#### *Infective Hepatitis*

A most difficult differentiation has often to be made between stone in the common duct and infective hepatitis. Clinically, hepatitis is usually ushered in by a period of 'feeling off-colour' for 7-10 days, the gradual onset of jaundice, enlarged tender liver, and absence of previous attacks of biliary colic. If the patient is young, this would favour hepatitis, but the elderly are more likely to have stones. However, one of our cases of hepatitis was 59 years of age.

Naturally we turn to the laboratory for help in the differential diagnosis of jaundice, and here we have had our biggest disappointments. Generally speaking, we

have found that laboratory tests might confirm a diagnosis which was clinically quite definite, but in cases where the diagnosis was doubtful the laboratory tests have been not helpful and, in some cases, misleading.

Severe liver damage early in the illness may point to hepatitis but, when obstructive jaundice caused by stone has been present for some time, similar liver damage may be demonstrated. Generally speaking, a high alkaline phosphatase points to obstructive jaundice, but even this has often not been helpful. We have had the mortification of attending a woman of 70 who had been diagnosed and treated as a case of hepatitis for 6 weeks and reached our department *in extremis*, at whose autopsy a large stone was found impacted in the common duct.

Mrs. H., aged 59, gave a history of abdominal discomfort and jaundice. She was seen by a physician who, supported by laboratory tests, made a diagnosis of hepatitis. When she did not improve on treatment, she resorted to quacks for 7 months. She came to us with severe liver damage, loss of weight, and deep jaundice. At operation, a large stone was removed from the common duct. She recovered well and is in good health.

Mr. D., aged 59, was admitted to the physicians with a history of lassitude, vague pain in the right upper quadrant, fever, and jaundice. The clinical diagnosis was hepatitis, but the laboratory report was an unequivocal one of obstructive jaundice. Because of the great uncertainty, operation was performed, and this revealed a normal gall-bladder, normal common duct, and an enlarged liver. The common duct was opened (to satisfy the pathologist), but there was no stone and no obstruction.

Mrs. B., aged 46, presented with a history of long-standing dyspepsia, with a recent attack of R.U.Q. pain, followed by jaundice. Blood examination showed an alkaline phosphatase of 11.25 K.A., and the pathologist thought that the case was not obstructive jaundice. At operation, gall-stones were found, with stone in the common duct.

Naturally, each case will be analysed and judged individually but, in case of great doubt, we feel it is safer to perform laparotomy to establish the diagnosis early on in the illness. It goes without saying that the anaesthetist will be consulted and will administer an anaesthetic non-toxic to the liver and kidneys and, if a diagnosis of hepatitis is confirmed, the operation will be completed as speedily as possible.

#### RADIOGRAPHY

In the diagnosis of stones, with a functioning or non-functioning gall-bladder, we have been very satisfied with the accuracy of oral cholecystography by Telepaque. For the demonstration of disease in the common duct, intravenous cholangiography by Biligrafin has been used. In our experience, this investigation is valuable but has its limitations. The shadow cast by the dye is frequently not very dense, and it is difficult to detect filling defects. We therefore say that when we have positive findings, such as a hugely dilated duct, or obvious filling defect, the investigation has helped us. If, however, the common duct shows up, but no obvious stones are seen, the presence of stones or other disease has not been excluded. The density of excreted dye also gives an indication of liver function. The investigation will thus also be of little use for the detection of stones in the presence of liver damage, for the excretion will be poor.

#### OPERATION

When an operation is performed for gall-stones, under what circumstances should the common duct be opened? Some surgeons solve this problem simply by making it a routine to incise and explore the common duct in every case of cholecystectomy. Others use the less satisfactory method of exploring by a bougie through the stump of the cystic duct. We do not think the former policy is wrong, *provided* the common duct is opened with great care, and explored with great gentleness. A common duct which is not dilated has thin walls and a narrow lumen and does not lend itself to easy exploration, so that some damage may be caused at the site of incision. A traumatic stricture may follow, which would be a great tragedy since the duct was normal in the first place. We therefore list the following indications for incising and exploring the common duct for stones:

1. Presence of jaundice, or history of jaundice. It is well to remember, however, that stones may be present in the common duct without jaundice having been present.

TABLE I

History of Jaundice	Stones in Common Duct	No.	Percentage
No	Yes	20	29.8%
No	No	18	26.8%
Yes	Yes	14	20.8%
Yes	No	15	22.4%

Table I indicates findings in a personal series of 230 cases of cholecystectomy, in which the common duct was explored in 67. Note that in 29.8% of cases stones were present in the common duct in the absence of history of jaundice.

2. Dilatation and/or thickening of the wall of the common duct. It is uncommon to find stones in a duct which is not dilated to a certain degree.

3. Small stones or 'gravel' in the gall-bladder. It is our routine to have a nurse open the gall-bladder immediately on removal so that its contents may be inspected. Small stones and gravel easily find their way into the common duct, especially when the cystic duct is wide.

4. Positive or suspicious findings on palpation of the common duct or head of the pancreas, or on operative cholangiography.

5. Presence of acute or chronic pancreatitis.

6. 'Peanut' gall-bladder—a small contracted gall-bladder indicates long-standing calculous disease, usually accompanied by dilated common duct containing stones.

7. Non-calculous gall-bladder in a patient with typical biliary colic. The state of the sphincter of Oddi has to be established.

Table II in Part I (page 183) indicates the findings in a series of 230 cholecystectomies performed by the author.

#### *When the common duct has been opened*

Once the common duct has been opened, a definite routine should be followed in a systematic search for stones. The opening in the duct should be made large enough to admit graduated bougies. The character of

the escaping bile should be noted, and gravel or stones removed. Palpation of the duct may reveal stones, which may be 'milked' to the opening. A urethral bougie is now gently inserted; palpation around the bougie is the surest method of detecting stones.

The usual type of gall-stone forceps for grasping a stone (Desjardin's) is not very satisfactory for use in the common duct, for it has not the correct angle. We use

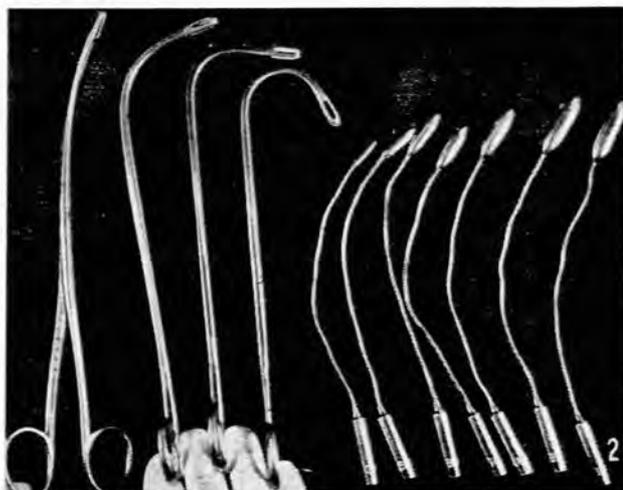


Fig. 2. Forceps for grasping stone in the common duct (left) and Bake dilators (right).

kidney stone forceps, which are bent to a right angle or more (Fig. 2); the ampulla of Vater is then dilated with Bake's dilators (Fig. 2)—it is usually not necessary to dilate to more than 7 or 8 mm. The dilators may be guided through the ampulla by grasping the head of the

pancreas and the second part of the duodenum between fingers and thumb of the left hand. This can only be done if these structures are mobilized by incising the peritoneum lateral to the duodenum (this is done in every case of cholecystectomy so that the duct may be properly palpated). Now the duct is thoroughly flushed out with saline.

After proceeding in the manner outlined above, it is possible to be reasonably certain that no stones remain in the distal part of the common duct. It is a real problem, however, to know whether residual stones remain in the common hepatic duct, or in the intra-hepatic portions of the duct. Such stones may or may not be detected by palpation with bougies. We have found an excellent way of dealing with such stones: A large bulb syringe, or a bladder syringe, with blunt end, is inserted into the opening in the duct, and directed upwards. Saline is injected carefully, but under reasonable pressure, so as to fill the hepatic ducts and distend them. Stones become loosened and, if the syringe is now suddenly removed, the saline flushes back rapidly and stones are brought down. In one patient, in whom already 22 stones had been removed from the common duct and we had used all known methods of clearing the duct, this technique was applied and 3 further large stones were released from the proximal hepatic ducts. We have no experience of the cholelithophone, which amplifies the sound of a bougie touching and scraping against a stone.

If a stone remains impacted in the lower end of the common duct, it may be removed transduodenally. The duodenum and head of the pancreas must be very thoroughly mobilized, the 2nd part of the duodenum incised longitudinally, the ampulla incised, the stone removed, and the duodenotomy closed transversely in two layers. If pancreatitis is present, the main pancreatic duct may also be searched for and dilated.

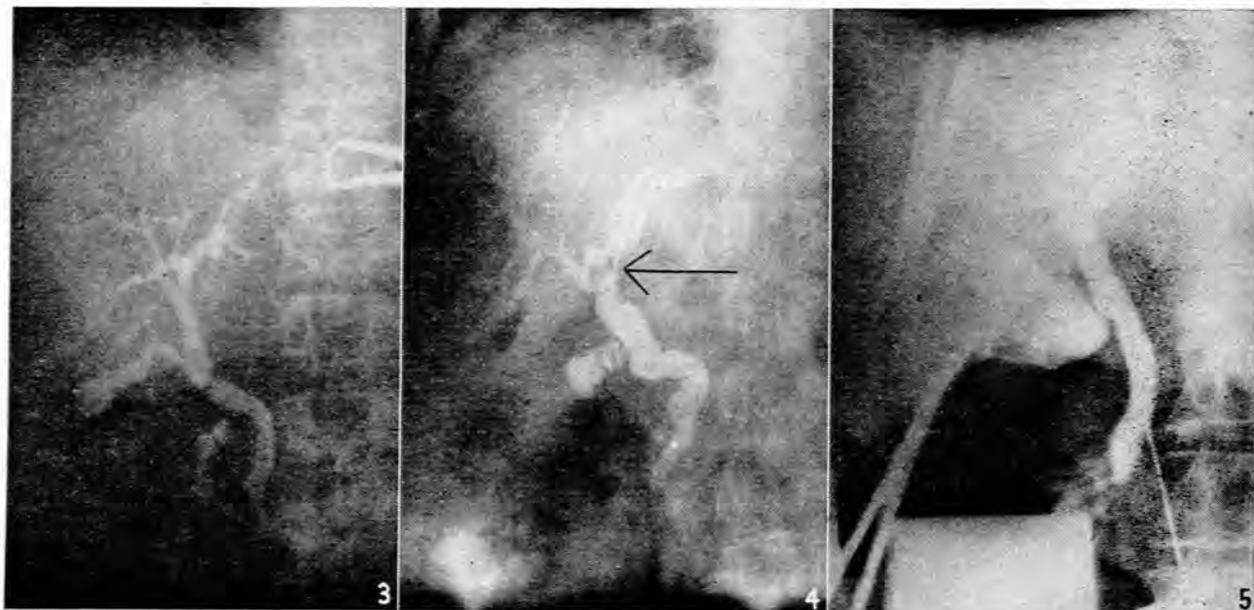


Fig. 3. Normal operative cholangiogram. Fig. 4. Operative cholangiogram showing stone. Fig. 5. Operative cholangiogram showing no stones. Common duct exploration, however, revealed a stone.

### Operative Cholangiogram

This appears to be an ideal method of detecting stones in the common duct. We have given the method a thorough trial and can testify, not only to its uses, but also to its limitations.

An X-ray plate covered by a Potter-Bucky grid is placed behind the right lower rib in a special cassette-holder, and the tube over the patient. When the gall-bladder and common duct have been exposed, all metal clips and instruments are removed, and 5, 10 or up to 20 c.c. of 35% Pyelosil are injected into the common duct, and an exposure is made. The operation proceeds, and the common duct is opened if any indication exists. The usual routine is followed, a T-tube is sewn tightly into the common duct, and a control cholangiogram is taken before the abdomen is closed.

We started originally with 70% Pyelosil, and injected 10 c.c. or more, but we found that stones could be missed by being surrounded by dye casting a dense shadow. We got more satisfactory pictures with a smaller amount of dye, of lower concentration.

Fig. 3 shows a normal operative cholangiogram. Fig. 4 shows stone in the common duct. Fig. 5 shows an operative cholangiogram with negative findings. In the last case the common duct was opened and a stone was found. This case indicates how misleading the information obtained in this manner may be.

Fig. 6 shows a post-operative cholangiogram taken 14 days after operation. It shows a stone in the right hepatic duct. An operative cholangiogram was not done in this case, and it is certain that it would have been of great value if it had been done before closing the abdomen. Fig. 7 shows an apparently normal cholangiogram, yet the common duct was opened and 'gravel' removed. Fig. 8 shows the dilated common duct in chronic pancreatitis.

We have had a case where a cholangiogram showed two stones in the common duct. Three stones were removed from the duct, and a cholangiogram 14 days later showed yet another residual stone!

We have many examples where the investigation was of great value but, as can be seen from the examples quoted, one may be misled in some cases. A factor also to be borne in mind is the difficulty of interpretation in some of the photographs obtained.

We have concluded that operative cholangiography is a valuable additional measure in our efforts to detect common-duct stones, and we use it as a routine. At the same time, we realize its limitations and do not use it as a substitute for other measures as outlined in this article. We have no experience of cholangio-manometry.

Generally, when a common duct has been opened, it should be drained by a soft T-tube. If a sphincterotomy has been performed, one limb of the T-tube should lie through the ampulla into the duodenum. This tube may be left in for many months, whereas the usual short-limbed T-tube is left in for an average of 14 days, when it may be removed if the cholangiogram is satisfactory or when, after clamping the vertical limb for 2 days, the patient experiences no discomfort or jaundice.

### Post-operative Cholangiogram

It is possible, in spite of the most careful search at the time of the operation, to overlook one or more stones in the common duct. At the estimated time of removal of the tube, it is first clamped for increasing periods each day; if there is no discomfort, pain or jaundice, the tube may be removed, but undetected stones may still be present, and they may be responsible for post-cholecystectomy symptoms.

One may also, however, perform a cholangiogram at the estimated time of removal of the tube. The T-tube

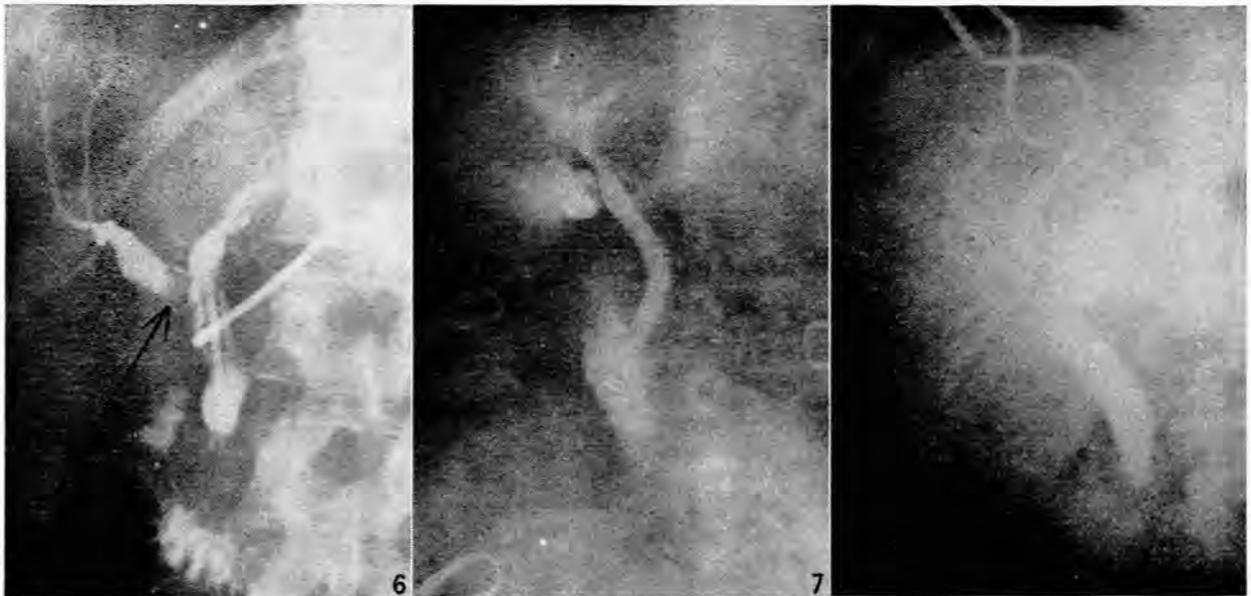


Fig. 6. 14-days post-operative cholangiogram, showing stone in right hepatic duct. Operative cholangiogram was not done in this case, but would have been of great value. Fig. 7. Normal operative cholangiogram, yet common duct contained gravel and debris. Fig. 8. Dilated common duct in chronic pancreatitis (operative cholangiogram).

is first filled with saline to eliminate air-bubbles, and a contrast medium is injected under fluoroscopic control. Exposures are made as required. If no stones are detected, if the dye enters the duodenum freely, and if there is no undue dilatation of the ducts, the T-tube may be removed.

Fig. 9 shows a normal post-operative cholangiogram.

What if stone or stones are detected in a cholangiogram taken 14 days post-operatively? Fig. 10 shows such a case. Early in our experience we used to re-operate on such a case right away; a more difficult procedure can hardly be imagined! A re-exploration at this stage may be accompanied by much morbidity, and even mortality. We think it is far safer to make a note of the presence of stones, clamp the T-tube and, if there is

stones have been removed, or especially when recurrent stones have been removed, and it is found that the sphincter cannot be dilated more than 3 or 4 mm. (Bake size). The duct does not drain properly, and stones will surely form again unless a sphincterotomy is performed. Fig. 11 shows a case.

There is another condition, which may be termed 'fibrosis of the sphincter of Oddi', for which sphincterotomy is indicated. This may be found in patients in whom laboratory and X-ray findings are consistently negative and yet have classical attacks of biliary colic, sometimes accompanied by jaundice. This also applies to cases where, after a cholecystectomy, the patient has attacks of pain without jaundice and Biligrafin examinations are repeatedly negative. If a laparotomy is per-

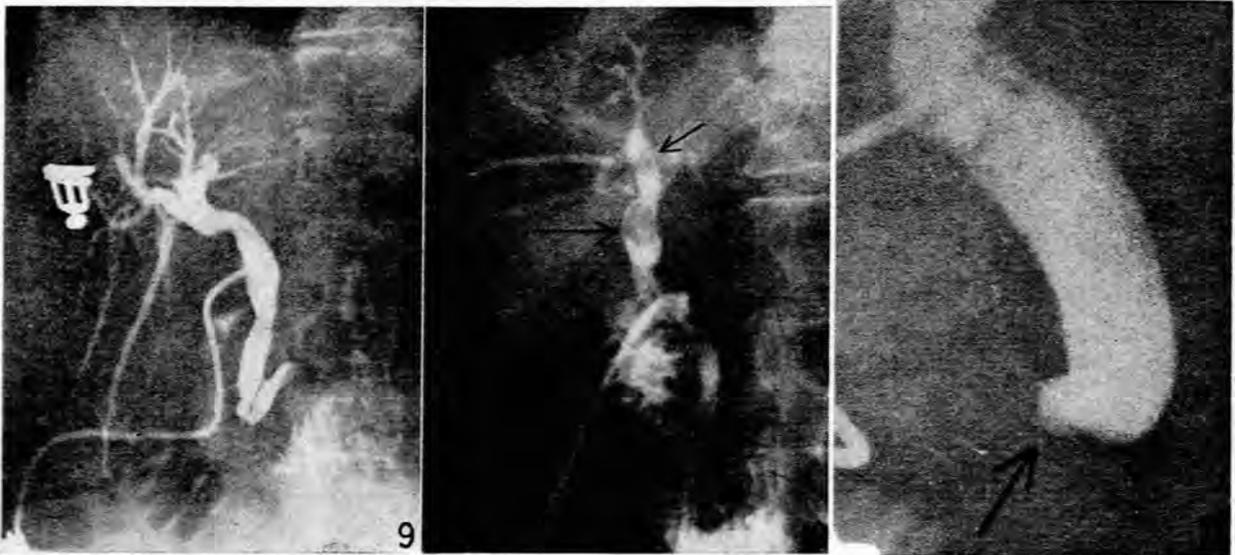


Fig. 9. Normal post-operative cholangiogram. Note filling of pancreatic duct with dye. Fig. 10. Post-operative cholangiogram showing residual stones. Fig. 11. Cholangiogram following removal of recurrent common-duct stones. Sphincterotomy should be performed. Arrow points to stenotic ampulla.

no discomfort or jaundice, remove it. The stones may subsequently pass, with or without pain, or if they should later cause obstructive symptoms they may then safely be removed. The stones may, of course, be removed at any time subsequently, when the patient's general condition allows, without waiting for symptoms. Biligrafin examinations may show whether stones are still present at any given time.

The results of injection of various relaxants and stone solvents through the T-tube, in an effort to relax the sphincter of Oddi and to dissolve the stone, have been disappointing in our hands. Dr. T. Marais, of our department, has tried many stone solvents *in vivo* and *in vitro*, without success.

#### Sphincterotomy

At times, the duodenum has to be opened in its 2nd part, the ampulla found, and the sphincter of Oddi divided. The indication for sphincterotomy to remove a stone impacted in the lower end of the duct is quite clear. Another absolute indication is when common-duct

formed, other pathological conditions must be very carefully excluded, and finally the common duct should be opened. If the ampulla will not admit more than 3-mm. Bake dilator, a sphincterotomy is indicated. If chronic pancreatitis is present, the pancreatic duct should also be searched for and dilated.

After sphincterotomy, a T-tube is inserted into the common duct, with a short limb in the duct towards the liver, and a long limb leading through the ampulla into the duodenum. This is left in for a period between 3 weeks and 3 months.

'Biliary dyskinesia' is, in our opinion, a questionable diagnosis to make. One should continue searching for an organic cause for severe attacks of pain.

#### SUMMARY

1. The clinical diagnosis of stone in the common duct is discussed, with special reference to its differentiation

from obstruction due to pressure from the head of the pancreas, and from infective hepatitis.

2. The operative procedure of exploration of the common bile duct for stone is discussed in detail.

3. Operative cholangiography is described and discussed.

4. Post-operative cholangiography is discussed.

5. Sphincterotomy of the sphincter of Oddi is discussed.

#### SAMEVATTING

1. Die kliniese diagnose van stene in die ductus choledochus word bespreek, met besondere verwysing na die differensiële diagnose van druk deur die pankreaskop, en infektiewe hepatitis.

2. Die stappe by die operasie van eksplorاسie van die ductus choledochus word bespreek.

3. Operatiewe cholangiografie word bespreek.

4. Na-operatiewe cholangiografie word bespreek.

5. Deursnyding van die Oddi sfincter word bespreek.