

## SOME RESULTS OF SURGERY OF THE BILIARY TRACT \*

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THIS paper represents a study of 136 cases of biliary tract disease. The cases are all personal ones, most of which were operated upon while on Service C of the University of Pennsylvania Hospital. The review includes 33 operations for acute gall-bladder disease with 2 deaths, 78 operations for chronic gall-bladder disease with 2 deaths, 21 operations for biliary disease with obstructive jaundice with 4 deaths, and 2 operations for carcinoma of the gall-bladder with 1 death, and 2 cases with associated duodenal ulcer with 1 death. A follow-up study has been made and a response has been obtained from 94 per cent. of the patients.

In an effort to clarify or confirm the existing ideas concerning the pathogenesis of gall-bladder disease, a study was made with respect to sex, age, and race, obesity and the relation of the disease to pregnancy.

*Race and Sex.*—Of the 134 patients with gall-bladder disease 83 were females and 17 were males. There are 3 negroes in this series. This relative infrequency of biliary disease has been noted by many authors. It would seem, therefore, that comparative studies between the white and black races might do much toward coming to a final definite decision with regard to the etiology of gall-bladder disease.

<i>Age.</i> —Less than 20	20–29	30–39	40–49	50–59	60–69	70+	
No. of cases	1	12	33	37	30	12	3

The group between twenty and forty years, usually considered below the gall-bladder age, included 36.5 per cent. of our patients. Sixty-five per cent. of the cases in females came to operation during the child-bearing period.

*Obesity.*—A note designating the patient as obese was found in 76 cases. In all but 2 of the cases occurring in males, obesity was found.

*Relation to Pregnancy.*—Some interesting observations were made of the relation of cholelithiasis to pregnancy. The data was not complete in all cases, but using that which was available it was found that 74 of the 111 female patients had passed through one or more pregnancies. Twenty-two of these noted that their attacks occurred or recurred during or shortly after a pregnancy. One patient gave a history of having an attack of gall-stone colic follow each one of five deliveries. A large majority of our cases in women between twenty and thirty occurred during or immediately following the first or second pregnancy.

With these factors in mind, we may say, then, that cholelithiasis is a disease primarily of women, that it occurs most often in the obese, and that it

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bears a definite relation to pregnancy. We believe then that gall-stone formation is not primarily a phenomenon of infection, but that it is a metabolic phenomenon brought about by an effort on the part of the body to excrete an increase of cholesterol from the blood. Any condition which causes an increase of cholesterol in the blood over a considerable period of time would predispose to gall-stone formation. It has long been known that during pregnancy there is a distinct hypercholesteræmia, and, since the blood cholesterol parallels very closely the blood fats, it is not hard to believe that a hypercholesteræmia had occurred in a patient who has covered her body with a thick layer of fat.

No doubt infection plays a very prominent part in gall-bladder disease, but we believe its rôle is late in the process. The operations performed on young women disclosed gall-bladders which were normal to inspection and to palpation. They contained single or multiple stones which were soft, round, and slightly lobulated in appearance. They were composed of almost pure cholesterol. The bile, which was cultured in several cases, was sterile. These cases were looked upon as the earliest form of gall-bladder disease.

The patients showing evidence of infection were found in the older patients with thickened gall-bladders and faceted stones, indicating a disease which had probably been present for years. It is the long-standing irritation of the gall-bladder wall by the presence of stones and the trauma caused by distention when a stone obstructs its outlet which open the way for infection by bacteria which are constantly being excreted through the bile from the liver or which come to it from the blood stream.

*Principles of Treatment.*—Few, if any, cases of gall-bladder disease need be considered surgical emergencies, and the disease is serious enough to demand thorough pre-operative study and treatment. The only exceptions to this dictum may be found in the acute group and even among this number are many which would be benefited rather than harmed by a day or two of observation.

The pre-operative treatment may be divided into two parts. First, measures for the relief of pain, of which hot poultices of flaxseed applied to the whole abdomen, continuously, seem the most efficacious. If necessary, morphine may be given hypodermically in addition. The patient should be given nothing by mouth. By this means the vomiting is controlled and the duration of the attack decreased.

Second, measures to reduce the risk of operation: Fluids, preferably 5 to 10 per cent. glucose solution, are given by enteroclysis. The pre-operative administration of carbohydrates is probably the best insurance against post-operative hepatic complications. If the patient shows jaundice, special precautions are necessary which will be discussed under the head of biliary obstruction.

Pre-operative study in the doubtful or chronic cases includes an X-ray examination. Of the patients examined before the Graham technic was

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adopted, 8 showed evidence of gall-bladder disease, while 18 gave no abdominal findings in a simple examination of the upper right abdomen.

Since using the Graham technic, a diagnosis of gall-bladder disease was verified in 12 cases, but in 3 others, cases in which a negative diagnosis was received, definite pathology was found in the gall-bladder region, an error of 20 per cent. In all of these cases the oral method of giving the dye was used.

Our opinion is, that an X-ray examination is not necessary in all cases of gall-bladder disease. It is more useful in the thinner patients who border somewhat on the ulcer type and in all cases in which the diagnosis is doubtful. The X-ray readings are correct in competent hands in about 80 per cent. of the cases. The patients the least likely to give a correct reading are the younger women in whom small stones have formed, but in whom the gall-bladder function is still good.

*Operation.*—1. *Anæsthetics.*—Operations on the biliary tract demand more care in the choice of anæsthesia than probably any group of abdominal operation. Gradually the tendency has been to change from the more shocking inhalation anæsthetics to the local and regional anæsthesia induced by novocaine, adding if necessary gas analgesia.

### *Anæsthetics*

Ether—43 cases with 4 deaths.

Nitrous oxide and ether—48 cases with 3 deaths.

Local and gas—15 cases with 2 deaths.

Gas—1 case—no deaths.

Local—7 cases—no deaths.

Splanchnic—18 cases—no deaths.

Splanchnic and gas—4 cases—no deaths.

By far the most satisfactory anæsthetic in our experience is obtained by blocking the splanchnic nerves posteriorly as suggested by Kappis. There must be a local infiltration of the abdominal wall in addition, with a block of the intercostal nerves at the costal margin. After the peritoneum is opened a wall of local anæsthesia is placed just beneath the parietal peritoneum, using the finger in the abdominal cavity as a guide. It is usually necessary to place a small amount of novocaine in the round ligament and at times the anæsthesia is not complete until the gastro-hepatic omentum near to the pylorus and about the cystic duct is infiltrated.

The induction of this anæsthesia is somewhat time-consuming but is not painful or irritating except to the very nervous patient. It is successful alone in about 82 per cent. of the cases. In the others a light gas anæsthesia is all that is necessary. Under the splanchnic block it is possible to explore the abdomen, except the pelvis, and often the appendix can be pulled into the wound and removed without additional anæsthesia.

2. *Incision.*—The incision used in most of the earlier cases, and in all the cases in which the diagnosis was not certain, was one through the upper

right rectus muscle. There were 56 patients in whom this incision was used and they have all healed without evidence of hernia. The difficulty of exposure and of closure in many cases, and the frequency with which serum collected in the wound, led to a change.

In practically all of our later cases, a transverse incision was used extending from the rib margin nearly to the midline, at a level about two fingers' breadth above the umbilicus. After cutting through skin and subcutaneous fat, the obliques and transversalis are divided in the line of their fibres outward, beginning at the edge of the rectus sheath. The peritoneum is then opened and with the finger in the abdomen, two rows of interrupted sutures are placed, catching the rectus with its anterior and posterior sheaths. The rectus is then divided between the sutures to within three-quarters of an inch of its mesial edge. This incision usually gives sufficient exposure for cases of acute cholecystitis in which a cholecystostomy is to be performed. It may be readily enlarged by carrying the incision upward through the rectus. This is usually necessary in order to perform a cholecystectomy or an operation on the common duct.

The transverse incision was used thirty-two times and of this number there was one incisional hernia, and one patient who showed a slight pouting at the site of a cholecystostomy opening. There were 35 cases in which the incision was enlarged upward through the rectus, all of whom have healed without hernia.

This incision has the advantage of giving much better exposure than can be obtained by the right rectus incision alone. It is also very easy to close.

3. *Special Apparatus.*—In those cases in which cholecystostomy is to be performed, some instruments have been devised which greatly facilitate the operator, and which decrease considerably the operative trauma.

A sharp, round-pointed aspirating trocar, with water pump suction, devised by the junior author, is used to rapidly evacuate the fluid in the gall-bladder without soiling the wound, later a blunt-pointed aspirator may be substituted to completely empty the organ.

When the gall-bladder is empty of fluid and stones, the senior author's cholecystoscope may be used to view the inside of the organ. This instrument was used in fifteen cases. In that number there were four cases in which stones were discovered in the gall-bladder after a thorough search with scoop and finger had failed to show further calculi. An incomplete operation was discovered then in 26 per cent. of the cases in which the scope was used. We believe that from this group come most of the patients who have a return of symptoms following cholecystectomy.

*Post-operative Treatment.*—The patients are placed in semi-Fowler position and are given enteroclysis routinely, a pint each of tap water with tincture of digitalis two fluid drachms, glucose 5 per cent. and sodium bicarbonate 2.5 per cent. in order named. Since the use of local anæsthesia, fluid may frequently be given by mouth, after the first or second pint of enteroclysis.

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Ill patients are encouraged to suck fruit lozenges or to use chewing gum, in an endeavor to keep the mouth moist and minimize the occurrence of parotitis.

Carbohydrate foods have proven the most helpful in these cases because of their rapid absorption and easy utilization by the body. Glucose with insulin intravenously we have found to be the best treatment for those cases of "liver deficiency" which appear a considerable time after operation.

The patient is instructed to take ten deep inspirations per hour. This has a tendency to clear the lungs and minimize pulmonary complications.

After the first week the cholecystostomy and common duct tubes are clamped for an hour after each meal, and the interval between clampings is decreased gradually so that toward the end of the second week the tubes may be clamped all the time. By thus allowing the bile to flow into the intestine during the periods of digestion, we have been able to overcome the nausea that frequently follows the taking of food in these cases of bile drainage.

In our cases the average time for the removal of the cholecystostomy tube was thirteen days. The choledochostomy tube, usually a T-tube, was removed from the sixteenth to the nineteenth day, *i.e.*, as soon as the tube could remain closed for several days at a time, without causing pain. No biliary fistulæ have resulted.

*Hospital Days.*—Cholecystostomy patients usually remain in bed until the tube has been removed (fourteen days). They are discharged after they have been up and around the ward for two or three days. The average stay in the hospital for these patients was twenty days, divided as follows:

Less than 15 days	16-19 days	20-29 days	30 days +
7 cases (1 in hospital)	13 cases	25 cases	4 cases

A cholecystectomy without drainage kept the patient in the hospital an average of seventeen days in 40 cases. These were divided as follows:

Less than 15 days	16-19 days	20-29 days	30 days +
23 cases (1 in hospital)	13 cases	4 cases	3 cases

A cholecystectomy with drainage demanded an average stay in the hospital of twenty-six days in 12 cases. These were divided as follows:

Less than 15 days	16-19 days	20-29 days	30 days +
2 cases	6 cases	4 cases	3 cases

More than half the cases of cholecystostomy demand a hospital stay of more than three weeks, while a cholecystectomy closed without drainage gives a patient a 50 per cent. chance of discharge in two weeks, and 85 per cent. of these cases can be discharged in two and one-half weeks. A cholecystectomy case with drainage demands a longer stay in the hospital, the delay in most cases being attributed to a wound infection.

*Post-operative Complications.*—Wound infections occurred eight times in this series, five times in a right rectus incision, once in a transverse, and twice in a right-angled incision.

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*Pulmonary Group.*—Broncho-pneumonia occurred in 4 cases, and acute bronchitis in 2. These cases were all in the group with acute cholecystitis.

- Lobar pneumonia—1 case with death.
- Massive atelectasis—1 case with death.
- Pulmonary embolism—1 case.
- Empyema thoracis—1 case following pericyclic abscess.

*Cardio-vascular group:*

- Chronic myocarditis—1 case with death.
- Femoral phlebitis—1 case.
- Hæmiplegia—1 case.

Early hepatic insufficiency (liver shock, or toxic liver) as characterized by high temperature, pulse and respiration, low blood-pressure, cold moist skin, etc., occurred in six instances, one or two days following operation. Death followed in each case.

Late hepatic insufficiency occurred in 2 cases two to three weeks after operation. These cases are usually ones with common duct drainage and are characterized by lassitude, low blood-pressure, subnormal temperature, anorexia, and vomiting. One of these patients died.

- Liver abscess—echmococcus—1 case.
- Acute pancreatitis—2 cases with 1 death.

The most serious of these complications fall in the group of so-called hepatic insufficiency. Our knowledge of the cause of these conditions is meagre, hence we know very little concerning their treatment.

*Analysis of the Cases with Follow-up Results.*—I. Acute Cholecystitis.—This group includes all the acute and subacute cases of gall-bladder disease, as evidenced by elevation of temperature, leucocytosis, and acute tenderness and rigidity in the upper right abdominal quadrant. In 14 of the 28 cases a mass was palpable in the upper right quadrant.

The choice of operation in these cases depends largely upon the conditions found at operation. When the gall-bladder is tense and thickened, the gastro-hepatic omentum œdematous and the head of the pancreas indurated, by far the safer operation is a cholecystostomy. Cholecystectomy should be performed only where drainage of the gall-bladder can not be accomplished because of gangrene or for other reasons apparent at the time of operation.

*Summary of the Follow-up Results for Acute Cholecystitis*

Operation	No symptoms	Improved	Unimproved	Operative death
Cholecystectomy				
10	9			1
Cholecystostomy				
21	16	4		1
Cholecystostomy with drainage of pancreas				
2	2			

Of the 4 patients listed as improved, one has had one attack of pain and vomiting of two days' duration, one indigestion, one has a slight hernia at the

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site of the drainage tube, and one returned with a pericystic abscess followed by an empyema thoracis.

The mortality in this group was 6.06 per cent., with cholecystectomy 10 per cent., and with cholecystostomy 4.3 per cent.

### *Analysis of Cases that Died Following Operation for Acute Cholecystitis*

Case	Age	Duration of acute symptoms	Operation	Post operative days	Cause of death	Necropsy findings
1	45	2 days	Cholecystectomy	1/6	Pulmonary embolism	Refused-obesity
2	65	20 days	Cholecystostomy Appendectomy	1	Acute hepatic insuf.	Hepatic cirrhosis. Chr. myocarditis. Chr. hypertrophic prostatitis. Extreme obesity.

2. *Chronic Gall-bladder Disease.*—This group comprised 78 cases. There were two cases in which an associated duodenal ulcer was found and for which a posterior gastro-jejunosomy was performed in addition to the removal of the gall-bladder. In 22 of these cases an appendectomy was also performed.

The choice of operation in this group is for a cholecystectomy, if it can be performed with safety to the patient. The operation should not be attempted if:

- (1) A very fat abdominal wall prohibits good exposure.
- (2) The patient is not a good operative risk because of jaundice, pancreatitis, cardiac or renal disease, age, respiratory infection, etc.
- (3) The assisting and nursing staff are strange or inadequate.
- (4) The anatomical difficulties found at operation are extraordinary.

In all these cases it is safer to drain the gall-bladder, *i.e.*, in case of doubt do a cholecystostomy.

### *Summary of the Follow-up Results for Chronic Cholecystitis*

Operation	No symptoms	Improved	Un-improved	Operative mortality	No report
Cholecystectomy					
49	37	2	1	2	6 1*
Cholecystectomy					
Posterior gastro-enterostomy					
2	1			1	
Cholecystostomy					
27	18	6	1		1 1*
Cholecystostomy					
2	2				

\* In hospital.

Of the patients in which cholecystectomy was performed two patients were not entirely well. They complained of "bilious attacks," distention and belching after eating. They had no pain. One patient in whom the pre-operative diagnosis was not clear complains of the same symptoms as before operation. She is a thin, neurotic individual and a regular attendant at the

medical dispensary. Of the 40 patients from whom follow-up reports have been obtained, 35 are entirely relieved—87.5 per cent. cures.

The operative mortality was 4 per cent. in cholecystectomy without associated disease. In the cholecystostomy cases without associated disease the mortality was nil, and the combined mortality 2.5 per cent.

There were 6 cases listed as improved following cholecystostomy. Of these two were free from pain, and complained only of belching and distention. Three patients had a return of pain, in one or more attacks, and a cholecystectomy was later performed on one of these. One patient has discharged several faceted stones from her drainage tract. There were no biliary fistulæ. The patient listed as unimproved later developed carcinoma of the gall-bladder.

Of the 25 patients followed, 18, or 72 per cent., are completely relieved by cholecystostomy. There were no deaths in the 26 cases.

This low morbidity figure is probably not quite a fair one in that many of these cases were operated upon but a short time ago (since September, 1922).

*Analysis of the Mortality Following Operation for Chronic Gall-Bladder Disease*

Case	Age	Duration of symptoms	Previous operation	Operation	Post-operative days	Cause of death	Associated conditions
1	41	3½ yrs.	Cholecystostomy	Cholecystectomy	1	Acute hepatic insufficiency	Mitral stenosis Incisional post-neg.
2	50	1 yr.	None	Cholecystectomy and Appendectomy	2	Acute hepatic insufficiency	Incisional post-neg.
3	40	2 yrs.	None	Cholecystectomy Posterior gastro-enterostomy	4	Acute pancreatitis	A b d o m e n showed fat necrosis

Combining groups 1 and 2, the mortality with cholecystectomy was 5 per cent. in 58 cases, and with cholecystostomy alone it was 2 per cent. In other words, in the 111 cases of gall-bladder disease, both acute and chronic, without associated lesions, the operative mortality was 3.6 per cent.; adding the one death in the two cases with associated duodenal ulcer makes a mortality of 4.4 per cent.

3. *Chronic Gall-bladder Disease with Common Duct Obstruction.*—The patients in whom there is a biliary obstruction are among the poorest of surgical risks. Their pre-operative preparation should be as thorough and complete as is that practiced for patients with toxic goitre. It should include an estimate of bile pigments in the blood serum, urine and fæces in order to accurately follow the course of the jaundice after operation. The clotting time should be estimated and calcium chloride given intravenously as a routine measure. It is well to have a donor ready and cross agglutinated with the patient before operation.

The fluid intake should be kept high, giving hypodermoclysis if necessary.



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Carbohydrate ingestion should be encouraged, by mouth, in solution, in the fluids given by enteroclysis or hypodermoclysis and even intravenously.

Splanchnic and infiltration anæsthesia is never more useful than in this group of cases. Ether seems to act poorly in these patients with damaged livers. Under splanchnic block a cholecystectomy and a choledochostomy may be performed, yet the temperature and pulse be within the normal range when the patient is returned to the ward.

### *Summary of Follow-up Results Following Operation for Chronic Cholecystitis with Biliary Obstruction*

Operation	No symptoms	Operative mortality
Cholecystectomy with common duct drainage	11	1
Cholecystostomy with common duct drainage	8	3
Choledochostomy	2	1

All of the patients who lived were completely relieved. The operative mortality was 23 per cent.

### *Analysis of Mortality Following Operation for Chronic Cholecystitis with Biliary Obstruction*

Case	Age	Duration of symptoms	Duration of jaundice	Operation	Position of stones	Post-operative days	Cause of death	Associated conditions
1	44	10 yrs.	Slight Intermittent	C. ostomy C. dochoostomy Appendectomy	Common duct above duodenum	5	Lobar pneumonia	Increase of jaundice Obesity
2	37	5 yrs.	7 wks.	C. ectomy C. dochoostomy	Common duct above duodenum	6	Massive atelectasis	None Obesity
3	54	1 yr.	7 wks.	C. ostomy C. dochoostomy	None Stricture at junction of cystic and hepatic duct	14	Hepatic insufficiency	Obesity
4	27	9 yrs.	2 wks.	C. ostomy C. dochoostomy	Behind duodenum	1	Acute hepatic insufficiency	Necropsy showed hepatic cirrhosis
5	50	7 yrs.	1 wk.	C. dochoostomy	Behind duodenum	1	Acute hepatic insufficiency	Necropsy showed hepatic cirrhosis

There is little choice in the operation in these cases. The common duct is always opened and the obstruction relieved by the removal of the stones. To

make sure that the duct is patent a small French catheter is usually passed through the sphincter into the duodenum. The common duct is usually drained by the use of a T-tube. If conditions allow, the gall-bladder is emptied of stones and a tube sutured in it. In these jaundiced cases the gall-bladder is not removed if it can be used for drainage. In some cases the gall-bladder shows so much damage that it must be removed and in other cases it may be so atrophic that it can be allowed to remain untouched. The least that can be done to relieve the immediate emergency in these cases offers the best chance for recovery.

4. *Carcinoma of the Gall-bladder.*—There were two cases in this group, an incidence of 1.4 per cent. for the 136 patients. Both of the patients were males, one fifty-four and the other sixty-one years of age. A history was obtained of upper right-sided pain of rather short duration and a mass could be palpated in the right hypochondrium in each case.

In one patient a cholecystostomy was performed without recognizing the carcinoma. Enlarged glands were noted about the cystic duct which were thought to be inflammatory. He returned one month after his discharge with complete biliary obstruction. At operation there was a mass of indurated tissue in the region of the gastro-hepatic omentum, but no evidence of common bile duct could be found. The patient died in the hospital fourteen days after operation.

The second patient was diagnosed as carcinoma of the gall-bladder before operation. A cholecystostomy was performed for the relief of pain. No attempt could be made to remove the gall-bladder because the growth had already invaded the liver. The patient died at home one month after operation.

#### SUMMARY

1. An analysis has been made of 136 cases of gall-bladder disease of whom 94 + per cent. have been followed.
2. A theory has been advanced against the infectious origin of cholelithiasis.
3. The surgical principles used in the treatment of these cases have been enumerated.
4. Of the cases of acute cholecystitis, 89 per cent. have been cured by cholecystectomy with an operative mortality of 10 per cent.; by cholecystostomy, 76.4 per cent. have been relieved of all symptoms, with an operative mortality of 4.3 per cent. Combined—6 per cent.
5. Of the cases of chronic cholecystitis, 87.5 per cent. of the patients who had a cholecystectomy were cured with an operative mortality of 4.1 per cent.; cholecystostomy resulted in no mortality and 72 per cent. of the patients were relieved. Combined 2.5 per cent.
6. The operative mortality of the combined acute and chronic infections of the gall-bladder unassociated with other lesions was 3.6 per cent.
7. Of the patients operated on for biliary obstruction 77 per cent. were relieved. The operative mortality was 23 per cent.