that in 15 cases malignant disease of the gall-bladder was found. The average age of the patients in this group was 64, and in all a long-standing history of gall-bladder disease was given. In every case gall-stones were present and there was evidence of old-standing cholecystitis. In only one of these cases was the disease removable, and in that one fatal recurrence took place two years later. The risk of malignant disease is therefore no small one, and is a strong point in favour of timely operation.

In 6 cases the operation was carried out for acute haemorrhagic or gangrenous pancreatitis. In 5 of these cases, which were all fatal, a long-standing history of cholecystitis and gall-stones was given. The average age of the patients in this group was 60 years. In 3 cases (jaundiced patients) an irremovable carcinoma of the common bile duct was found, and in 7 a carcinoma of the head of the pancreas. In all of these 10 cases a palliative cholecyst-enterostomy was performed. Excluding these 31 cases (25 malignant and 6 acute pancreatitis) there remain 421 cases, of which 367 were cases of cholecystitis, with or without cholelithiasis. The sex ratio was 91 males and 306 females, and the average age at operation was 50 years. The disease was found with equal frequency in hospital and private practice (213 hospital, 184 private cases).

Several striking differences were noted in the two social classes, however. In the first place, there was a much larger percentage of male cases in private practice—30 per cent. to 17.3 in hospital practice—due, no doubt, to the sedentary occupation in the former. Secondly, the average age at operation in private cases was 54, in hospital cases 46.5, and the length of history corresponded to this age difference—that is, expectant and medical treatment was persisted with much longer in those in better financial circumstances. The most notable difference, however, was in the operative mortality, which in private cases was 6 per cent. and in hospital cases 1.4 per cent. This pronounced difference was attributable to the secondary changes and complications which had developed in many of the former; thus in the fatal group there were examples of subacute pancreatitis, 2 cases; cholecystitis with cirrhosis of liver, 2 cases; bleeding duodenal or gastric ulcer, 2 cases. Furthermore, the incidence of carcinoma of the gall-bladder in private was exactly double that in hospital practice, and as in many of these cases the patient survived the operation for only a few weeks or months the penalty of delay becomes the more evident.

It must be clearly understood that it is the age and severity of the disease, and not the age of the patient, which is the important factor in prognosis as regards operation. In my experience elderly patients stand operation on the biliary passages very well, provided none of the more dangerous complications have arisen. Thus among the 74 patients in this series who were over 60 years of age at operation only 5 died (6.7 per cent.), and among the 15 patients over 70 years of age there was but one death.

In dealing with elderly or bronchitic patients the advantages of local anaesthesia, aided by twilight sleep, cannot be too strongly emphasized. On numerous occasions I have removed the gall-bladder and stones from the common duct under such anaesthesia without the patient being conscious of the operation.

A large proportion of patients suffering from gall-bladder disease are grossly obese, and their muscles, including heart muscle, are flabby and in poor condition. It is a wise plan, and one which we practise regularly, to put these patients on a preliminary course of exercises for three months, that they may get into training for the operative ordeal. The remarkable improvement in general tone with loss of weight which results makes the operation both easier and safer.

Cholecystectomy was performed in 253 cases, cholecystostomy in 144. In the earlier years of the period under review cholecystostomy was the commoner operation, but in the past three years it has been almost entirely replaced by cholecystectomy, with no increase in operative mortality and a vast improvement as regards the diminution of post-operative morbidity.

In 257 cases calculi were present in the gall-bladder, in 140 cases cholecystitis without stone. The improvement in health following cholecystectomy in the 76 cases of the

latter group in which this operation was performed was, almost without exception, gratifying; in the 64 cases in which drainage of the gall-bladder was practised the improvement following the operation was, in many cases, only temporary.

Common Duct Stones.

In 47 cases—that is, 18 per cent. of the cases of cholelithiasis—one or more stones were found and were removed from the common duct. In the majority of patients in this group the history of recurring jaundice with colic, rigors, and loss of weight left no doubt as to the presence of a stone in the duct. In a third of the patients in this group, however, the history did not present anything approaching the typical Charcot syndrome, the stones being of the silent, floating type. Without adequate exposure and careful exploration they might readily have been missed, and indeed in 9 cases a previous operation for gall-stones had been performed.

When the patient, at the time of operation, was not deeply jaundiced the gall-bladder was removed. When the patient was jaundiced, or otherwise very ill, it was drained. There were three deaths in this group—a mortality of just over 6 per cent. The improvement in health, and rapid gain in weight, following a successful operation for stone in the common duct are remarkable.

CONCLUSIONS.

Infection of the gall-bladder is probably the commonest of all abdominal maladies, particularly among persons of sedentary habits.

It is usually an intramural blood-borne streptococcal infection, and is frequently associated with the formation of gall-stones.

If neglected serious, and often fatal, complications may ensue.

When firmly established the disease can only be cured by radical surgery.

In the absence of secondary changes and complications, such as malignant disease, pancreatitis, hepatic cirrhosis, and insufficiency or toxic myocarditis, operation has a low mortality and the results, as regards subsequent health, are very good.

Elderly patients may be safely operated on under twilight sleep and local anaesthesia.

I wish to express my thanks to Mr. J. J. M. Shaw for the specimen depicted in Fig. 5; to Mr. C. F. W. Illingworth for his help in the investigation of the cases of cholesterosis, and to Dr. A. L. Wilkie, whose remarkable work forms the basis of our present attitude towards cholecystitis.

THE X-RAY DIAGNOSIS OF PATHOLOGICAL CONDITIONS OF THE GALL-BLADDER.

BY

JAMES F. BRAILSFORD, M.B.BIRM., M.R.C.S.ENG.,

RADIOLOGIST, ST. CHAD'S HOSPITAL, BIRMINGHAM.

(With Special Plate.)

FIVE years ago the generally accepted opinion of physicians and surgeons was that a report on the x-ray examination of the gall-bladder was of no value. This was due to the fact that though Beck (1899) had demonstrated the shadows of gall-stones on radiographs, most radiologists were of the opinion that it was a rare and chance finding.

Thurstan Holland and Robert Knox in this country, Pfahler, Case, Cole, George, and Leonard in America, and Haenisch in Germany, who carefully studied the problem, came to the conclusion that gall-stones could be demonstrated in a fairly large percentage of cases, and that the percentage of correct x-ray diagnoses of gall-stones grows in proportion to the intensity of the interest, the more careful attention, the refinement of the technique, the study of the establishment of a diagnosis, the training of the eyes, and the improvement which comes of constant use and experience. (An account of the earlier work on gall-bladder radiography was given in a previous paper.¹)

The number of radiologists who hold this opinion is steadily growing. My own experience is that about 30 per

JAMES F. BRAILSFORD: THE X RAY DIAGNOSIS OF PATHOLOGICAL CONDITIONS OF THE GALL-BLADDER.

FIG. 1.—Radiograph showing a collection of faceted stones in the gall-bladder with a large branching stone in the pelvis of the right kidney.

FIG. 2.—Radiograph of same patient as Fig. 1, showing that all but one gall-stone has been passed.

FIG. 3.—Radiograph showing a collection of rounded stones in the gall-bladder and a deformity of the descending colon due to carcinoma.

FIG. 4.—Radiograph showing a collection of gall-stones in the gall-bladder and isolated stones in the cystic duct.

FIG. 5.—Radiograph showing a normal gall-bladder and a deformity of the duodenal cap due to an ulcer.

J. F. DOBSON: LATE RESULTS OF OPERATION FOR RENAL CALCULUS.

FIG. 1.—Shadow of calcareous gland simulating calculus.

FIG. 2.—The same with pyelogram.

FIG. 3.—Left renal calculus; right ureteric calculus.

FIG. 4.—The same case, the right calculus now in the kidney.

FIG. 5.—Pyelogram of the right side, showing hydronephrosis.

cent. of gall-stones contain sufficient calcium to cast a shadow which can be recognized on a good average radiograph. A small proportion of these are very opaque, and cast shadows as dense and as typical as the densest renal stone. These are usually ring-shaped or typical faceted gall-stones, the aggregation of which gives the outline of the gall-bladder (see Fig. 1). The majority, however, are ill-defined flaky shadows which can only be seen on good quality radiographs taken so rapidly that peristaltic and body movements are eliminated, as the slightest movement completely obliterates the shadows.

With the added development and improvement of Graham's cholecystography the x-ray diagnosis of pathological conditions of the gall-bladder ranks as high for a diagnostic procedure as the barium meal does for the examination of the stomach and duodenum. I have carried out nearly 500 x-ray investigations on the gall-bladder, and the high percentage of accurate results, as proved by operation, in my opinion fully justifies the procedure. Most of the patients were sent because of obscure symptoms in the upper abdomen, which were not sufficiently characteristic or acute to warrant the surgeon doing a laparotomy. Some were sent to confirm the clinical diagnosis of gall-stones. The value of the test for such conditions will be seen from the short histories which are given at the end of this paper.

I have continued to use the intravenous method of administration of the dye—except in a few instances where I have not thought it advisable, or where difficulty has been met with in injecting the vein—because I regard it as the most accurate. This method has been used to confirm the diagnosis of cholecystitis—indicated by non-filling of the gall-bladder when the dye has been given by the mouth—in five cases, and in each case a normal shadow of the gall-bladder was obtained.

It is essential that the technique of the intravenous injection be carefully carried out, and for this purpose it may be necessary to ask a surgeon to give the injection. This was my early practice, but for the last year or so I have been asked to carry out the injection myself, and from the occasional difficulties met with, and the fact that the test is in a sense quantitative, I am confident that the knowledge of these conditions enables the radiologist to give a more accurate report.

In a previous paper² I have given the details of the technique, the errors which may be made owing to faults in the technique, the causes of failure, the nature of the reactions to the dye, the other methods of administration, and an estimate of the value of the test. In this paper I also pointed out the importance of (a) a preliminary x-ray examination, and (b) a subsequent barium meal while the gall-bladder is still visible. The preliminary radiography will often throw much light on the diagnosis, and may give indications which render the dye injection unnecessary.

Among the lesions previously unsuspected which have been revealed by the preliminary investigation are:

- (a) In the thorax: (1) Early phthisis with gastric symptoms. (2) Pulmonary tumour; primary or multiple secondaries from abdominal organs; hydatid cysts. (3) Aneurysm.
- (b) In the abdomen: (1) Stone in the kidney or ureter. (2) Calcified tumour in the kidney. (3) Gall-stones. (4) Lesions of the spine causing abdominal pain (tubercle, gumma, neoplasm, Paget's disease). (5) Abdominal aneurysm.

An example of the value of the preliminary examination was recently met with. A patient who had pain in the upper abdomen was cholecystographed by the oral method and the gall-bladder had failed to fill. Several months later he was brought for a confirmatory x-ray examination. The preliminary radiograph showed carcinomatous destruction of the body of the second lumbar vertebra.

The preliminary radiograph may show the gall-bladder full of opaque sand, which produces a shadow not unlike a normal gall-bladder filled with dye.

The details of the following case indicate that where the preliminary radiograph shows gall-stones it is advisable, particularly in those cases where the symptoms are atypical

of gall-bladder pathology, to carry out a barium meal investigation of the alimentary tract.

A married woman, aged 60, complained of indefinite pain in the upper abdomen. She gave a history of having had indigestion and a similar pain for several years, but during the last few months the symptoms had been more marked. The surgeon who was called in expressed the opinion that the symptoms were due to gall-stones, and arrangements were made for the removal of the gall-bladder. It had previously been decided to have an x-ray investigation, and this was proceeded with the day before operation.

The preliminary radiograph showed a collection of large gall-stones in the gall-bladder. A barium meal was given, and at the eighth hour an irregularity of the first part of the descending colon was seen (see Fig. 3). This irregularity was still present at the twelfth hour. Its appearance was so suggestive of a small carcinoma that I asked the surgeon if he would examine the area after he had removed the gall-bladder. This he did, and he found a carcinoma, which he resected. The patient made a good recovery.

Similarly it is advisable to follow up the cholecystography with a barium meal even in those cases where the symptoms strongly suggest a pathological condition of the gall-bladder and the radiographs show a normal gall-bladder filling (see Fig. 5), for in one case in my series in which the gall-bladder filled normally it was decided that operative measures were not indicated. No barium meal investigation was made. The patient went home and returned a fortnight later with a perforated duodenal ulcer from which she died. The *post-mortem* examination revealed the ulcer with massive adhesions and a normal gall-bladder.

On the other hand, two women patients, aged respectively 32 and 38, had complained of symptoms in the upper abdomen for several years, during which time they had been seen by several consultants, who had advised barium meal examinations; these failed to demonstrate any lesion. Their symptoms were attributed to neurasthenia until a cholecystographic examination showed that neither gall-bladder filled. In both cases at operation gall-stones were found in the gall-bladder and cystic duct.

All gall-stones shown on preliminary radiographs contain calcium, and it is considered that these are usually associated with inflammation; their demonstration is therefore of great diagnostic value. In no case where gall-stones were shown has the patient been entirely free from abdominal pain or discomfort.

One patient sent to me for an x-ray examination of the urinary tract, the left kidney being large and tender, gave no definite history of gall-stone colic, though the radiographs showed the gall-bladder to be full of stones containing calcium. She was not operated upon because a large calculus occupied the pelvis and calyces of the right kidney, in addition to a stone in the pelvis of the enlarged and inflamed left kidney (Fig. 1). A few weeks afterwards she had an acute attack of gall-stone colic, and these attacks were repeated so frequently during the next nine months that the patient was kept in bed. When they had ceased her condition improved. By the end of the year she was able to do her housework. A further x-ray examination (Fig. 2) at this time showed that though the kidney stones appeared identical with the previous radiographs only one small stone remained in the gall-bladder. A radiograph twelve months after this showed no gall-stones. She had put on 3 or 4 st. in weight, had no pain, and felt well.

In another case in which calcium gall-stones were shown on preliminary radiography, a radiograph taken some months afterwards showed no gall-stones; the gall-bladder failed to fill with the dye, and at operation only a little grit was found in the chronically inflamed gall-bladder, the gall-stones having been passed.

The details of the following case also demonstrate that the signs and symptoms may be atypical.

The patient, who had had her right breast removed for carcinoma a few years previously, had an attack of agonizing pain in the left hypochondrium. The pain radiated through the left side of the thorax and down the left arm, and lasted with great severity for twenty-four hours. The surgeon who had removed the breast was called in, but he could find no evidence of secondary growth, and suggested that the pain was due to haemorrhage into a deep-seated secondary growth pressing upon nerves supplying the area. A radiograph was taken to demonstrate if possible the position and extent of the secondary deposits. The lung fields were seen to be clear, and the heart and aorta were normal in size, shape, and position. The diaphragm moved normally on both sides. I suggested that the pain might be due to gall-stones, as I had recently seen several such cases of gall-stone colic in which all the symptoms had been on the left side. A radiograph showed the gall-bladder to be full of gall-stones containing calcium, and isolated stones were shown in a line, suggesting that they were in the cystic duct (see Fig. 4).

Cholecystography had a setback in its early days owing to a proportion of the patients showing a reaction to the injected dye. This was chiefly due to the use of sodium tetrabromophenolphthalein, many preparations of which were impure and very toxic, while a solution of some preparations gave no denser shadow than water. Since Whitacre and Milliken showed that sodium tetraiodophenolphthalein could be used in smaller quantities, that it cast a better shadow, and the chemists have manufactured purer preparations of the dye, few toxic effects have been seen. They have not been entirely eradicated. Using this dye I have only seen five severe reactions—two in private practice and three in hospital. For nearly two years I saw no reaction, but recently a patient within fifteen minutes of the injection showed all the signs of severe shock.

This patient, a woman of about 30 years of age, gave a history of eight former operations, after several of which thrombosis had occurred in her legs. She now complained of pain in the gall-bladder area; she had been seen by several surgeons, who had diagnosed gall-stones, and advised that the gall-bladder should be removed. Owing to her previous experiences she did not wish to have an operation until more definite proof of the lesion had been obtained. She was acquainted with the details of a cholecystographic examination, but had been advised not to have it done. She, however, insisted on the test being done. The dye was injected at 11 p.m., and after fifteen minutes the patient developed all the signs of severe shock, which gradually passed off during the next hour. The next morning radiographs

were taken; they showed a gall-bladder shadow normal in size, shape, and density, and after taking food it gradually diminished in size. The patient said that she felt no effects whatever of the shock, and that the experience was not to be compared with the feeling after an anaesthetic.

It may be urged that it is preferable to do a laparotomy than risk a chance of a reaction, but the x-ray investigation in many cases proved that the laparotomy would have been useless. Further, the x-ray examination enables us to give a fairly accurate opinion of the function of the gall-bladder, and a laparotomy may fail to do this. It is also probable that the patient who reacts to the dye would be a very unfavourable subject for a general anaesthetic and a laparotomy, and so far it has been my experience that those patients who react have a gall-bladder which fills in a normal manner.

It will be seen, therefore, that while there are many patients with symptoms so severe and urgent that a laparotomy is essential, there are patients with symptoms so indefinite and atypical that no surgeon would care to do a laparotomy. In this latter type of case an x-ray investigation of the gall-bladder will often prove of much value.

REFERENCES.

¹ Brailsford, J. F.: The X-Ray Diagnosis of Pathological Conditions of the Gall-bladder, *Brit. Journ. of Radiol.*, February and March, 1927.

² Cholecystography, *Proc. Roy. Soc. Med.*, 1927, vol. xx, pp. 45-58.

THE LATE RESULTS OF OPERATION FOR RENAL CALCULUS.

BY

J. F. DOBSON, M.S.LOND., F.R.C.S.,

PROFESSOR OF SURGERY IN THE UNIVERSITY, AND SENIOR SURGEON TO
THE GENERAL INFIRMARY AT LEEDS.

(With Special Plate.)

An attempt has been made during the last two years to trace the late history of all the cases of renal and ureteral calculus upon which I have operated since the war. The cases investigated number about a hundred, and a very large proportion have replied to inquiries. It would perhaps be useful first to give the results and then to discuss certain points of interest which arise.

Pyelo-lithotomy (28 Cases).

Untraced	...	...	...	...	...	1
Perfectly satisfactory	...	...	...	...	...	24
Complaint of backache (x ray negative)	...	...	...	...	...	1
" " haematuria (investigation refused)	...	...	...	...	...	1
Late fistula and nephrectomy (perfectly well since)	...	...	...	...	...	1

One of the satisfactory cases died three years after operation from cancer of the larynx.

Nephro-lithotomy (18 Cases).

Not traced	...	...	...	...	...	2
Perfectly satisfactory	...	...	...	...	...	13
Unsatisfactory	...	...	...	...	...	3

Uretero-lithotomy (14 Cases).

Perfectly satisfactory	...	...	...	...	...	11
Well, but deposit in urine (not investigated)	...	...	...	...	...	1
Backache and shortness of breath (not investigated)	...	...	...	...	...	1
Late fistula and nephrectomy (since perfectly well)	...	...	...	...	...	1

Nephrectomy (29 Cases).

Perfectly satisfactory	...	...	...	...	...	23
Well, but has developed disseminated sclerosis	...	...	...	...	...	1
Well, but suffers from asthma	...	...	...	...	...	1
Physically well, but melancholic	...	...	...	...	...	1
Not able to work (not investigated)	...	...	...	...	...	1
Well, but slight backache (not investigated)	...	...	...	...	...	2

Nephrostomy (7 Cases).

Well and healed (6 years and 3 years)	...	...	...	...	...	2
Well and healed (lived 9 years)	...	...	...	...	...	1
Well, but slight watery discharge (1 year)	...	...	...	...	...	1
Fairly well, but still discharging and has backache (4 years)	...	...	...	...	...	1
Fairly well, but some discharge	...	...	...	...	...	1
Perinephric abscess and death two years later	...	...	...	...	...	1

For Bilateral Renal Calculus (5 Cases).

Perfectly well	...	...	...	...	...	2
Well, but cloudy urine	...	...	...	...	...	1
Well, but operation on second kidney refused	...	...	...	...	...	1
Recurrence and fatal anuria four years later	...	...	...	...	...	1

In one of the cases of pyelo-lithotomy there was a considerable degree of hydronephrosis, yet four years afterwards the patient is perfectly well.

The three unsatisfactory cases after nephro-lithotomy are the following.

Case 1.—In June, 1920, right nephro-lithotomy was performed on a man for a single calculus in the kidney. There was a small stone in the corresponding ureter, which, however, was passed just before the operation. He recovered satisfactorily and remained free from symptoms for a time. Some two years later a recurrence of calculus was found in both kidneys, and the patient died from acute haemorrhagic pancreatitis five years after the original operation.

Case 2.—In 1920 nephro-lithotomy was performed on a woman aged 48; one stone was removed from the right kidney. Six years later she reported that she had had one or two attacks of haematuria since her operation, and x-ray examination revealed a single calculus in the pelvis of the left kidney and two or three calculi in the right kidney. Owing to the unsatisfactory condition of the patient further operative treatment was not thought advisable.

Case 3.—A woman, aged 28, was operated upon in 1925. Three stones were removed from the right kidney, one by an incision into the pelvis and two through an incision through the lower calyx, which contained purulent urine. She was readmitted a year later with a discharging sinus. X-ray examination was negative. The kidney was explored and found to be so densely adherent to the surrounding structures that nephrostomy only was done. The patient's general condition improved very much, and a subcapsular nephrectomy has now been successfully performed. In this case primary nephrectomy would have been preferable to a conservative operation.

The following three cases are remarkable.

Case 4.—In a woman who was operated upon in 1921 the left kidney contained multiple calculi; its function was very deficient. The kidney was explored and found to be hydronephrotic. There was a large quantity of putty-like material in the pelvis in addition to several calculi. It was thought desirable to perform nephrectomy, but the patient's husband, a doctor, demurred. The patient made a good recovery; she had some pain and frequency for a time, but this disappeared after a course of vaccine treatment. Five years later she was perfectly well. There is, however, no information as to the functional capacity of the kidney that was operated on.

Case 5.—A man, admitted in 1919, had suffered for some months from attacks of typical renal colic on the left side. The pain commenced in the loin and radiated downwards into the testicle and the thigh. Slight haematuria always accompanied the attacks of colic. X-ray examination showed the renal areas to be free from calculus and demonstrated a shadow in the pelvis on the left side, but not in the normal course of the ureter. An opaque ureteral catheter was passed up the left ureter and was arrested; an x-ray photograph showed the catheter in contact with the shadow, which was therefore thought to be a calculus impacted in an abnormally placed ureter. Unfortunately a pyelogram was not taken. Extra-peritoneal exploration of the ureter was performed, and the left kidney was found just below the pelvic brim with a calculus in the pelvis. Nephro-lithotomy was performed. Seven years later the patient was perfectly well.

Case 6.—A man, aged 33, was admitted in 1924 with the usual symptoms of a calculus in the left kidney. A skiagram showed the shadow of a calculus, and no suspicion was entertained that it was in any way unusual. Cystoscopy showed adequate function of both kidneys. Exposure was difficult, and the organ was found to be a