has already been given tempts us to hope that some day we shall be able to isolate endogenous carcinogenic substances, local malproducts of metabolism it may be, which have similar effects on tissues long subjected to their action. It is true that we know nothing regarding the intimate cell processes that are set up by the irritants, but the investigation is not beyond practical methods of inquiry.

May I recall some old experiments that I did several years ago? I had a transplantable mouse carcinoma which had passed into a depressed phase: the percentage of successful inoculations was very low; when tumours did result they were very slow in their growth. I ground up some of the tumour material in fine sand in a mortar and shook this up with saline solution. A batch of mice were injected with this extract and subsequently they were inoculated subcutaneously with living tumour tissue at the same time as another untreated series of mice. The contrast between the two sets was striking: in the untreated series the proportion of successful inoculations was small and the tumours were slow in developing; in those previously treated with the extract the percentage of successful inoculations rose from 30 to 80 and the rate of growth was rapid. We had supplied something—a "growth aggressin"—which was not supplied to the controls, and we had obtained it from the same tumour tissue. Such a substance, whatever its nature may prove to be, may be produced in small amounts in ordinary wound repair: it may be produced in excessive amounts in the neoplastic reaction.*

Looking back on the great discoveries of the past, we may wonder why they were so long delayed. The essential data for a conclusion, the materials with which to build, the terrain for the advance, all were already prepared, available for everybody, and sufficiently obvious, we should imagine, to the ordinary mind. It is all so simple to us now, for we fail to appreciate the difficulties of the pioneer. A future generation, knowing surely the causes of cancer, will have no patience with our floundering, our guesses, and our contending arguments. Had we not all the facts before us, they will say, staring us in the face, clamouring for recognition? Probably we have, but we are like children gazing at a starry sky—the stars that are so bright to us may be very small worlds and those that we barely see may be infinitely great. When we can place our facts in their order of importance, and make order out of seeming disorder, the answer will be easy. At present do we stand in respect of our subject as our predecessors stood fifty years ago at the dawn of bacteriology, and will our discoveries be as great, as rapid, and as epoch-making as theirs? I wonder.

SURGERY OF THE HEPATIC AND COMMON BILE DUCTS.†

BY

WILLIAM J. MAYO, F.A.C.S., HON. F.R.C.S.
(ENG. AND IRE.),

SURGEON TO ST. MARY'S HOSPITAL, ROCHESTER, MINNESOTA.

THE great bile duct as a whole, from the point where the hepatic duct emerges from the liver to the duodenal papilla, is discussed because the pathologic processes with which the surgeon is concerned in this special field must be treated as a whole.

In the period from December 31st, 1890, to December 31st, 1922, there were 16,980 operations performed on the biliary tract for all conditions—acute, chronic, and malignant—by the eleven surgeons on the general staff of the Mayo Clinic, with an average mortality of 2.6 per cent. Of these operations 1,920 were on the hepatic and common ducts; with an average mortality of 7.8 per cent. In the ten years from 1910 to 1920 the average mortality for operations on the great bile duct was 6.8 per cent. In 1921 the mortality for operations on the common and hepatic ducts was 5.6 per cent., in 1922 it had dropped to 3.8 per cent., while in 1922, for 942 cholecystectomies, it was 1.6 per cent.

* Important experiments in tissue culture which are being carried out by A. H. Drew of the Imperial Cancer Research Fund may have an important bearing on these points.

† Abstract of paper read before the Surgical Section of the Royal Society of Medicine, London, June 27th, 1923.

All patients dying in the hospital following operation, without regard to the length of time thereafter or the immediate cause of death, were classified as having died from the operation. It may seem somewhat severe to classify patients as having died from operation who, when operated on, had chronic nephritis, hepatic insufficiency from biliary cirrhosis, and secondary cardio-renal disturbance, the result of months of cholaemia and duct infection, and patients who died in the hospital some weeks after operation from causes not connected with the operation. However, without an arbitrary standard of classification it is difficult to secure comparable statistics from different hospitals. Perhaps, too, there is a certain stimulation in holding to a high standard of responsibility.

A satisfactory improvement, so far as mortality is concerned, is manifest by these data. Improvement has been greater than would be apparent from a study of mortality alone, because of constantly increasing knowledge and improvement in technique. Because of a better understanding of the conditions more and more severe cases have been undertaken, and operations carried out successfully which, in earlier days, were not attempted.

Certain fundamental principles which greatly affect the welfare of surgical patients must be evaluated. They concern (1) mortality from the operation, (2) benefit from the operation, and (3) disability following the operation.

The pride of the operator and his statistical skill in honestly juggling percentages make most astonishing apparent differences in statistics which are nearly identical. For instance, the early transference of the dangerously ill patient to the medical side of the hospital because of a medical complication, from the standpoint of surgical statistics, is helpful. If operations rather than cases are counted, and a number of operations are performed on the same patient, a small series of cases may make a large series of operations. Mortality estimated by cases is high; estimated by the number of operations it is low, although the number of deaths would be the same. Again, a slight operation which does not cure will be the test in a bad case. If the patient does not react well, the curative procedure with the major operative risk, for many reasons, may not be undertaken; consequently the patient is not given the chance for cure which a primary, radical operation would have given.

We study surgical tragedies and endeavour in every way to hold operative mortality at the lowest point, but the mere fact that a patient recovers from an operation is not in itself sufficient. If he does not receive sufficient benefit to warrant the risk of life, the pain and suffering from the operation itself, the expense, and the loss of time, he has just cause for dissatisfaction. On the other hand, if a more radical operation would have resulted in correspondingly greater benefit, an increase of primary risk might be justified.

The question of post-operative disability is important. A surgical procedure should be planned so that the patient, with the least possible risk and loss of time, will receive the greatest possible benefit. To-day industry is on a full-time basis, and every unnecessary day that the patient is disabled is an economic loss. To perform several operations when one would suffice, and thus deduce an apparent but not a true reduction in mortality, to use a type of incision not strictly indicated for the work at hand, or to use unnecessary drainage which will confine the patient to bed longer, or leave him with a greater hernia liability, is unjust. This economic loss is illustrated by a comparison, at ten-year intervals, of the hospital morbidity following operations on the biliary tract. The methods in use to-day, as compared with methods used ten years ago, save for each patient operated on in the clinic ten days of hospital time, or thirty-six years of the lifetime of one person each year.

The incision used in the majority of operations on the biliary passages has been the incision introduced by Bevan in 1898, slightly modified. The method of McArthur, in leaving undivided the posterior aponeurosis, the peritoneum, and the nerves in the lower third of the incision, is followed because the posterior aponeurosis, peritoneum, and nerves are sufficiently mobile to be drawn down readily by a retractor.

Secondary operations on the common duct for the removal

of stones, especially if the gall bladder has been removed at the first operation, may be most difficult, particularly if dense adhesions bind the area in a confused mat, and a state of hepatitis, or biliary cirrhosis, makes the liver bleed at a touch.

The importance of removing all stones from the common duct cannot be overestimated. In nearly one-third of the deaths following operation on the common duct for stone in our series, *post-mortem* examination revealed that all stones had not been removed. Since *post-mortem* examinations are made on more than 90 per cent. of patients who die in the hospital, this checking up has been of very great importance in adding to knowledge, although often most humiliating to the surgeon. Perhaps some of the stones which are supposed to have re-formed in the common duct are left-overs.

Next to gall stones in the hepatic and common ducts, operative injuries during cholecystectomy are the most common cause for operations on the common duct. The most serious and difficult operations are those which have for their purpose restoration of totally interrupted biliary connexion between the liver and the intestinal tract. When the common or hepatic duct has been injured, and the fact has been recognized at the time, failure successfully to repair the injured duct has not occurred in a single instance. A study of the operative methods employed in these cases, from the standpoint of ultimate results, indicates that in any case in which a piece of the duct has been accidentally removed, and the injury not discovered and repaired at the time, thus necessitating secondary reconstruction, direct union between the stump of the hepatic duct and the duodenum is the best operation.

Of the causes of death after operation, haemorrhage, hepatic and renal insufficiency, and infections of the bile ducts are the most common. These conditions are directly related to the existing chronic obstructive jaundice, hepatitis, biliary cirrhosis, dehydration, and chronic under-nourishment. Walters reviewed the *post-mortem* records, for a five-year period, of patients who died following operation on the biliary tract, and demonstrated that in 58 per cent. of the patients with jaundice who died within the first week after operation, there was more or less blood in the abdominal cavity, usually the result of oozing from slight injuries to the liver. Of itself the haemorrhage was not always sufficient to cause death, but it was a contributing factor. In jaundiced patients in poor condition, unless there is a definite indication, cholecystectomy is not added to the risk of operation on the common bile duct because of the danger of injury to the liver, which adds to the possibility of slow post-operative oozing.

As these patients are dehydrated and usually unable to take much nourishment, an attempt is made before operation to introduce a quantity of water into the system to aid renal elimination. As a rule it is difficult to accomplish this by mouth; it is best accomplished by proctoclysis, or subcutaneously.

A third factor of importance in these cases is hepatic insufficiency, which runs parallel with renal insufficiency. In the presence of hepatic insufficiency the blood sugar may appear to be at the normal level when it is not truly so, because of the concentrated state of the blood from dehydration. Therefore, in the presence of hepatic insufficiency, 5 per cent. glucose, in plain water by rectum, or 3 per cent. in sodium chloride solution subcutaneously, is given.

In order to check the haemorrhage calcium chloride intravenously has proved effective, and in certain cases blood transfusion is a remedy of remarkable efficiency. Failure of normal blood-clotting in the jaundiced patient is a specific indication of deprivation of blood calcium. It remained for Lee and Vincent to give calcium in a 10 per cent. aqueous solution intravenously, with striking results. When the administration of calcium fails to reduce the clotting time to normal, blood transfusion will usually cause a temporary reduction in the clotting time sufficient for an operation to be performed.

The careful pre-operative management of jaundiced patients has greatly reduced the mortality of operations. In two years in not a single instance in the clinic has a patient so prepared died from haemorrhage following the operation.

CASES ILLUSTRATING METHODS OF DIAGNOSIS IN RENAL SURGERY.*

(With Special Plate.)

BY

F. STRONG HEANEY, M.A., M.D., F.R.C.S.IRE.,
HONORARY SURGEON, LIVERPOOL STANLEY HOSPITAL AND LIVERPOOL
CANCER HOSPITAL; LECTURER IN CLINICAL SURGERY IN
LIVERPOOL UNIVERSITY.

IN spite of its already voluminous literature, the subject of cystoscopy, pyelography, and ureterography is so important that no apology is needed for bringing forward some interesting points in the application of these methods of diagnosis.

Kidney or ureter cases usually present themselves for investigation because of one or other of the symptoms—pain, haematuria, dysuria, or pyuria which does not yield to potassium citrate or the usual urinary antiseptics. On the other hand, some cases which eventually prove to be of urinary origin come under observation because of symptoms not necessarily suggesting the upper urinary tract as the seat of trouble; for example, in one case which I shall quote, asthma was the only symptom of ill health in the first instance.

Assuming that one of the typical urinary symptoms is present, that a pathological and bacteriological examination of the urine, and a clinical and x-ray examination of the renal, ureteric, and bladder regions have been made, an approximate diagnosis will probably have been reached, but many points will still remain to be investigated. Thus, if pyuria is present, the question whether it is of bladder or renal origin remains. The general recognition of the fact that most cases of persistent pyuria are of renal origin must be credited to the wide adoption of cystoscopy. Simple observation of the ureteric orifices or ureteral catheterization will localize infection or haemorrhage to one or other kidney. The ureteric catheter will provide material for estimating the efficiency of each kidney. Catheterization and aspiration may determine the existence of a hydro-nephrosis.

In almost every case pyelography will contribute some fresh details in the investigation. In renal calculus one will learn whether the stone is in the renal pelvis or in a calyx—an important point in planning operation. The shadow of a ureteral stone can be differentiated from other shadows like it by a pyelogram, but sometimes an x-ray photograph of the opaque ureteral bougie *in situ* will suffice. The cases mentioned below will illustrate these among other points.

The method of performing cystoscopy and of obtaining a pyelogram are now standardized. In injecting the ureters one depends on the patient's sensation of fullness or pain to indicate when enough of the opaque solution has been injected. For ordinary cases no special apparatus is necessary, save the cystoscope, ureteral catheters, and access to a radiologist. Dr. Oram has taken all the photographs in the cases mentioned in this paper. In most cases the ordinary x-ray couch serves for the various cystoscopic procedures, and conversely the x-ray tube can be used with the patient resting on the cystoscopy table. The latter arrangement will suit best when a photograph in semi-upright position is desired.

The first case I shall mention is one illustrating how, in certain cases of chronic pyuria, cystoscopy by itself excludes the bladder, and localizes the active septic focus to the kidney.

CASE I.

Some six months before I saw him, the patient, a man of 53, had an acute attack of cystitis with frequent micturition, suprapubic pain, and abundant pus in the urine. The attack came on after six hours' exposure to tropical rain. He was very ill and was admitted to a foreign hospital, where his bladder was washed out several times a day and urinary antiseptics administered. Under treatment his symptoms improved, but albumin and pus, as well as staphylococci and a coliform bacillus, remained constantly in the urine. On examination one saw that the mucous membrane was healthy everywhere save at the orifice of the right ureter,

*A paper read at a clinical meeting of the Lancashire and Cheshire Branch of the British Medical Association.