

member that any amount of kidney tissue may be sacrificed; but that if a large portion of the organ is to be removed, it is convenient to preface this operation by clamping that branch of the renal artery which supplies it. After resection the cut edges of the gap are to be united by deep catgut sutures. Large, branched *calculi*, fitting closely in the pelvis, are often very hard to remove. Rather than to struggle for an indefinite period in the effort to extricate such a stone it may be preferable to enlarge the parietal incision, to split the kidney from end to end, or even to remove it. But smaller stones are more easily handled: they may be picked from the pelvis or the calices by fingers or forceps, and in any case, whether the expected stone has been found or not, *the operation should never be considered complete until a probe has been passed from the pelvis of the kidney down into the bladder.*

Finally, the wound is irrigated according to the requirements of the case, and closed. An incision in the parenchyma of the kidney is best closed by one or two deep sutures of heavy catgut or chromicized gut. For incisions in the pelvis the finest silk is preferable, the sutures being inserted so as not to include the mucous membrane. But in the majority of cases the kidney is suppurating and requires to be drained. For this drainage a rubber tube is often more satisfactory than gauze, because of the very free flow of urine usually occurring during the first days after operation. This tube is inserted into the pelvis of the kidney, and drainage is also afforded by one or two strips of gauze leading to the dependent and pocketed portions of the wound. The external wound is sutured in its lower part, and the drain is left protruding from the upper end. No fear need be felt for the subsequent integrity of the abdominal wall. I have never seen hernia follow this operation, and I do not think it at all necessary to employ the incision suggested by Senn and others—namely, a muscle-splitting process comparable to the McBurney incision for appendicitis, the kidney being approached through the space between the abdominal muscles in front and the quadratus lumborum behind, or through the abdominal muscles themselves by splitting them along the line of their fibres.

NEPHRECTOMY

It may not be amiss to repeat in this place that, unless forced to it by immediate danger to the patient's life—such an excessive hemorrhage from the renal vessels—the kidney should never be removed unless the presence and functional capacity of the other kidney has been previously ascertained by the use of the ureteral cath-

ter. It is even proper to defer nephrectomy until after nephrotomy shall have separated the urines—the urine from one kidney passing through the wound in the loin, that from the other issuing through the urethra. Nor should nephrectomy be contemplated, except for malignant disease, for tuberculosis, for inoperable obstruction of the ureter, or for such grade of renal disintegration by calculous or other suppuration as would make the organ a menace to its possessor. Nephrectomy is, immediately and remotely, a greater shock than nephrotomy. It involves longer anesthesia, inflicts greater traumatism, and lops off a large and important though damaged viscus. Hence it may be necessary to forego a contemplated nephrectomy and be satisfied with nephrotomy for any one of several reasons. First, the functional activity of the opposite kidney may not be known; second, the patient may be so weak that it is deemed inadvisable to expose him to the shock of the greater operation; and third, the suppuration may be so severe that it is thought prudent to drain the abscess for a few weeks, and then, after the suppuration shall have abated and the patient shall have rallied, to perform the radical procedure. In these cases the choice between primary and secondary nephrectomy is often entirely a matter of personal judgment. In any case, if a secondary nephrectomy is to be performed it should not be delayed many weeks, lest the kidney acquire adhesions to the surrounding parts that may many times multiply the difficulties of nephrectomy.

Lumbar Nephrectomy.—The kidney is reached by the oblique lumbar incision described above. Liberation of the organ is performed as in nephrotomy, but when dense adhesions are encountered the issue thus raised cannot be avoided: the kidney must be removed. In order to accomplish this one of several devices may be employed:

1. **Supplementary Incisions.**—The oblique incision may be enlarged by a transverse or a vertical incision from either extremity, or instead of the oblique incision a transverse cut one inch below and parallel to the last rib may be employed. A vertical incision dropped from the posterior extremity of this gives a very wide wound. Or it may seem preferable to use the combined incision of Morris, tying the pedicle, freeing the anterior and upper adhesions, and extracting the kidney through a vertical incision in the linea semilunaris after the lower and posterior adhesions have been freed through the lumbar wound.

2. **Resection of Ribs.**—Even in difficult cases of nephrotomy it is sometimes of the greatest assistance to enlarge the field of operation by extending the cutaneous incision up over the last two ribs and

by excising subperiosteally the outer half of these bones. Care must be taken to avoid wounding the pleura, which extends fully to the lower border of the twelfth rib and sometimes even lower. Excision of portions of these one or two lower ribs almost doubles the size of the operative field.

3. Subcapsular Nephrectomy (Ollier) and Morcellation (Tuffier).—When in spite of extending the incision the kidney still remains firmly adherent to its fatty capsule and to the surrounding tissue, the parenchyma may sometimes be stripped from under the fibrous capsule and the organ thus removed; but it is very difficult to control hemorrhage during this operation, and a procedure somewhat less troublesome is the morcellation of Tuffier. Even this operation requires plenty of light, plenty of time, and should not be undertaken unless the patient is in excellent condition. The lower extremity of the kidney is first attacked and usually can be quite readily separated from the surrounding strictures. One or two large, curved clamps are then fastened to the organ as high up as possible, and the lower third is removed.

The vascular pedicle is now sought for in front of the kidney, and when it has been recognised by the arterial pulsation it is clamped as near as possible to the kidney. This part of the operation is the most difficult and the most delicate. The middle third of the kidney is next attacked and its posterior surface freed from the parietes behind. The anterior surface is then somewhat liberated, another clamp applied, and the greater part of the middle third of the organ cut away. It may be of assistance to split the organ vertically at this juncture and remove the posterior half first. This done it is usually possible to separate the vascular pedicle completely and to clamp it satisfactorily, after which the upper third of the organ is shelled out bit by bit.

Treatment of the Pedicle.—If the kidney is readily separable the quickest way to remove it is to place a heavy clamp upon its pedicle as near as possible to the kidney tissue, to cut away the organ, and then, with plenty of space to work in, to ligate the artery and vein separately with heavy silk and to cut away the upper part of the ureter, ligating it as low down as possible. In those cases of malignant growth in which the kidney is not adherent, this procedure especially commends itself; although, if the tumour is large it is best to free the kidney without attempting to extract it from the wound, and to clamp the pedicle by the sense of touch only, after which the tumour may be morcellated or extracted whole. Israel insists upon the propriety of removing the cancerous kidney in one piece with its fatty capsule. Though this procedure commends itself

it is not always practicable; but in any case it is not advisable to ligature the pedicle of an enlarged kidney before removing the organ. The slipping of ligatures has permitted fatal hemorrhage too often to leave any room for doubt upon this subject.

When the adherent kidney is to be removed piecemeal, or when the adhesions about the pelvis of a kidney make accurate identification of the vessels impossible, it is often necessary to grasp with clamps a mass of tissue containing the vessels, which may well be indistinguishable from the surrounding scar even after the kidney has been removed. In such an event it is safest to leave the clamps in place and to remove them at the end of the third or the fourth day.

Nephro-ureterectomy.—In tubercular or suppurative cases it is always proper and often essential to remove the ureter as low as the brim of the pelvis and there to ligate it, cauterizing the mucous membrane above the point of ligature. In tubercular cases it may be necessary to extend the parietal incision into the loin (parallel to and two fingers' breadth above Poupart's ligament) and to follow the ureter down into the pelvis, where it can be tied off almost at its point of entrance into the bladder.

Abdominal Nephrectomy.—In some cases, especially in very large adherent tumours, more space can be gained by boldly entering the peritoneal cavity through an incision in the linea semilunaris (Langenbuch) or in the linea alba, or by employing a transverse incision (Fig. 153). After entering the peritoneal cavity and pushing the intestines towards the median line, the outer layer of the mesocolon is incised (not the inner layer, for this implies division of the colic arteries and risks gangrene of the bowel). The peritoneum and colon are stripped up towards the median line, the vessels are secured, and the tumour removed. In tubercular or suppurative cases it is proper to fix the stump of the ureter into a hollow punched in the loin (Morris). The incision may be enlarged by transverse cuts at either extremity. The intraperitoneal incision has been employed for diagnosis and for the purpose of ligating or temporarily compressing the renal vessels in connection with extraperitoneal nephrectomy.

Closure of the Wound.—While the lumbar wound may be freely drained without fear of hernia, every effort should be made, if the peritoneum has been opened, to protect that cavity from infection by suture. The abdominal wall is usually sutured in layers.

OPERATIVE COMPLICATIONS

The immediate dangers of renal operations are injury to the peritoneum, the bowel, the pleura, and hemorrhage. If in removing

an aseptic kidney the peritoneum is torn, it may be easily sutured and no harm is likely to result. Injury to the bowel is a more serious matter, for if the gut is opened upon a surface uncovered by peritoneum, as is usually the case, the resultant fecal fistula is likely to continue indefinitely. Injury to the pleura is rare and requires suture. Hemorrhage during operations upon the kidney is usually more alarming than dangerous. Every incision into the kidney evokes a gush of blood which may be controlled as readily as it is evoked. Exceptionally, however, alarming hemorrhage is encountered by reason of an inadvertent incision or tearing of one of the larger renal vessels, and this bleeding may require a hasty nephrectomy. Morris specifies a class of calculous cases in which the kidney is found filled with blood, and states that such cases are so prone to bleed upon section that they require immediate nephrectomy without any attempt to extract the stone.

The vena cava may be torn during nephrectomy, an accident which has been remedied by lateral clamping, but which, needless to state, is usually fatal. Pulmonary or cardiac embolism is an immediately fatal complication that may occur from thrombosis of the renal vein due to malignant growth.

IMMEDIATE POST-OPERATIVE COMPLICATIONS

Shock, suppression, and sepsis are the three notable complications that occur immediately after operation. Shock may be associated with heart failure or it may be due simply to a severe and prolonged operation upon an enfeebled constitution. For this reason rapidity of operation and light anesthetization are especially desirable as preventives.

Shock.—The treatment of shock consists of the usual stimulants, saline infusion, and the external application of heat.

Suppression.—Suppression of urine, or uremia, with deficient urinary excretion, is doubtless due to congestion of the opposite kidney. This is obviously the case when suppression occurs after nephrotomy for calculous anuria. Therefore, if there is any question of surgical disease of the opposite kidney it is well to consider the propriety of a secondary rapid nephrotomy for the purpose of relieving congestion. Yet, practically speaking, the opportunities for such an operation are few. For if the patient becomes uremic after a nephrotomy, his vitality is likely to have sunk so low as not to withstand the shock of a second operative procedure. For this reason double nephrotomy is sometimes done simultaneously; and while I believe this treatment should almost always be adopted in cases of calculous anuria, the evidence thus far adduced is not sufficient to lead one

to perform nephrotomy or to split the kidney capsule, as Sir Reginald Harrison and Edebohls would have us do, to relieve the tension alleged to exist in chronic nephritis.

In most cases, then, the treatment of suppression will be the administration of urotropin and diuretic fluids, catharsis, diaphoresis by the hot pack, and saline infusion (p. 373).

Sepsis.—Sepsis of an acute fulminating type sometimes follows nephrotomy for stone. It is very likely to carry the patient off in spite of the most vigorous stimulation and local antiseptics; but in most instances surgical wounds of the kidney drain well and are singularly free from septic complications. I have never known a clean lumbar incision to become infected, nor in my own practice have I ever had any difficulty in obtaining adequate drainage for whatever suppuration might exist in or about the kidney.

Secondary hemorrhage and hypostatic pneumonia are conditions that may follow any major operation.

RENAL FISTULA

Spontaneous Fistula.—Spontaneous renal fistula caused by the rupture of a perinephritic abscess is so rare in this surgical generation and post-operative fistula so common that it seems proper to classify renal fistula as the late complication of operations upon the kidney. Spontaneous fistula may be dismissed with a word. A pyonephrosis or a perinephritic abscess may burst through the loin into the stomach or bowel or into the pleura or lung. The occurrence of such a rupture is heralded by a sharp pain and followed by the passage of pus through the skin, from the bowel or from the bronchi, as the case may be. It is common knowledge that a large abscess bursting thus spontaneously will drain but poorly and should be submitted to prompt incision, even though the patient's condition is considered desperate; for, however ill he may be, the prolonged suppuration will only sap his strength, and his safety lies in adequate drainage.

Post-operative Fistula.—Post-operative fistula may be expected to remain patent for several weeks. In the first days the gush of urine through the wound is often considerable. In a case of calculous anuria which I operated upon on the seventh day, the kidney reacted so overwhelmingly that for twenty-four hours a bucket had to be kept under the patient's bed to catch the overflow which ran from the wound in his side. (Unhappily, the sequel was suppression and death.) In any case, this flow of urine will continue for a week or two, and probably longer after a pyelotomy than

after an incision of the kidney substance. But all ordinary surgical wounds of the kidney may be expected to heal kindly unless foreign body, obstruction, disease, or a considerable loss of tissue impedes the natural process of repair.

Thus the causes of post-operative fistula may be grouped as follows:

1. Occlusion of the ureter.
2. Foreign body—e. g., stone, suture.
3. Inefficient drainage of suppurating pockets.
4. Tuberculosis or neoplasm.
5. Loss of substance of pelvis or ureter.
6. Low general vitality.
7. Lesion of the colon causing fecal fistula.

Occlusion of the ureter is probably the commonest cause of fistula after nephrotomy, and it is easily understood that so long as the ureter remains obstructed the urine will seek the right of way through the loin. In a certain number of cases the obstruction may be only comparative, the kidney being pouched and the ureter kinked. Such cases have been cured by the ureteral catheter *à demeure* (Albarran); but one cannot feel sure that a case so treated may not subsequently develop into a hydronephrosis.

The *symptoms* of a fistula are the discharge of urine or of urine mingled with pus, or, if the kidney be completely disorganized, of pure pus. In this last class of cases there is often a great deal of pocketing and marked sepsis.

Treatment.—The treatment of renal fistula is surgical. The manipulative treatment by ureteral catheter is rarely applicable. The removal of foreign bodies need not be insisted upon. For example, I have known a man to carry a tube in his loin for eight years because he feared to be without it, and to heal up in three weeks after it was extracted.

Of course local treatment by antiseptic and stimulating irrigations should be employed in conjunction with appropriate tonics and hygiene for a sufficient time before operative treatment of the fistula is considered. But if in spite of all such measures the discharge persists it can only be cured by operation. Before proceeding to cut down upon such a kidney the surgeon should familiarize himself with every detail of the patient's history and avail himself of every means of physical diagnosis in order to estimate the condition of the two kidneys. If, as is usually the case, all the urine of one kidney issues through the loin, the condition of the other is readily ascertained by examining the urine drawn from the bladder.

From the data thus obtained the surgeon should endeavour to

decide beforehand whether it is preferable to perform nephrotomy or nephrectomy. If the case is an old pyonephrosis and the opposite kidney is sound, nephrectomy usually offers the easier solution of the problem, although, under these circumstances, it is a difficult and dangerous operation. But if the kidney is comparatively sound every endeavour should be made by the use of the ureteral catheter and of any other device that may fit the case to save the kidney and to re-establish the ureteral right of way. All operations under these circumstances are complicated by the presence of masses of old fibrous scar. Hence the incision must be so planned as to reach the kidney after going through as little scar tissue as possible. In general it is preferable to make the external incision behind and below the line of the old scar (though this may not always be practicable), and to follow down behind it, guided by a finger or an instrument in the fistulous tract. The scar tissue leading down to the kidney had then best be completely excised, and the organ itself, lying embedded in a mass of fibrous tissue, dealt with as seems proper. It is in such cases as this that subcapsular nephrectomy and nephrectomy by *morcellement* are oftenest employed. Here the longest and most irregular incision and the resection of several ribs are quite justifiable procedures, while the surgeon will often save time by entering the peritoneum boldly at the beginning of the operation rather than to potter along and tear into it several times during the procedure.