for such a case by lumbar drainage is apt to be fallacious.

The details of the operation of nephrectomy will be dealt with in the next article. In the present place it is only pertinent to add that, in general, anæsthesia with nitrous oxide gas and ether is to be preferred. Whatever the site and shape of incision selected, the kidney and any desired portion of its ureter should be removed extraperitoneally. Both the ilio-hypogastric and ilio-inguinal

FIG. 3070.—Anterior T-incision; Extraperitoneal Nephrectomy. Photograph taken two years after the operation and fifteen years after an operation for appendicitis. (Writer's case.)

nerves should be spared severance. The costo-iliac oblique incision offers the simplest access to the kidney,—less stripping of parietal peritoneum being required,—but the patient's posture is here one which sometimes involves an undesirable amount of pressure on the opposite kidney; and besides, if much of the ureter is found diseased and its removal is practised, the necessary extension downward of this incision severs the internal oblique and transversalis muscles more or less transversely. Mainly for these reasons the writer prefers to maintain the patient in the dorsal position and to employ an antero-lateral incision which conforms to the costal margin, and by means of which, after the skin has been divided, some degree of intermuscular separation can be effected. After stripping forward the parietal peritoneum good access is given to the kidney. Fig. 3069 shows the cicatrix after such a nephrectomy.

In cases in which it is found necessary to perform a considerable ureterectomy in addition, the usual preliminary incision may be made as if for a nephrectomy, and then the inner extremity of this incision should be extended at right angles downward along the outer border of the rectus muscle for the necessary distance, exposing the peritoneum to be separated and deflected toward the median line.

Any tear of the peritoneum calls for immediate closure by a continuous catgut suture.

If a tuberculous kidney has its ureter similarly and continuously diseased beyond the sacral brim we are not disposed to urge that a total extirpation of the ureter should then or even at a later operation be attempted. Numerous operators have observed that the leaving of a considerable amount of tuberculous ureter has been followed by no subsequent detriment. This is explained by the supposition that removal of the kidney has left the ureter in a functionless state of repose and amenable to the curative processes of systemic invigoration. At the same time sufficient experience has not accumulated to warrant us in maintaining that a routine practice based on this presumption is always the best surgery. If it were not for the fact that a total removal necessitates such an increased operative exposure, the more radical step would better satisfy the surgical indications present in these cases, and at the same time would afford a satisfactory method of dealing with any remaining tuberculosis.

When the other kidney is in a satisfactory condition—and information on this point should always be sought well in advance of any surgical procedure—the operation itself is a comparatively safe one, certainly safer than nephrectomy undertaken for any other cause. The writer has had seven such cases without a death, while the mortality in his cases of nephrectomy and nephrotomy for other diseases has convinced him of a marked difference in the dangers attached to renal surgery.

Cases are met with in which, with the removal of a tuberculous kidney, all the vesical symptoms, especially thamuria, have disappeared. This has not been the happy result in the majority of the writer's cases, although the frequency of micturition has lessened and repeated microscopic and animal-inoculation tests during a period of two years and more have failed to show remaining tuberculosis of the urinary tract. A satisfactory explanation of this persistence of frequency of micturition is yet to be made. The claims are that any one of several causes may be the controlling factor in different cases. The value of training such bladders to tolerate greater degrees of distention by the daily use of warm

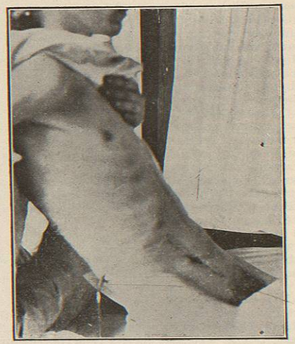

FIG. 3071.—Abdominal Wound after Lumbar Transplantation of the Ureter. In the loin is a ureter catheter draining a tuberculous kidney. Patient in bad condition. Subsequent nephrectomy followed by unexpected restoration despite disease of left kidney. (Writer's case.)

boric-acid solutions, introduced by siphonage or gravity flow, has been evident in the writer's experience. French writers have recently advocated inflation of the bladder with air in such cases. But, unless the medium is previously warmed, the writer would suggest caution in such a procedure.

In connection with the subject of treatment it is only fair to state that some authorities maintain that a certain





number of the patients who suffer from tuberculous disease of the kidneys make complete clinical recoveries under the simple influences of change in climate and altered hygienic conditions, and they advocate, therefore, that operative interference be resorted to only after these measures have been given a thorough trial. It is plain, however, that in the majority of instances the question of expense will make it impossible for these patients to adopt such a course. For them the best plan is to spend a few weeks under the improved hygienic influences of a properly organized hospital and then to undergo a suitable surgical operation. Afterward, if arrangements can possibly be made by the patient to secure the benefits, for a period of several months or for life, of a residence in a better climate and under good hygienic influences, such a course should by all means be adopted.

*F. Tilden Brown.*

**KIDNEYS, INJURIES OF.** See *Abdomen.* (*Surgical.*)

**KIDNEYS, SURGICAL AFFECTIONS OF.**—The operative treatment of diseases of the kidney has developed to such a degree within the past few years as to make it

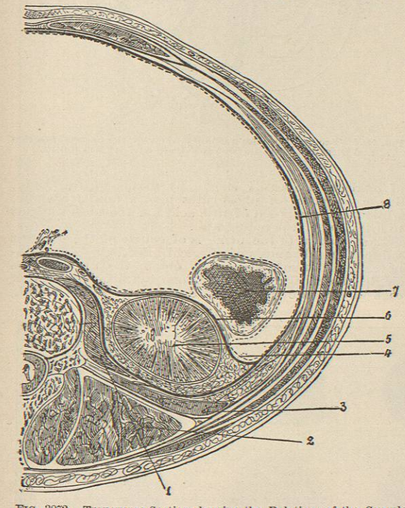


FIG. 3072.—Transverse Section showing the Relations of the Capsule of the Kidney. (After Gerota.) 1, Psoas muscle; 2, body of the sacro-lumbalis muscle; 3, quadratus lumborum muscle; 4 (dotted line), peritoneum; 5, kidney; 6, anterior fold of the perirenal fascia; 7, colon; 8, subperitoneal fascia.

desirable to discuss the subject in detail. It will therefore be considered under the headings of Surgical Anatomy, Methods of Examination, Operative Technique, Effects of Operation, Movable Kidney, Hydronephrosis, Suppuration, Paranephritis, Calculus, Essential Hemorrhage and Nephralgia, Aneurism, Syphilis, Cystic Tumors, and Suprarenal Gland.

*Surgical Anatomy.*—The anatomy of the kidney is considered in a separate article, but it is worth while to emphasize certain facts in the structure and relations of the organ, a knowledge of which is essential to the proper understanding and treatment of its surgical diseases.

The chief support of the kidney is the fibrous capsule which surrounds the gland as far as the hilus and sends a firm prolongation behind the renal vessels to join with the sheath of the aorta and the fascia which covers the

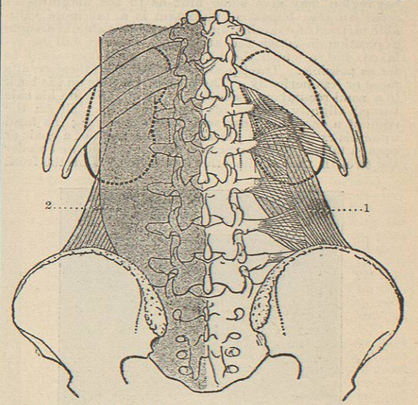


FIG. 3073.—Situation of the Kidneys. (After Récamier.) 1, Quadratus lumborum muscle; 2, sacro-lumbalis muscle.

pillars of the diaphragm. This fibrous prolongation acts as a suspensory ligament to maintain the kidney in position (Fig. 3073).

The kidney normally occupies a position between the level of the spinous process of the eleventh dorsal vertebra and that of the spinous process of the second lumbar vertebra, being situated slightly lower on the right side than on the left.

The lowest point of the pleural cavity is where it touches the eleventh rib some four or five inches from the median line. Hence the upper portion of the kidney lies very close to the pleural cavity, especially on the left side.

The relation of the colon to the kidney may be of importance in the diagnosis of abdominal tumors. It is commonly stated that the ascending colon crosses the lower pole of the right kidney, and the descending colon crosses in front of the left kidney. But this rule is by no means invariable. The ascending colon may lie wholly below the right kidney, and the descending colon may cross entirely above the left kidney. Hence the distention of the colon with air pumped into the rectum is not an infallible means of differential diagnosis between such conditions as a tumor of the right kidney and a constricted lobe of the liver, or an enlarged spleen.

The vascular supply of the kidney is variable. According to Jössel the renal artery has two anterior branches, one superior branch, and one posterior branch; but this is by no means a universal arrangement. Indeed, there are often two and sometimes three renal arteries (Fig. 3074). While the renal artery or its branches usually enter the hilus, there is often a separate artery to one or the other pole which may escape ligation and give rise to troublesome hemorrhage when the kidney is removed.

One definite condition of the arterial supply is the fact that all branches are terminal branches. Hence if one of them is cut, necrosis of the pyramidal-shaped portion of the parenchyma which it supplies will follow.

In opening the kidney along its convex border, the incision should be made between the areas of distribution

of the different branches. The best line of incision, therefore, does not follow the crest of the convex border, but lies about one-third of an inch posterior to it.

*Methods of Examination.*—While inspection of the lumbar region may give some hint as to the diagnosis of renal trouble, bimanual palpation is a far more valuable method of examination. The patient should assume a position in which the abdominal muscles will be relaxed, and in which the kidney will sink downward as far as possible. Three positions accomplish these results more or less perfectly. The patient may lie on his back in a semi-recumbent position, or he may lie on his side turned slightly toward his face, or he may sit on the edge of a chajr and lean well forward, resting his head upon his crossed arms placed upon the back of a chair or upon a table. The surgeon places one hand just under the twelfth rib and the other opposite to it on the front

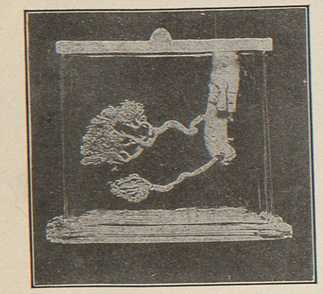

FIG. 3074.—Corrosion Preparation of the Renal Vessels showing a Separate Artery to the Lower Pole. (Zondek).

of the abdomen. If the kidney is displaced downward or is much enlarged or is movable, it will easily be felt by one of these methods of examination. An anæsthetic is necessary only in case the patient is unable, because of pain or for other reasons, to relax the abdominal muscles.

The normal kidney is palpable in the case of a few men and most women. The figures given for the right kidney are eight per cent. for men and eighty per cent. for women, while the figures for the left kidney are six per cent. for men and thirty per cent. for women. Becker and Lennhoff assert that most of the kidneys which are palpable are found in persons with a long, slender trunk. "If the distance from the suprasternal notch to the symphysis pubis be divided by the smallest circumference of the abdomen the index figure obtained will vary from sixty-three, or less, to ninety-five." * A kidney is rarely palpable unless the index figure of its possessor is over seventy-five.

The *x*-ray has already proved itself to be a valuable aid to diagnosis, especially in the case of renal calculus, and it is likely to become more serviceable for this purpose as operators learn to differentiate more nicely between tissues. Calculi composed

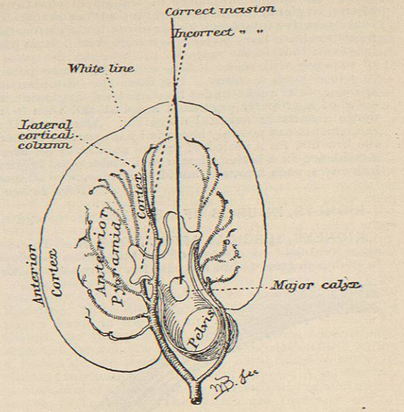


FIG. 3075.—Section Through a Kidney, showing the Correct Position and Direction of an Incision into its Pelvis. (From Kelly.)

of oxalates are easily shown by means of the *x*-ray. Those composed of phosphates give a fainter shadow, while those composed of uric acid are the most difficult to bring out in the radiograph.

Examination of the urine is of course of the greatest value in the diagnosis of surgical affections of the kidney. It is often necessary to obtain the urine from a single kidney, which may be done by catheterization of each ureter (see article on *Cystoscopy*), or by making

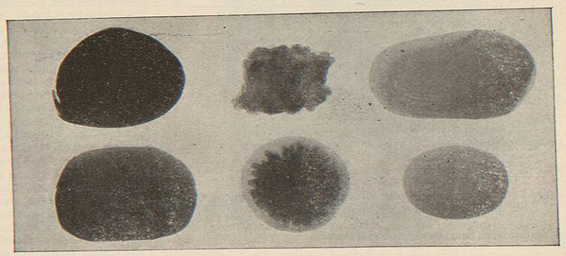

FIG. 3076.—Radiograph of Calculi from the Pelvis of the Kidney. The two on the left are composed of uric acid and urates; those on the right of phosphates. The two calculi in the middle are composed of oxalate of calcium and uric acid, the upper one having an outside coating of urates. (From "The Roentgen Rays in Medicine and Surgery," by Francis K. Williams, M.D. Macmillan, 1901.)

collected from the two kidneys separately, if the functional capacity of each is to be shown.

Another valuable means of estimating the functional activity of the kidneys is to determine the freezing point of the blood and of the urine. The freezing point of normal urine is from 1° to 2° C. below that of distilled water. If the freezing point rises it indicates that the work of the kidneys is insufficient. The freezing point of the blood is less variable in health than that of the urine, and hence is a more certain guide to urinary excretion. Normally it is 0.56° C. below that of water. If the activity of the kidney is deficient the blood will contain more than the normal proportion of salts which ought to have been excreted, and hence its freezing point will fall. A drop of 0.03° or 0.04° is good proof that both kidneys are acting insufficiently; and if the freezing point is lower than this, one organ ought not to be extirpated unless it is known to contain no parenchymatous tissue. The best apparatus to determine the freezing point is that devised by Beckmann.

*Operative Technique.*—Schede mentions seven operations which may be performed for diagnosis or treatment in the case of renal disease. These operations are (1) incision into a paranephritic abscess; (2) evacuation of extravasated blood or urine in the case of traumatism; (3) nephropexy, or fixation of a movable kidney; (4) incision of the contracted capsule in order to relieve renal neuralgia; (5) nephrotomy or pyelotomy, that is, incision into the pelvis of the kidney, through the cortex or directly, to remove a calculus or to afford drainage in case of suppuration; (6) resection of a portion of the kidney for diagnostic or therapeutic reasons; (7) nephrectomy, or extirpation of the whole kidney, an operation which may be necessitated by traumatism, hydronephrosis, suppuration, calculus, ureteral fistula, tuberculosis, or malignant new growth.

As the anterior surface of the kidney is partly covered with peritoneum the organ can be reached from in front through an abdominal incision, or through an incision made in the lumbar region. The usual laparotomy incision in the median line may be employed, or one may be made along the outer border of the rectus muscle, or the operator may resort to the oblique incision of Trendelenburg, extending from the costal margin in the anterior axillary line to the pubic spine. This incision gives the best access to the organ. The posterior peritoneum is divided outside of the colon and the colon is pushed toward the median line out of the way.

Some surgeons advocate one method for certain operations, and some another. Each method has certain advantages and disadvantages which must be admitted by all. The transperitoneal method gives a good exposure of the diseased kidney and enables the surgeon to examine other abdominal organs, and especially the other kidney. In the removal of very large tumors there is probably a saving of time if the transperitoneal method is followed. This method is said to give the surgeon a better opportunity to remove diseased lymphatic glands in the neighborhood of the vena cava.

A disadvantage of the method is the risk of infecting the abdominal cavity from septic matter which may be contained in the kidney. Moreover, the necessity of handling and possibly of tearing the abdominal organs in the efforts to get at the kidney should also be taken into consideration. If the kidney is removed there will be left a retroperitoneal cavity left which require drainage either through the loin or through the abdominal wound. This is at best an awkward procedure. Abdominal drainage will be followed by adhesions between the anterior and posterior layers of peritoneum. This scar may later be dissected out and the wound in each layer be sutured by itself (Heidenhain).

The lumbar method, provided it is carried out without any injury to the peritoneum, saves the abdominal cavity from the risk of infection. The shock to the patient is less than when the abdominal cavity is opened. If it is necessary to examine the other kidney, the peritoneum

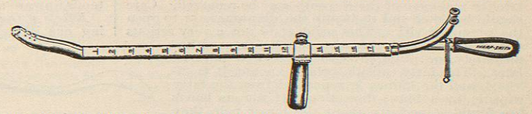

FIG. 3078.—Harris' Instrument for Obtaining Urine from the Two Ureters Separately. The two catheters are placed side by side for ease of introduction through the urethra. *Journal of the American Medical Association*, January 29th, 1898.)

may be divided sufficiently to allow the operator to pass his hand through the lumbar wound into the peritoneal cavity. When the examination is completed the peritoneal wound may be sutured. This can be done before the diseased kidney is cut into, and therefore with only

FIG. 3077.—*x*-Ray Picture of a Renal and a Ureteral Calculus. (From Dr. Alexander B. Johnston's article in the *Annals of Surgery*). In the left kidney there was a large calculus which formed a cast of the dilated pelvis and calyces; in the ureter of the same side there was a stone. The patient, a man forty-one years of age, weighed about one hundred and forty pounds.

* Thus, for example, if the distance between the first two points is 22 inches and the girth of the abdomen 32 inches, the index figure will be 68 $\left(\frac{22}{32}=0.68\right)$.

slight risk of infection. The other kidney may also be examined through an incision in the other lumbar region.

Objections which have been made to the lumbar method are based upon the fact that it is difficult to expose and to remove an enlarged kidney in this manner. This criticism was doubtless true of many of the lumbar incisions previously employed, but at the present time the method has been so perfected that so experienced a man as Israel uses it altogether, while Schede recommends it for all operations excepting those per-

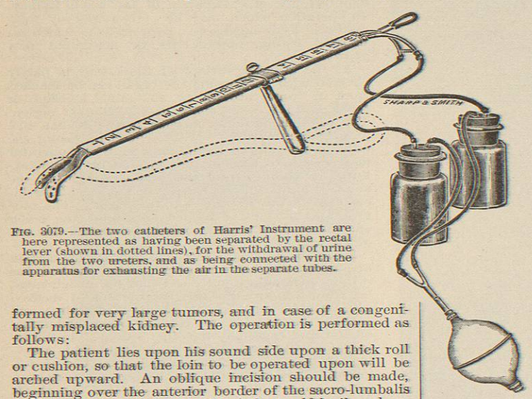


FIG. 3079.—The two catheters of Harris' Instrument are here represented as having been separated by the rectal lever (shown in dotted lines), for the withdrawal of urine from the two ureters, and as being connected with the apparatus for exhausting the air in the separate tubes.

formed for very large tumors, and in case of a congenitally misplaced kidney. The operation is performed as follows:

The patient lies upon his sound side upon a thick roll or cushion, so that the loin to be operated upon will be arched upward. An oblique incision should be made, beginning over the anterior border of the sacro-lumbalis muscle just below the margin of the twelfth rib and extending downward and forward parallel to the rib. The incision may be extended until it reaches the anterior axillary line; or, if this is not sufficient, it may be prolonged still farther forward and downward. The sacro-lumbalis muscle is felt with difficulty in stout persons. It is well to remember that this anterior border is from 2.5 to 3 inches from the spinous process of the first lumbar vertebra. The subcutaneous fat is divided, after this the superficial fascia, and then the latissimus dorsi muscle, which in this situation is not more than an eighth of an inch in thickness. The firm fascia covering the sacro-lumbalis muscle is next divided and the rounded edge of the muscle exposed. It may be necessary to ligate the twelfth intercostal and first lumbar arteries as they pass into the quadratus lumborum muscle close to its insertion near the twelfth rib. The retro-peritoneal connective tissue is exposed and the peritoneum is pushed forward out of the way. If the ribs interfere with free access to the kidney a portion of the twelfth and even of the eleventh may be removed. Care should be taken not to injure the diaphragm or to open the pleural cavity. This accident is not a very serious one, however, and the rent may be sutured immediately, or plugged with gauze and sutured later. The fatty capsule being exposed, it is divided, and the kidney is separated from the fatty capsule by a blunt dissection. If fibrous bands are found, especially about the lower pole, they should not be cut through until ligatures have been placed around them, since they often contain good-sized vessels. When the kidney has been freed as far as the hilus it can be brought up into or out of the wound to permit inspection.

If the kidney is a movable one which is to be fixed in position, a strip of the capsule may be marked out with the scalpel and peeled off and the organ fixed in position by sutures which pass well through the parenchymatous tissue and through the strong layers of fascia and muscle on either side of the lumbar wound.

If nephrotomy is to be performed the incision should be made about one-third of an inch back of the convex margin of the kidney, and in a plane parallel to its posterior surface so as to avoid wounding arterial trunks (see Fig. 3075). The ureter may then be explored from within the pelvis of the kidney, or it may be palpated externally by continuing the blunt dissection downward.

A section of the kidney may be removed for microscopical examination or because it is diseased. The terminal arrangement of arteries in the kidney explains the occurrence of a local tuberculosis, and when this exists an early resection of the diseased portion may rid the patient of his trouble, while preserving a considerable part of the affected kidney.

If the kidney is to be drained it may be left in its natural position or sutured in the subcutaneous portion of the wound.

In extirpation of the kidney the organ is exposed, freed, and, if possible, brought into the wound in the manner already described. The vessels of the ureter will then be exposed, the renal vein lying anteriorly, the artery next, and the ureter farthest behind. These should be ligated separately. They may then be divided, and the kidney, being entirely freed, may be lifted out of the wound.

There are cases in which, on account of adhesions, it is difficult to bring the kidney out of the wound. The plan of procedure should then be to divide such small sections of tissue as are visible, and to ligate their vessels. This can usually be done if the assistants hold the edges of the wound well apart. As far as possible one should avoid cutting in the dark. It is even better to pass an elastic ligature around the whole pedicle and to remove a portion of the organ if thereby space is gained to enable the surgeon to see where he is cutting. Too great tension should not be brought upon the pedicle, as instances are recorded in which this has suddenly parted and fatal hemorrhage has followed.

The general rule is to carry out the dissection between the fibrous and fatty capsules. In some instances the two are so adherent that it is better to shell the kidney out of its fibrous capsule, while in case of tuberculous or malignant disease one naturally removes with the kidney as much of the fatty capsule as possible.

The oblique incision described above is the simplest, and in many respects the best lumbar incision. Some surgeons prefer a transverse incision, some a T-incision, and some an angular incision, the longitudinal portion of which extends along the border of the sacro-lumbalis and then bends sharply to follow the crest of the ilium, or extends upward along the costal margin, as the case may be.

*Effects of Operation.*—The immediate effect of removing one kidney is to diminish the urine to about one-


FIG. 3080.—The Rectal Lever, for making a Watershed in the Bladder.

fourth of the previous daily quantity. If the case progresses favorably the quantity of urine gradually increases until in five or six days it is normal and contains the normal amount of urea. There are, however, many variations from this type: thus, if the kidney which is removed has not for a long time excreted any urine, the effect on the other kidney may be insignificant.





If the case progresses unfavorably, the quantity of urine which during the day following the operation is perhaps ten or twelve ounces, may fall on the second day to half of that amount, while on the third or fourth day there may be total anuria with speedy death. Microscopic examination of the remaining kidney will show extensive degeneration of the convoluted tubules.

Sometimes the patient will apparently do well for a week or two and will then begin to pass a gradually decreasing quantity of urine which contains hyaline and waxy casts and degenerated renal epithelium. A few days later, anuria will be complete and death results. The remaining kidney under these circumstances will show signs of degeneration, not only of the convoluted tubules, but also of the straight tubules and of the glomeruli. But not all of these patients with unfavorable symptoms die. There are cases in which insufficient urinary excretion continues for some time and then gradual betterment takes place.

When a patient recovers from nephrectomy the remaining kidney undergoes hypertrophy. It was at one time supposed that this renal enlargement was due to a new formation of tubules and glomeruli. Such is not the case. A tubule may increase in size and length from multiplication of its cells, but there is no good evidence that new tubules or new glomeruli are formed.

When a kidney is incised and drained, urine will flow from the wound for a variable length of time. If there is obstruction in the ureter, the flow from the wound will be permanent. If the ureter is open and there is no disease in the kidney—tuberculosis, for example—the urinary flow from the wound will grow less and less and finally cease altogether. Such is the usual result after nephrotomy for renal calculus.

*Movable Kidney.*—The normal kidney moves with respiration, and if the patient is not too fat, and has a wide space between the crest of the ilium and the margin of the ribs, and especially if the abdominal walls are lax, the normal kidney may often be palpated. The etiology of movable kidney is a widely discussed subject. In the first place it is noticeable that eighty-five per cent. of the cases of movable kidney occur in women. In the second place movable kidney occurs about fifteen times as often on the right side as on the left. The kidney is normally held in place by a fascial prolongation from its fibrous capsule to the spinal column (see above) and also, according to Wolkoff and Delitzin, by the shape of the recess in which the kidney lies. The normal recess is slightly funnel-shaped. In a case of movable kidney the recess is shallow and more cylindrical. Other alleged causes are reduction of the intra-abdominal pressure by relaxation of the abdominal walls, tight lacing, especially if so carried out as to compress the ribs, and muscular strains and blows.

A movable kidney may be recognized bimanually if the patient is placed in one of the three positions mentioned above. It can be easily crowded back into its normal position, and will often return there without manipulation if the patient lies flat upon his back. A movable kidney causes discomfort, and a dragging pain in the lumbar region and back which is worse after long standing and is increased by heavy lifting. These symptoms are much relieved by rest in a recumbent position. At other times a kidney will be movable to a high degree without giving rise to symptoms. Most of the patients who complain of movable kidney suffer from a disordered digestion, and are of a neurasthenic type. It is often impossible to say just how many of the symptoms complained of are really caused by the kidney.

A movable kidney may become strangulated by twisting upon its pedicle. The congestion and œdema and perhaps urinary obstruction which follow produce an intense and at times unbearable pain. Such an attack of strangulation is accompanied by anuria. The attack usually passes off in a few hours and is followed by a greatly increased flow of dilute urine.

The treatment of an attack of strangulation of this character is rest in bed, the local application of ice, and the hypodermic administration of morphine. In a few instances a surgeon has been able bimanually to untwist the pedicle of the kidney and thus to relieve the strangulation. The twist sometimes occurs in one direction and sometimes in another.

Palliative treatment of movable kidney consists in the avoidance of jars and undue muscular exertion, the improvement of the digestion, and, if possible, increase in body weight, since emaciation is an important factor in the development of movable kidney. A well-fitting abdominal bandage will often give a patient a good deal of comfort. Attempts to hold the kidney in place by means of a pad are generally unsuccessful and frequently add to the patient's discomfort by reason of the pressure which the pad makes upon the kidney which has slipped down beneath it.

More than twenty years ago Hahn attempted to fix a movable kidney by passing catgut stitches through the posterior part of the fatty capsule. The operation in this crude form has been variously modified and improved until to-day fixation of a movable kidney is one of the most successful surgical operations. A longitudinal incision along the border of the quadratus muscle is sufficient to give access to the organ. The kidney is exposed behind the peritoneal reflection and a strip of the fibrous capsule is removed. Sutures are passed through the parenchyma and the kidney is fastened to the lumbar muscles as high up as possible. The tissue planes are closed by suture, a small drain being left in the wound if desired. The patient should remain in bed at least four weeks. Some surgeons keep the patient in bed for from ten to twelve weeks. This operation is called *nephropexy*, or *nephrorrhaphy*. Its mortality is no more than one per cent. If properly carried out the operation will almost always permanently fix the kidney. It sometimes fails, however, to relieve the symptoms of the patient, which tends to show that many of the symptoms complained of by these patients are not due to the movement of the kidney, but to some other cause. Some surgeons do not regard fixation of a movable kidney as a justifiable operation in most of the cases in which it is performed. For example, Israel says that it is the fashion at present to go to a surgeon to have the kidneys anchored just as it used to be to go to a gynecologist to have the ovaries removed.

*Hydronephrosis.*—Obstruction to the urinary flow if occurring at any point above the opening of the ureter into the bladder, will cause a cystic dilatation of the kidney. If the urine is aseptic the dilatation is spoken of as hydronephrosis, or uronephrosis. If the urine contains pus the term pyonephrosis is used. Such obstruction may be temporary or permanent; it may be complete or incomplete. Both kidneys may be affected, but complete obstruction on both sides can exist for only a short time without causing death; hence obstruction at the neck of the bladder or in the urethra fails to produce much dilatation of the kidney. If the obstruction is an incomplete or an intermittent one the dilatation will usually be the most marked, since the renal parenchyma is then not entirely destroyed. In the early stages of the trouble the dilated pelvis and calices closely resemble the normal structures. Later, the kidney is changed to a sac with a relatively thin wall, in which may be found microscopically more or less parenchymatous tissue. Even after a hydronephrosis has lasted a long time the remains of the glomeruli and tubules still possess some excretory power, and within a short time after the pressure is relieved this functional activity of the kidney greatly increases. It is a good plan, therefore, in operating upon a long-standing complete obstruction, to wait several days before deciding upon the removal of the affected kidney.

The obstruction which causes the hydronephrosis may be either congenital or acquired. The ureter may be too small, or it may be twisted, or either its upper or lower opening may be faulty, or there may be valves somewhere in its course.

The chief causes of acquired hydronephrosis are found