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OPERATION FOR THE RELIEF OF VALVE-FORMATION AND STRICTURE OF THE URETER IN HYDRO- OR PYO-NEPHROSIS.

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In all cases of pyonephrosis we may expect to find some obstruction to the flow of urine either in the renal pelvis, the ureter, the bladder or the urethra. If the obstruction is external to the ureteral opening in the bladder, the pyonephrosis is double; if on one side, the obstruction must be in the ureter or the pelvis of the kidney.

Lumbar nephrotomy for pyonephrosis has a mortality of 23.3 per cent., and primary lumbar nephrectomy a mortality of 34 per cent. (Tuffier.)[1] Secondary nephrectomy must be made to close the fistula after some time has passed, but this should not be delayed until amyloid nephritis of the other kidney has set in. The mortality from this operation is low, 5.9 per cent. If we add the 5.9 per cent. mortality from secondary nephrectomy to the 23.3 per cent. mortality from primary nephrotomy, the total of 29.2 per cent. is still 7.8 per cent. less than the mortality from primary abdominal nephrectomy, which is 37 per cent. and 4.8 per cent. less than the mortality from primary lumbar nephrectomy, which is 34 per cent. Consequently, in pyonephrosis, nephrotomy is the operation of choice. (Tuffier.)

The disadvantage of nephrotomy as compared

with nephrectomy for pyonephrosis is that a fistula remains in 45 per cent. of the cases. This means that after a time a secondary nephrectomy must be made. Fistulas remained in 34 per cent. of the cases of calculous pyelitis and in 54 per cent. of the cases of non-calculous pyelitis. The smaller number of fistulas in calculous pyelitis is to be accounted for by the fact that in a certain number of these cases, the stone prevents the passage of urine, and with the removal of the stone, the obstruction is removed. Where there is no stone, simple nephrotomy will leave the impediment in all cases. If in both calculous and non-calculous pyonephrosis we can reëstablish the permeability of the ureter, we may expect to materially diminish the percentage of permanent fistulas.

Tuffier, in the discussion of pyonephrosis, in his excellent monograph on surgery of the urinary organs remarks: "It would be interesting to know the condition of the ureter, the strictures, bands, valve-formations that transform an open pyelonephritis into a temporarily closed hydro- or pyonephrosis. As yet these investigations for the intermittent pyonephrosis have not been made."

VALVE-FORMATION AND BENDING AT THE PELVIC ORIFICE OF THE URETER.

Valve-formation and oblique insertion of the ureter was first noticed in a case reported by Glass [2] and cited by Rayer.[3] A girl was born with right hydronephrosis and died at age of 23. At autopsy three gallons of liquid was found in the sac. On interior surface of sac the orifice of the ureter was seen as large as a goose quill. The ureter passed obliquely for twelve inches between the membranes of the sac, and was patent the entire distance to the bladder. On account of the non-obstruction of ureter, Rayer considers this the most remarkable case on record.

Rayer observed a case of double hydronephrosis

in which the ureters were also patent, which he attributes to congenital malformation. The patient was a boy of 17, who had been sickly all his life, and had had pain for seven years in the region of the left kidney. A tumor was found and the diagnosis made of left hydronephrosis. He died from septic infection of the sacs. At autopsy, left ureter was found patent, the upper portion situated in wall of sac with an opening almost similar to a valve in a vein. Water passed easily from below upward, but not down from the sac into the ureter. There was a smaller hydronephrosis in the right kidney. The right ureter was dilated to the size of a lead pencil from the bladder up to the sac. At the upper end it was retracted and when water was injected from below, it entered the sac through an opening the size of the lachrymal punctum.

Virchow[4] in discussing hydronephrosis remarks: "The cases are extraordinary in which hydronephrosis exists with the ureter patent. I have examined such cases several times, and have found in each case a valvular obstruction caused by folding of the wall, due to oblique origin of the ureter from the renal pelvis."

Simon[5] gives a full and comprehensive description of this condition. The ureter does not enter the pelvis of the kidney at its lowest point, with a funnel-shaped opening, but enters it at the side, at an acute angle, and often even runs for a variable distance in the wall of the pelvis. In two similar observed cases, the ureter ran, not in the wall proper, but between the wall and the peritoneal covering for seven to ten centimeters. In contra-distinction to the previous authors, who thought that valve formation was the cause of the hydronephrosis and therefore congenital, Simon believes that the hydronephrosis in its beginning causes the valve-formation and consequently that valve-formation is not a congenital affection. He has examined a specimen in which a stone was found in the ureter five centimeters from

the pelvic orifice, in a case of hydronephrosis the size of a child's head, and with valve-formation in the upper end of the ureter. He believes that temporary obstruction from any cause may produce sufficient asymmetrical dilatation of the pelvis to give rise to oblique insertion and valve-formation, which when it once exists, even if the primary cause of obstruction disappear, may remain as a permanent obstruction of greater or less degree to the passage of urine. He considers valve-formation in hydronephrosis very common, as he found it in eleven out of eighteen reported cases.

The mechanical aspect of valve-formation in the causation of intermittent hydronephrosis was studied by Krakauer,[6] who made experiments designed to explain the fact that spontaneous evacuation of urine is sometimes seen in hydronephrosis due to this cause. Acting upon the proposal of Simon, Krakauer produced an imitation of the hydronephrosis due to valve-formation in the following manner: He caused to be made a rubber balloon having a capacity of 150 cubic centimeters with a tube which ran for several centimeters in the wall before opening at an acute angle into the side of the balloon. When the balloon was filled to distension he observed that the first fifty cubic centimeters were evacuated rapidly, the second fifty cubic centimeters less rapidly and the remainder still less readily. From this experiment Krakauer concluded that a higher pressure in the balloon, equivalent to an over-filling of the distended pelvis, is capable of overcoming a greater hindrance or impediment in the tube of exit, the ureter, than is a lower pressure. Applying this fact to the obliquely inserted ureter in the dilated renal pelvis, he concludes that partial filling of the dilated pelvis will close the valve of entrance and permit no evacuation through the ureter; further accumulation of urine and over-distension of the dilated pelvis will overcome the obstacle and the urine will be evacuated through the ureter. This

fact explains the intermittent hydronephrosis observed in Case 1.

Landau[7] states that intermittent hydronephrosis, where there is no gross pathologic impediment to the passage of urine, is not so rare as might be judged from the infrequency of reports of this condition in the literature. He has seen four cases, all women aged from 30 to 60 years. In one case, infection pyonephrosis and perinephritis took place which necessitated nephrotomy.

The etiology of this condition was given by Landau as: *a*, bending; *b*, torsion; *c*, oblique insertion of the ureter. These conditions caused stagnation of urine in the pelvis of the kidney, dilatation of the pelvis, and then compression of the upper part of the ureter by the distended pelvis. These pathologic conditions of the ureter are in many cases caused by floating kidney. Direct traction upon the ureter has also been reported as the cause of hydronephrosis in certain cases of prolapsus of the uterus.

The amount of secreting kidney substance left is very variable; more of it is to be found in the smaller tumors, but even in large tumors secreting kidney substance may be spread out over a large surface. In one of Simon's cases he could feel the calices from the tenth rib to the crest of the ilium.

The ureter is small on account of atrophy from non-use. Its upper portion, which passes up through or in the wall of the pelvis, is stenosed from pressure of the sac. Its opening into the pelvis is a narrow crescentic slit sometimes only a line in length and often difficult to find on the specimen. (Simon.)

Spontaneous cure with *restitutio ad integrum* is impossible, because more or less kidney substance must necessarily be destroyed by the dilatation; but a condition almost identical with recovery is seen when the obstacle to the passage of urine disappears spontaneously, as for instance when a stone passes away. This is only possible, however, when no secondary valve-formation has taken place. (Simon.)

Nephrectomy.—In large hydronephroses, often mistaken for ovarian tumors, nephrectomy or rather extirpation, is exceedingly difficult,as hydrcnephrosis is a retro-peritoneal tumor, and as in the course of the extirpation the meso-colon must be divided. At the time of Simon's report the mortality was absolute; in two cases where total extirpation was made, and in four cases in which it was tried and given up as impossible, all the patients died.

Puncture and Aspiration—are only palliative measures, and in only one out of eleven cases collected by Simon was there even temporary improvement.

Nephrotomy.—An abdominal opening into the sac of a hydronephrosis can not be done without first procuring adhesions to the wall, either by leaving the canula in or by Recamier's cauterization. The patients died either from the operation or later from infection through the fistulas, with the exception of two out of the eight, one of whom, (Spencer Wells' case) recovered accidentally by passing of stones. In the other case (Simon's) a fistula remained. Spencer Wells'[8] case was as follows: "A woman of 50 had had intermittent attacks of pain in the region of the right kidney for seventeen years. Having made a diagnosis of intermittent pyonephrosis and finding a large tumor with indistinct outlines, on May 19, 1865, he evacuated by puncture through the abdomen with a fine trocar, two to three pints of pus. Eight days later he reopened the wound and dilated with a laminaria tent to evacuate the accumulated fluid. One month after the first puncture, on June 20, two uric acid calculi the size and shape of a broad bean passed, followed by relief. After a few weeks the tumor disappeared and the patient was well for the fifteen remaining years of her life."

Obliteration of Sac after Nephrotomy.—The difficulty, we might almost say impossibility of curing hydronephrosis without reëstablishing the passage

through the ureter, is well illustrated by one of Simon's cases. A man of 22 had a hydronephrosis of sixteen years' standing, for which five abdominal aspirations had been made in seven years. A large abdominal incision was made after double puncture to get adhesions. Unsuccessful attempts were made to obliterate the sac by cauterization of the sac wall and its kidney substance. Partial extirpation of the secreting kidney substance was abandoned on account of hemorrhage. After this, the daily secretion diminished one-fourth, but 150 cubic centimeters were still secreted. He then attempted to open up the ureter from the pelvis, without success, in the following manner: He filled the sac with milk, but none passed down into the bladder. He therefore concluded to open the pelvic ostium of the ureter, or dilate it if valve formation was present. He enlarged the abdominal wound until the opening would admit the hand and then searched all over with artificial light and probes, but in vain. A year later the patient's condition was satisfactory as to general health, but 150 to 180 cubic centimeters of fluid containing 0.7 per cent. to 1.1 per cent. of urea was passed daily.

Simon therefore came to the conclusion that it is probably impossible to obliterate the sac of a hydronephrosis as long as secreting kidney substance remains.

Reëstablishment of the Passage through the Ureter—would give the best results in the treatment of hydro- and pyonephrosis, even if no *restitutio ad integrum* of the kidney is possible. (Simon.) Spencer Wells' case has proven that a condition may result in which the patient may be restored to perfect health. If it should be possible to reopen the ureter, the same good results may be expected as in Spencer Wells' case.

There are two ways in which the ureter might be opened; from the bladder or from the pelvis of the kidney.

1. Catheterization of the Ureter from the Bladder.—This is considered by Simon as the more natural and easy way in women. He succeeded in finding the ureter in fifteen out of seventeen cases. He therefore proposes in this way to empty the contents of a hydro- or pyonephrosis, but he has never put the method in practice.

The catheterization proposed by Simon, was taken up by Pawlik[9] who constructed his ureteral sound, later improved by Howard Kelly.[10] The catheterization of the ureters in women has thus been made practicable, but for the purpose of overcoming stenosis, or the cure of pyo- or hydronephrosis, little or nothing has been accomplished.

Pawlik mentions a case from Billroth's clinic, of pyonephrosis in which he introduced through the ureter from the bladder, a long elastic catheter with a metal point, which passed through a stenosis of the ureter up into a cavity above. From previous nephrotomy, the patient had an abdomdominal fistula, a probe passed through which would touch the metal tip of the ureteral catheter. On attempting to withdraw the catheter, the tip was caught in the stenosis and broken off. Dr. v. Hacker removed it through the abdominal fistula.

Pawlik[11] cited by Alberran,[12] has two reports of cases of hydronephrosis in which his method was used. In one case (observation 6) cure was accomplished after thirty successive soundings of the ureter. In the other (observation 10) the ureter was impermeable and nephrotomy had to be resorted to. As regards leaving the catheter permanently in the ureter, Pawlik mentions a case of uretero-vaginal fistula in which a catheter was left in for seven days. Force was necessary to remove it and it was found incrusted with salts.

2. Catheterization of the Ureter from the Pelvis of the Kidney.—Simon, after his unsuccessful trial in the case above cited, states that the opening in the pelvis must be large,in order to find the ureteral opening,and

still, even if access is good, we will probably be able only in exceptional cases to sound the ureter and remove the obstruction, because in large tumors there is valve formation and so small a pelvic ostium that it can not be found in the large cavity, anatomic landmarks being absent, by inspection either with natural or artificial light. It would be only in exceptional cases where the pelvic ostium is dilated or not too small that it could be found and a probe inserted. If the pelvic ostium was found, a stenosis could be dilated with bougies or knives and the valve might be operated upon by cutting the inner wall away. Simon, however, never had occasion to bring these proposals into execution.

Landau recommends not nephrectomy but rather abdominal nephrotomy, eventually followed by probing of the ureter and perhaps by high fixation of the hydronephrotic sac, nephropexy, so as to facilitate the exit of urine from the pelvis into the ureter. Landau, however, has not yet operated in this manner.

The valve-formation can be remedied by a plastic operation after previous opening of the dilated pelvis following lumbar nephrotomy. It is natural to select the lumbar region for entering the pelvis because the operation is extra-peritoneal, and consequently there is no danger of infecting the peritoneal cavity, and because the lumbar incision gives the readiest access to the upper portion of the ureter. If it is possible in this manner to reëstablish the flow of urine, we can save for future function what active kidney tissue may be left, the danger of primary nephrectomy is avoided, and the patient may regain perfect health without urinary fistula. That this can be accomplished satisfactorily and promptly is illustrated by the following case:

Case 1.—Synopsis: Valvular stricture or stenosis of pelvic orifice of ureter in a somewhat floating kidney; intermittent hydronephrosis for eight years; more and more frequent attacks until finally one a week; nephrotomy in interval

between attacks; no stone in pelvis; pelvic orifice of ureter could not be found through opening in kidney; incision of pelvis; valvular opening of ureter seen; plastic operation on valve; bougie left in ureter for two days; pelvic wound sutured; fixation of floating kidney; recovery without fistula.

Mrs. D. H. consulted me at my office Feb. 22, 1892. She gave the following history: Age 28; family history good; previous health good; married eight years; two children living, one dead. Four months after marriage had an attack of pain in the region of the left kidney, with the formation of a tumor at the site of pain, immovable and tender on pressure. At the end of two weeks, tumor and pain suddenly disappeared. Two or three days after the birth of her first child she had a similar attack which lasted about eight days. She had intermittent attacks, every month or two from that time until 1878. The attacks varied little in intensity and persisted usually for about one week. In September, 1888, after the birth of her third child she had a severe attack of pain in the region of the kidney with frequent shooting pains along the course of the ureter and accompanied by a swelling, tender on pressure, and by difficult but painless micturition. This attack lasted for two or three weeks. Since that time she has had similar attacks every two weeks, which last on the average two days, and are always accompanied by difficult urination. The last attack, which occurred on Feb. 8, 1892, lasted for a week. Since that time she has had no pain.

The patient began to menstruate at 10 years of age and has been regular until a year ago. Flow normal, but considerable dysmenorrhea. For the past year menstruation has been irregular, every two to four weeks, but the flow has been normal.

Present condition: The patient is somewhat emaciated, has a nervous suffering expression, not pale, abdomen easy to palpate, heart and lungs normal. Temperature 99 degrees. Urine contains pus, but neither albumen nor sugar.

On March 11, during an attack of pain, a tumor could be felt in the region of the left kidney, but five days later no tumor could be found. During and immediately after the disappearance of the tumor the urine was milky from pus. May 24 she had another attack which lasted two days. During the days of pain, urine is scanty and dark-colored.

Diagnosis: Intermittent hydronephrosis; stenosis in pelvis of kidney or ureter, probably from stone. Advised nephrotomy, removal of stone from kidney or ureter without opening into ureter if possible. If necessary to open ureter, pass bougie from opening in kidney to bladder, and suture ureter over bougie.

Operation: May 31, at the Emergency Hospital in the

presence of the doctors from the Policlinic, and Drs. Waters, Bernauer and Krost, the patient was anesthetized with ether, and placed on the right side with a pillow under the loin. No tumor could be felt. An incision four inches long was made from the angle of the twelfth rib and the extensor dorsi muscle, obliquely downward and forward to the iliac crest above the anterior superior spine. It was necessary to divide the quadratus lumborum for an inch and a half below the rib, in order to gain space for operating. The transversalis fascia was now divided. The retro-peritoneal adipose tissue was scanty. Two tumors could now be felt; one close under the margin of the ribs was recognized as the spleen. Behind and below this could be felt the convex posterior border of the left kidney. During inspiration the spleen was pushed down upon the kidney, but it could be easily replaced. Dissection of the adipose capsule from the kidney was difficult, on account of a plastic perinephritis which had made the capsule tense and adherent to the kidney. The surface of the kidney was not smooth and glistening, but velvety from connective tissue strips. By pressure over the anterior portion of the lumbar region of the abdomen, the kidney was pushed into the wound and the adipose capsule dissected off by forceps and the finger, so as to permit palpation of the kidney between the thumb and index finger. The kidney was rather small, three and one-half inches long, one and one-half inches broad and one and one-half inches thick. Neither hard or soft spots could be felt. Palpation of the pelvis was accomplished by pushing the fingers of the left hand forward toward the hilum, holding the upper half of the kidney meanwhile between the thumb and index finger of the right hand. The pelvis contained no fluid and no stone could be felt. Following down from the pelvis no ureter could be felt, nor could any hard spot or stone be discovered.

A long exploring needle was introduced through the convex surface of the kidney, at a point between the middle and lower thirds, in the direction of the pelvis for a distance of two inches. An empty cavity was entered by the needle, in which no stone could be felt. The needle was next inserted into the upper half of the kidney but neither fluid or stone could be felt.

The pelvis was now opened through the kidney by means of the Paquelin cautery along the needle as a guide, in the middle third of the kidney. The hemorrhage was slight; no fluid escaped. The opening was dilated with forceps so as to permit palpation of the pelvis and calices with the left index finger. The calices were dilated, but still the kidney substance was half an inch thick. The pelvis was a large cavity extending to the lower border of the kidney with a round, smooth, soft surface. No stone could be felt, nor was the

ureteral entrance perceptible to the finger. Through a small opening, or over a ridge, the palpating finger could be passed into the upper part of the pelvis. The calices here were dilated but no stone could be felt. Examination with a steel urethral sound gave similar negative results.

In order to find, if possible, a stone in the ureter a small bent metal probe was passed into the pelvis, but the ureteral entrance could not be discovered. The dilated pelvis was now isolated and opened for ocular inspection, to determine the pelvic entrance to the ureter. The lower third of the kidney was lifted forward and drawn into the wound by means of a blunt retractor passed through the wound in the kidney, the posterior surface of the pelvis isolated from the adipose tissue and an incision three-quarters of an inch to an inch in length, made obliquely downward from about one-quarter of an inch from the hilum of the kidney. The wall of the pelvis was two millimeters thick. Neither fluid or urine escaped. The borders of the wound were grasped and held open with forceps. The inner surface of the pelvis was now seen to be normal in color and appearance. At the lower posterior portion of its inner wall was seen a small semicircular opening two lines in length from above downward, and three lines in transverse diameter. The posterior border was convex; the anterior border straight. A metal probe introduced through this opening passed easily down seven or eight inches into the bladder without encountering resistance, either from stricture or stone.

An olive pointed bougie, No. 5 French, which was passed down was tightly grasped by the ureter. By lifting up the pelvis the ureter could now be palpated. The wall was thin and seemed liable to rupture unless great care was exercised. The bougie was removed and on again lifting the pelvis and inspecting the entrance into the ureter it was seen that the ureter came off not from the most dependent portion of the dilated pelvis, but from its posterior half or wall. Thus the anterior straight border of the ureteral entrance formed a valve or fold, resembling the valve in a vein, which would close against the posterior wall of the opening when the pelvis was filled with urine or fluid to a slight or medium degree. A greater degree of dilatation would push away the posterior wall of the pelvis and thus reopen the entrance to the ureter. This accounted for the evacuation of urine containing pus after a period of occlusion of two days duration.

To do away with this valve-formation, the following operation was performed on the plan of the Heinecke–Mikulicz operation for stricture of the pylorus (Fig. 1.): An incision two and a half lines in length was made through the mucous membrane into the muscular wall or fold of the pelvis. The terminal points of the incision through the valve were now

approximated by a fine silk suture, thereby changing the former vertical incision into a horizontal line. The entrance into the ureter was by this means made wider and more nearly circular.

A No. 11 French bougie was now passed through the open-

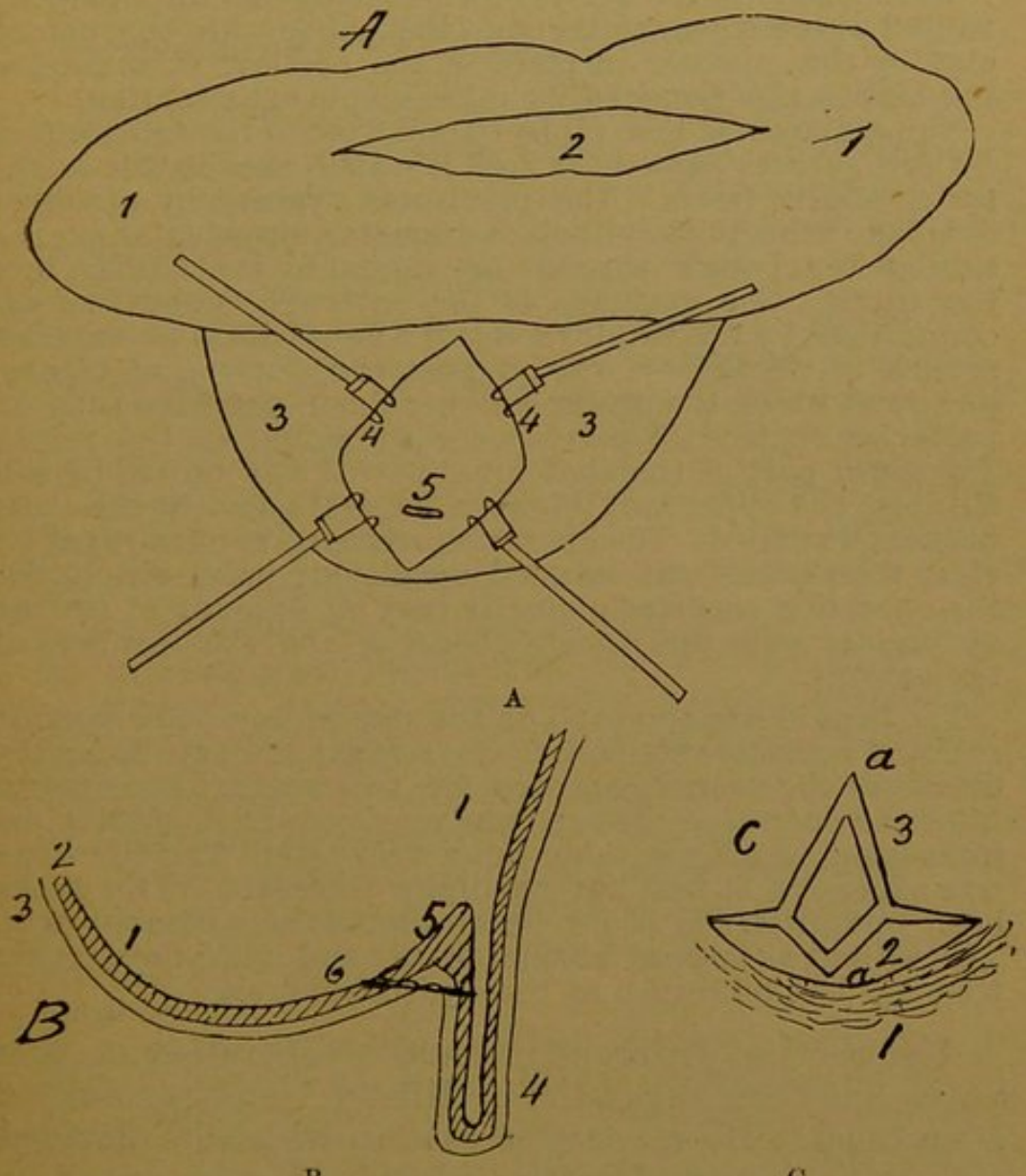

Fig. 1.—Case 1.—Illustrating Operation for Valve-Formation.

A.—Kidney and dilated pelvis 1, kidney; 2, opening on its convex surface after nephrotomy; 3, dilated pelvis, 4, with opening on its posterior surface from pelviotomy; 5, opening of the ureter into the pelvis, a small transverse crescent-shaped slit.

B.—Dilated pelvis and ureter, showing valve-formation. 1, pelvis; 2, mucous membrane; 3, muscular and external coat; 4, ureter; 5, valve; 6, line of incision dividing valve.

C.—Valve seen from the pelvis and divided to illustrate the plastic operation. 1, Inner wall of pelvis above the ureteral opening; 2, ureteral opening; 3, the divided valve; a and a' the corners of incision to be united by a suture.

ing in the pelvis down five inches into the ureter, and the upper end brought up through the pelvis and out of the wound in the kidney, to keep the opening into the ureter dilated during healing of the wound.

The incision in the pelvis was united by ten fine silk interrupted sutures passed through the pelvic wall but not including the mucosa. A piece of the cortical substance of the kidney was removed for microscopic examination.

The kidney was now replaced and fixed in normal position by two sutures passed through it which anchored it to the transversalis fascia. The pelvis was drained by a rubber drainage tube half an inch in diameter, inserted along the side of the bougie through the wound in the kidney, into the pelvis. The drainage of the external wound was accomplished by the employment of a gauze drain on anterior surface of the kidney, one on posterior surface of kidney, one down along the ureter and a rubber drainage tube on posterior surface of pelvis, over the wound in the pelvis. The lower part of the abdominal wound was united by silk sutures; the upper half left open for drainage and the usual dressings applied. The operation required two hours; at its close the patient was in good condition; pulse strong, 90; the operation was mechanically easy on account of the lax abdominal walls due to childbearing and the leanness of the patient.

The bougie was removed on the second day. The patient suffered considerable pain for four days; the pain along the course of the ureter persisted for two weeks. Four weeks after the operation the tube was removed and a smaller one introduced which was taken out a week later. The discharge was excessive at first but gradually decreased. Two weeks after operation she could lie on the left side without pain. The patient recovered without fistula and up to the present time has had no return of the hydronephrosis.

A somewhat different method of operating on this valve has been suggested by Küster,[13] but has not yet been tried. He reports a case in which he divided the valve longitudinally as I did. He proposed to freshen each flap and unite it by sutures to the freshened inner wall of the sac. Küster was not able to carry out this plan because he found in addition to the valve, a stricture in the ureter two centimeters below the pelvis. This condition caused him to resect the upper three centimeters of the ureter and unite the upper end of the distal portion to the pelvis by a plastic operation to which I shall refer later.

It appears to me that my method of operating upon the valve is simpler than Küster's; his requires at least two sutures, mine only one; the method, moreover, proved efficient in my case just reported.

STRICTURES IN THE UPPER PORTION OF THE URETER.

It has been seen, in the description of valve formation, that stricture often forms in the portion of the ureter located in the wall of the dilated pelvis; but this stricture is treated by the operation for valve formation—as described above. Independent strictures below the pelvis require different treatment. If such strictures are single and accessible they can be operated upon with a view to reëstablishing the continuity of the canal.

Outside of observations at the postmortem table, little attention has been called to the question of strictures of the ureter, because in the cases of hydro- and pyonephrosis operated upon, the kidney has been opened or extirpated, and no attention has been paid to the ureter. From the postmortem table we know that multiple strictures can be found as a result of chronic inflammation of the canal, as in the instance depicted by Hallé[14] mentioned by Tuffier, in which not less than three strictures were found, the canal between the strictures being dilated. It is doubtful if cases of this kind would be suitable for operation.

As a result of traumatism, limited strictures have been seen to be formed, as in the cases of Pye-Smith[15] and Sollier.[16] Pye-Smith reports the following case of stricture of the ureter and dilatation of the kidney, apparently of traumatic origin:

Pye-Smith's Case. Aug. 16, 1871. Male, 24; farrier. Never had stricture. Frequently been kicked in abdomen. Two years before kicked on left side "under the short ribs" and passed blood with urine several days. In bed only three days. August 7, diarrhea, swelling of abdomen, vomiting, pain in abdomen. No difficulty in passing water. Examination: Large tumor occupying left half of abdomen, smooth, deep fluctuation. Urine contained trace of albumen. Diag-

nosis: Probable vascular fibro-cystic growth. August 22. Tapped, and six and one-half pints of a reddish fluid containing pus and blood corpuscles flowed out. Tumor gradually filled and was again tapped. Patient improved and went home in October. He had return of the diarrhea and died October 14. Autopsy October 17: Renal tumor firmly adherent to surroundings. Right kidney swollen, early parenchymatous nephritis. Bladder normal, ureter dilated one and one-half inches, then contracted so as not to admit smallest probe. No impacted calculus; no sign of recent inflammation. Tumor; little renal tissue remained. Organ dilated into a series of communicating cysts containing yellow puriform fluid; scarcely any blood. No trace of calculus; no cheesy material. No abnormal tissue. In one of the cavities vegetable fibers, apple core and fragment of clove were found; therefore opening must have existed during life with communication with adherent bowel. Disease probably traumatic. Ureter probably injured. During two years following, canal was gradually contracting and forming stricture. Consequently, pelvis of kidney gradually expanded. Adhesion to colon determined diarrhea and suppuration from which patient died.

Sollier's case was one of traumatic stricture of the ureter in a man of 45 who, in 1870, sustained a traumatism by a kick from a horse in the left hypochondrium. The injury was followed by pain in the left side gradually increasing for nine years, when symptoms of nephritis appeared and the patient died from uremia. At the autopsy it was found that the left kidney had been transformed into a number of cavities the size of nuts. The calices, pelvis and upper portion of ureter were dilated. In the middle portion of the ureter was found a "cicatricial stenosis." Hypertrophy of the heart was found which had already been diagnosed during the patient's life.

Little is also known as to the frequency of strictures, but it may possibly be concluded from the frequency of permanent urinary fistulas following nephrotomy that they are not of infrequent occurrence. Tuffier states that fistulas followed nephrotomy in 45 per cent. of the cases collected, and we are forced to believe that the permanency of the fistula is caused by imperviousness of the ureter either from valve-formation or from stricture. How often this is caused by a stone lodged in the canal and how often by a stricture without stone we will not know until the ureter has been investigated by probing

from above in a large number of nephrotomies. From the statistics collected by Tuffier, which show that nephrotomy for calculous pyelitis was followed by 34 per cent of fistulas in 114 collected cases, and that nephrotomy for non-calculous pyelitis was followed by 57 per cent. of fistulas, we can not draw any certain conclusions as to the frequency of stricture in non-calculous pyelitis as compared with the frequency of stones in the ureter; but it is likely that strictures are common.

As to the frequency with which strictures occur in different parts of the ureter, we have a statement from Tuffier to the effect that in twenty-nine instances of congenital hydronephrosis, a stricture was found in the upper end of the ureter in fifteen cases, and at the lower end in fourteen. In Sollier's case of traumatic stricture, it was located in the middle portion of the ureter.

The question of gaining access to different portions of the ureter in order to overcome obstruction, has been solved as far as the removal of stones is concerned, by a number of operations already on record as follows: The vesical end of the ureter has been reached from the bladder by Emmet, Richmond and others; from the vagina, by Emmet and Cabot.

The pelvic portion of the ureter has been reached by extra-peritoneal lumbar incision, and the stones removed either by pushing them up into the pelvis, and pyelotomy in four cases (Tuffier), or by longitudinal incision of the ureter, in four cases (Tuffier), and in my case published in *Chicago Medical Recorder*.

From the middle portion of the ureter, stones have been removed in four cases (Tuffier,) by longitudinal ureterotomy by the prolonged lumbar incision. There is no difficulty in gaining access to the upper two-thirds or three-fourths of the ureter by the oblique lumbar incision. It is different with the lower third or fourth of the ureter, which is located deep down in the pelvis, and is even held by Le Dentu to be inaccessible. But Cabot has justly pointed out that

this portion of the ureter is also accessible without opening into the peritoneum by means of the sacral operation of Kraske, with removal of part of the sacrum, or temporary resection of the latter.

As far as strictures are concerned, there have as yet been made only two attempts at operating, namely, by Küster and myself, and a successful result in both cases was reached by a somewhat different method. Both were strictures in the upper part of the ureter close to the pelvis of the kidney.

Küster resorted to resection of the narrow portion of the ureter and united the distal portion to the pelvis of the kidney. His most remarkable and interesting case was as follows:

The patient was a boy 11 years of age. As a baby and until his fifth year he was sickly, but afterwards was healthy. In June, 1889, spontaneous enlargement of the abdomen was noticed accompanied by pain. This was diagnosed as left hydronephrosis. The urine was clear and sufficient in quantity, indicating open hydronephrosis. On June 23, Professor Braun made a lumbar nephrotomy which was followed by vesical anuria and the patient left the hospital with a fistula.

On May 25, 1891, the boy was seen by Küster. The fistula was permanent and little or no urine came from the bladder. The fistula in the lumbar region was dilated and digital exploration of the pelvis made. Catheterization of the ureter from the dilated pelvis could not be effected. The operation was followed by septic pyelitis.

July 14, 1891, it was decided to attempt to make the ureter patent, which was accomplished by Küster in the following manner: A lumbar extra-peritoneal incision was first made into the sac, but the ureter could not be found. The lower end of the sac, the dilated pelvis, was then incised, on the upper border of which was seen a layer of kidney substance the thickness of a thumb. The ureter could now be seen running several centimeters in or upon the posterior wall of the sac, and terminating in a slit in the pelvis. It was then intended to divide the pelvic wall of the ureter by pushing a probe-pointed knife down into the ureter from the pelvis to a point close to its exit from the sac to spread out the divided walls and unite them to the wall of the sac, thus making a funnel-shaped opening into the ureter. (See Fig. 2); but on attempting to introduce a fine probe into the ureter, a stricture was encountered two centimeters below the pelvis. The ureter was therefore

divided from above downward, as far as the stricture, through which a fine probe could now be passed.

As cure seemed impossible without removing the stricture, the ureter was transversely divided below the stricture and at the entrance to the sac. The ureter was now united to the pelvis by dividing the upper end of the ureter, unfolding the divided end, suturing it to the opening into the sac, and closing the remainder of the wound in the pelvis by catgut sutures.

The next day some bloody urine escaped into the bladder, but ordinarily the urine passed out through the lumbar fistula. From this time more and more urine passed into the bladder, until four months after the operation as much as 100 cubic centimeters passed in the twenty-four hours. The pelvis was now washed out for pyuria with one-fourth of 1 per cent. solution of nitrate of silver; this was followed by local and general improvement.

Nov. 6, 1891, the fistula was closed by curetting, dilating and closing the canal by step sutures. In the first twenty-four hours after the operation the patient passed 1,300 cubic centimeters of bloody urine from the bladder. He recovered, but with a lumbar hernia which had to be held in place with a bandage; the fistula remained closed. The boy is able to work and has excellent health. The urine contains a few pus corpuscles and a small quantity of albumen.

Plastic operation on the stricture without resection of the ureter was practiced by me in the following case:

Case 2.—Synopsis: Traumatic stricture of ureter close to entrance into pelvis of the kidney; intermittent pyonephrosis of four years' standing; increased frequency of attacks; nephrotomy; no stone found in sacculated kidney; ureteral entrance could neither be found through wound in kidney nor through incised pelvis; longitudinal ureterotomy revealed stricture at upper end of ureter; longitudinal division of stricture and plastic operation on ureter; recovery without fistula in six weeks.

W. B., a farmer 47 years of age came under my care Nov. 12, 1892. Father died as a result of accident. Mother dead; cause unknown; one brother died of phthisis. Patient's health good up to age of 13. The present trouble dates back thirty-four years, when as a boy of 13, in jumping from a horse to the ground, on account of miscalculation of distance he sustained a violent jerk, his feet not having touched the ground while his hands still retained hold of the hames. This injury was immediately followed by a sharp constant pain in the left side, which was mitigated by blistering, but he was obliged to remain in bed for a month. He suffered

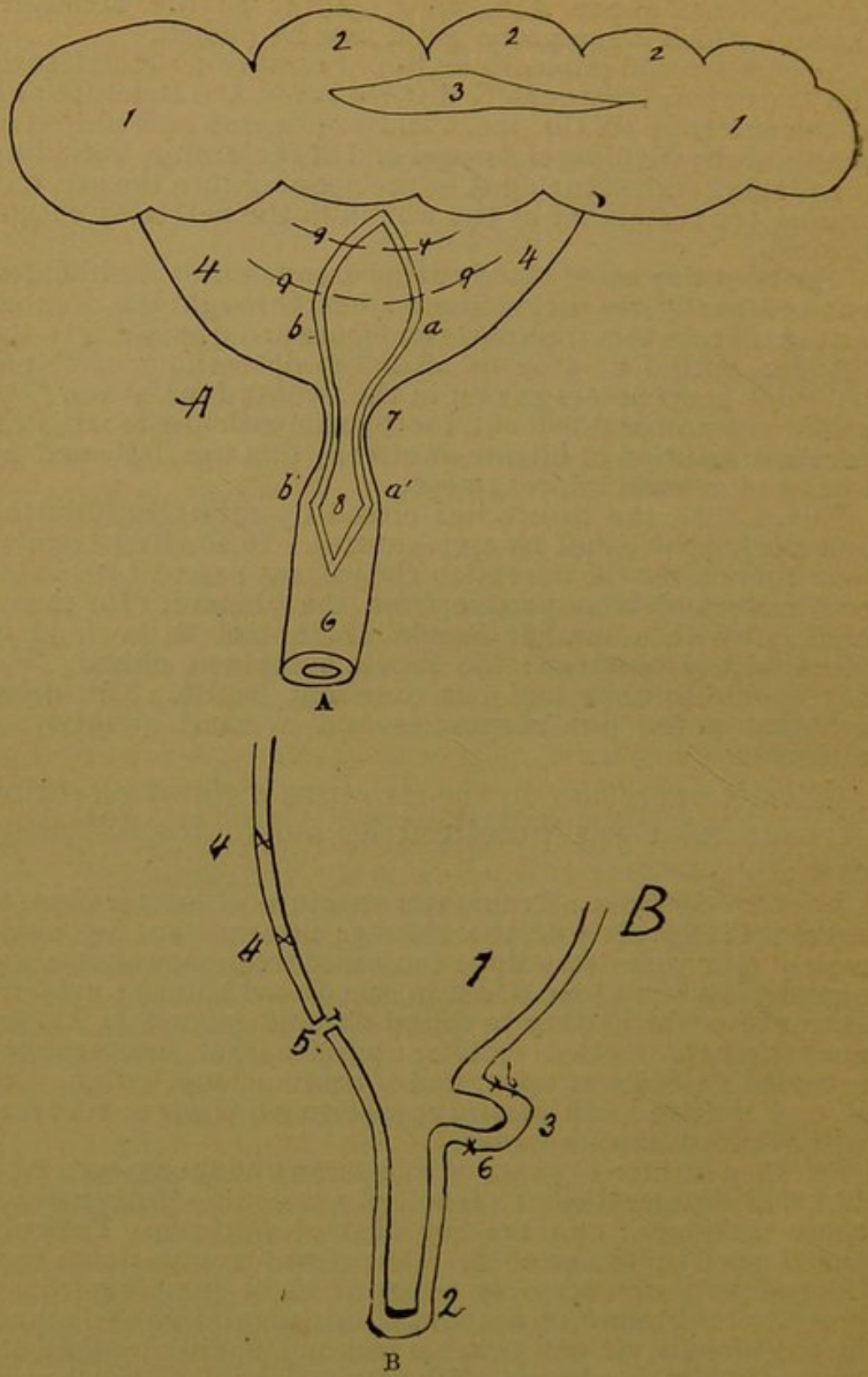

Fig. 2. CASE 2. ILLUSTRATING OPERATION FOR STRICTURE OF URETER

A.—Sacculated kidney, dilated pelvis, ureter with stricture at its upper end. 1, kidney; 2, sacs corresponding to dilated calices; 3, nephrotomy; 4, dilated pelvis; 5, opening in posterior surface of pelvis-

pelviotomy wound; 6, ureter below stricture; 7, stricture in upper end of ureter; 8, opening in ureter below stricture, extending up through the stricture into the pelvis; 9, sutures closing the upper half of the wound in the pelvis; a-a' and b-b', points of incision in ureter and pelvis to be united by sutures after folding the ureter upon itself at the place of stricture.

B.—Pelvis and ureter after union by sutures. 1, pelvis; 2, ureter; 3, fold of ureter at place of stricture; 4, sutures of wound in pelvis; 5, place of sutures between points a-a' and b-b'; 6, 6, additional sutures, as many as needed, to close borders of the fold formed by approximations of a to a' and b to b'.

no inconvenience with the exception of slight soreness in the region of the left kidney, increased by hard work, until ten years later when, after over-exertion, he had an attack of sharp pain in the left side; at this time he was in bed about a week. One year later he had a third attack which followed free indulgence in liquor. This attack was attended by pain, soreness and obstinate constipation. For the next ten or fifteen years he had four or five attacks a year, lasting from two to three days and always after indulgence in liquor. During the last six years the attacks have apparently been caused by over-exertion, with the exception of one attack a year ago for which no cause could be assigned. The last attack occurred Oct. 22, 1892. It was no more violent than previous attacks but was of longer duration.

Examination: Nov. 12, 1892. Patient well nourished. In left hypochondrium could be found a tumor immovable, hard and not nodular, which extended two inches below the ribs and to within three inches of the umbilicus. Temperature 101 degrees; urine contained a little pus. Diagnosis: Nephrolithiasis in the pelvis or infundibulum, or pyonephrosis from stone or obstruction in the ureter.

November 26. For the past week there has been more pus in the urine, indicating that the contents of the pyonephrosis has been evacuated through the ureter. Examination in narcosis showed that the tumor had disappeared. Operation at the German Hospital. The patient was anesthetized with ether and placed on the right side with a pillow under the loin. An incision was made from the angle of the twelfth rib six inches downward and forward, to within one inch above and anterior to the crest of the ilium. The muscles were strong. After division of the transversalis fascia and removal of a layer of adipose tissue, the adipose capsule of the kidney was exposed, which was so adherent to the surface of the kidney that when it was removed the fibrous capsule was stripped off also. The exposed surface of the kidney was not shining but was red and velvety. It was nodulated, each nodule forming a flat prominence, about two centimeters in diameter. Each prominence was compressible and resembled a dilated calyx. The kidney was of normal size, about nine centimeters long, four centimeters broad and three centimeters thick. In one place a

cyst the size of a pea with clear yellowish contents was seen. After excision of a piece of the kidney substance for microscopic examination, the dilated cavity of pelvis and calices was opened, and a jet of urine tinged with pus came out over the wound. The incision along the convex border of the kidney was enlarged by the Paquelin cautery.

Digital exploration revealed that the globular protuberances were dilated calices, which communicated with the pelvis, forming a common cavity. Some of the calices had openings large enough to admit the tip of the finger; others had openings which would admit a No. 10 urethral sound. No small abscesses could be seen on the surface of the kidney or in the incised substance. The protuberances now appeared to be collapsed, but a reasonable amount of kidney substance appeared to be present, especially in the lower part. The index finger was passed through the wound in the kidney down into the pelvis which was seven centimeters long and four centimeters deep. The wall was smooth and there was no stone or gravel. Neither by the palpating finger nor by the sound or probe could anything be discovered resembling an entrance to the ureter.

The kidney was therefore lifted up over the border of the twelfth rib, so that its anterior surface was directed upward and toward the median line, and its posterior surface backward and downward, thus exposing the posterior surface of the dilated ureteral half of the pelvis. A longitudinal incision, one inch long, was made in the pelvis and the edges held apart with retractors. The pelvic mucosa looked red and inflamed, but no ureteral entrance could be seen or felt.

The external wound was now prolonged downward for an inch and a half, to within an inch of the anterior superior spine of the ilium, to secure more operating space. The ureter could now be seen as a string or band, not dilated. Its upper end for half an inch was imbedded in cicatricial tissue. A longitudinal incision one centimeter long was made in the ureter half or three-quarters of an inch below the pelvic opening. A small metal probe introduced into the ureter through this incision passed downward freely for six inches. In passing it upward, however, a stricture was found just below the point of entrance of the ureter into the pelvis. The ureter was adherent to the surrounding adipose tissue at this point. The adhesions were separated by the handle of the scalpel and the stricture opened by a longitudinal incision on the probe as a guide. The opened stricture was seen to be one centimeter long. The remainder of the ureter was examined by a French bougie, which would pass down four or five inches, but would then be caught by the ureter. There was no stricture, but a diffuse atrophic narrowing of the ureter. A fine probe or a

small bougie could, however, be passed without difficulty into the bladder.

The patency of the ureter was reëstablished by uniting the wall of the ureter below the stricture to the pelvic wall, leaving the stricture as a loop as shown in Fig. 3. This procedure was similar to the Heinecke-Mikulicz operation upon the pylorus.

The upper part of the wound in the pelvis was closed by sutures. No bougie was left in the ureter. The wound was drained by a large tube passed into the wound in the kidney three inches upward to the upper corner of the kidney. A smaller drain was passed down to the pelvis and ureter. Gauze strips were packed around the anterior and posterior surfaces of the kidney, and three inches down along the ureter. The divided muscles of the abdominal wall were then united, with the exception of the lower three inches, which was packed with gauze. The external wound was united by sutures and dressed in the usual way. The operation occupied two hours. The patient was weak at its close, pulse 130; much pain along course of ureter. The next day he passed naturally water containing no blood. The wound was dressed daily, and the dressings were found to be saturated with five ounces of urine. The amount was determined by the difference in weight of the dressings on application and after removal. The patient steadily improved. The pain decreased, and the amount of urine in the dressings became progressively less. November 29 to 31 blood was found in the urine, which showed that the ureter was patent from the third day after the operation. December 19, half the tube was removed and a day later the remainder was taken out.

Jan. 5, 1893, the wound was closed. The patient was well and strong, suffered no pain and could walk around all day. No tumor could be made out. Pressure in renal region was painless. The urine at this time was normal in quantity, forty-six ounces, and upon microscopic examination of the sediment a few pus cells could be seen. No trace of albumen could be found in the urine. The patient thinks he has gained flesh and is much better than before the operation.

November 14 while the tumor was present and the temperature high, the quantity of urine for the twenty-four hours was eighteen ounces. After the disappearance of the tumor on November 17 and 18, the temperature fell to normal, and the amount of urine increased to thirty-four ounces on November 19, and to thirty-two ounces on November 20. On the evening of the day of operation the patient passed eighteen ounces of urine; on November 27, twenty-six ounces; on November 28, thirty-two ounces, and from this time on the amount of urine passed averaged thirty ounces a day.

Reunion of a transversely divided ureter first studied experimentally on dogs by Tuffier[17] and others, was not successful until the method of invaginating the upper into the lower portion was devised by Poggi[18] and Van Hook. It was first practiced successfully in man by Kelly who used Van Hook's method. Poggi found that by invaginating the upper end into the lower, union would take place. He divided both ureters in dogs, dilated the lower end with a forceps, invaginated the upper end into the lower and united with sutures. When the animals were killed fifteen days and three and one-half months

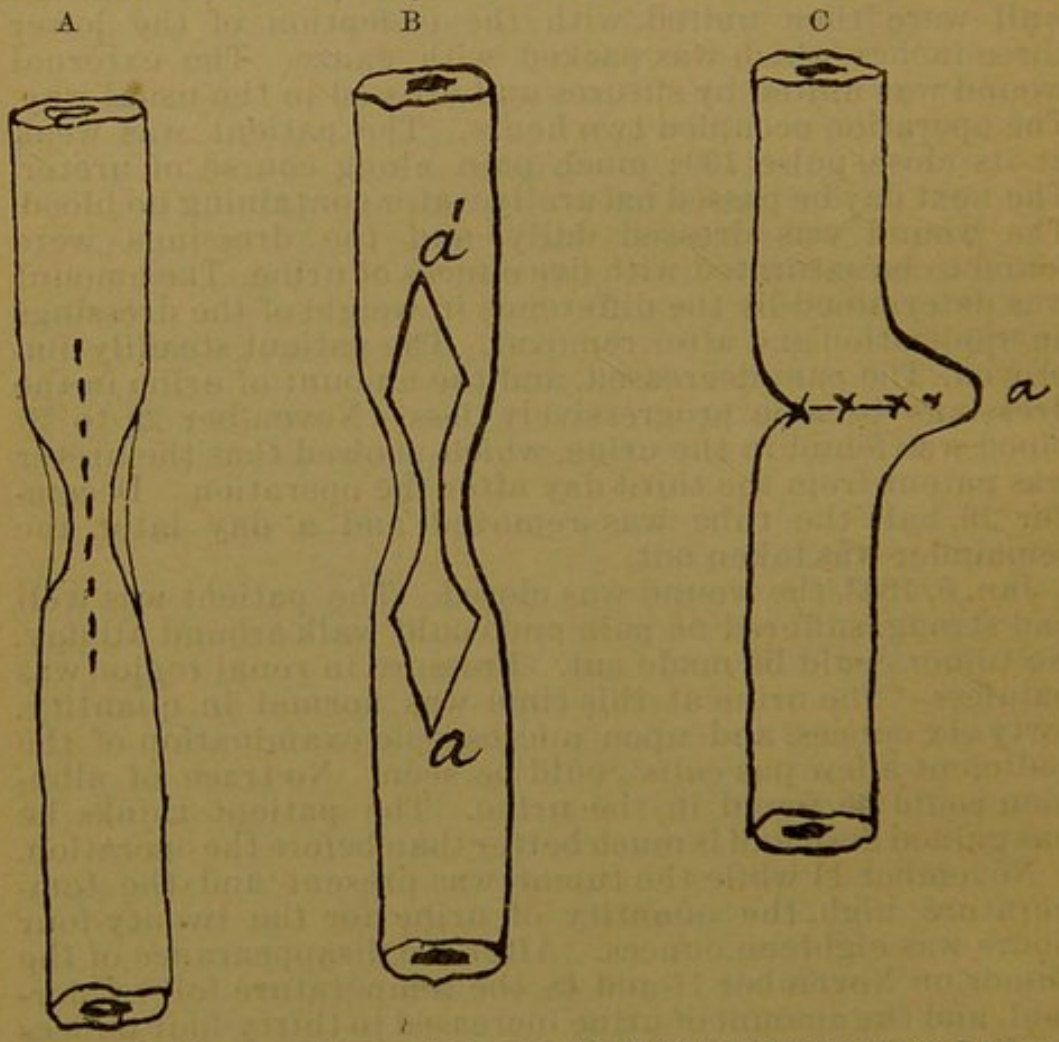

Fig. 3.—My Plan of Operating for Ureteral Stricture on Extraperitoneal Surface of Ureter.

A.—Ureter showing stricture and line of incision.
B.—Opening through the stricture extending into the proximal and distal portion of the ureter. The extreme ends of the incision a and a' to be united.
C.—Ureter after suturing; a, the bend at the site of the stricture.

later, respectively, he found union without stenosis at the point of operation.

Van Hook [19] in a preliminary contribution has also succeeded in reuniting the completely divided ureter by a different method which might be termed lateral implantation of the upper into the lower end after the closure of the end of the latter. In a very elaborate paper upon the surgery of the ureter [20] he gives the reasons why his method of lateral implantation is preferable to the simple invagination of Poggi. He believes that the ureter can sustain resection involving a considerable amount of tissue, since ureters measuring ten inches while in situ will easily measure twelve to fourteen inches when removed, and he further remarks that traction on the divided ends, is probably admissible to a very considerable extent.

The first reunion of a completely divided ureter by uretero-ureteral anastomosis, or uretero-ureterostomy in the human subject has recently been reported by Kelly.[21] Eight years ago his attention was called to the danger of cutting a ureter during operation for an abdominal tumor which had displaced it. He now reports:

Mulatto, 25 years of age, who had a large uterine myoma the uterus filled true and false pelvis and extended above umbilicus. Hysteromyomectomy was performed May 1, 1892. Ureter ligated and cut supposing it to be an engorged vein. Ureter was four times its normal size by reason of pressure from the tumor (hydro-ureter). On removal of upper ligature twenty cubic centimeters of clear urine escaped. Van Hook's plan tried of tying lower end of divided ureter, making slit in ureter below ligature and invaginating upper into lower end by means of silk traction sutures. Edges also sutured to intussuscepted portion by ten fine silk rectangular sutures passed through outer coat only. Gauze laid over anastomosed end, and brought out at lower angle of abdominal wound to insure drainage. No urinary odor about dressings. Passed water second day. Discharged in six weeks. After Kelly's successful operation Bloodgood made an experiment upon the dog. He performed anastomosis of right ureter after section. Kidney and ureter were removed two and one-half months later. The kidney was found normal, ureter not dilated, caliber and mucous membrane restored without stricture.

CONCLUSIONS.

1. Exploration of the ureter as to its permeability should be done from the renal wound by a long flexible silver probe (a uterine probe) or an elastic bougie, either olive pointed or not. If the bougie passes into the bladder, the examination is at an end. The size of bougie that will pass through a healthy ureter is from 9 to 12 French scale.

2. If the pelvic orifice of the ureter can not be found from the renal wound, it should be sought for by opening the pelvis, pyelotomy, or by incising the ureter, ureterotomy.

3. A longitudinal incision, half an inch to an inch long, in the posterior wall of the pelvis can be made while the kidney is lifted upward against the twelfth rib. This procedure is easy if the pelvis is dilated, but may be impossible if the pelvis is of normal size.

4. A stricture in the ureter, if not too extensive, can be treated by a plastic operation on the plan of the Heinecke-Mikulicz operation for stenosis of the pylorus; namely, longitudinal division of the stricture and transverse union of the longitudinal wound. (Fig. 3). This method of operating for ureteral stricture seems to me preferable to resection of the strictured part of the ureter (Küster's operation) for the following reason: It is a more economical operation and preferable when the elongation of the ureter is not sufficient to permit the two cut ends of the ureter, after excision of the stricture, not only to come in contact but even to permit of closure and invagination without stretching.

5. Resection of the upper end of the ureter and implantation of the distal end into the pelvis has been performed in an important and interesting case by Küster, and the result was a brilliant success. His method was to split and unfold the end of the ureter, and to implant it into the opened pelvis, to which it was united with sutures.

6. In a similar case of stricture in the upper end

of the ureter, especially if the ureter were not elongated or the kidney movable, I should prefer the plastic operation already described, as it is easier of technique, and as it proved successful in my case of traumatic stricture in the ureter below the pelvic orifice.

7. The ureter is accessible through an extra-peritoneal incision, a continuation of the oblique incision for lumbar nephrotomy, from the twelfth rib down along and one inch anterior to the ilium and along Poupart's ligament to about its middle. This incision gives access to the upper three-fourths of the ureter and down to within an inch and a half or two inches above the bladder.

8. The vesical and lower pelvic portions of the ureter may be reached, as Cabot of Boston, has pointed out, by means of the sacral operation, or Kraske's method modified by osteoplastic, temporary resection of the os sacrum. In woman, the vesical portion of the ureter is accessible through the vagina.

9. The vesical orifice of the ureter may be reached from within the bladder by supra-pubic cystotomy in man, or by dilatation of the urethra, or supra-pubic or vaginal cystotomy in woman.

In conclusion, I wish to cite literally the remarks made by Küster at the conclusion of his communication to the German Surgical Congress, because I fully agree with Küster and think that his remarks apply well to my suggestions made above. Küster says:

"Gentlemen: When I bring this case before you, it is not to present to you a curious operation or a curiosity in the line of operating. The value of the observation appears to me to lie in the fact that it shows a method by which it may be possible to avoid the mutilating and dangerous operation of nephrectomy in cases of pyonephrosis where and when we do not know that the other kidney is perfectly healthy."

I would add—and a means to save or avoid some instances of permanent fistulas following nephrotomy for pyo- or hydronephrosis.

NOTE:—When I commenced to investigate the question of stenosis of the ureter and its possible operative treatment, I did not know that Küster had commenced work in the same direction. The first publication of Küster's case which reached me was his report before the Twenty-first German Surgical Congress, June 8 to 11, 1892, which appeared in the *Centralblatt für Gesammte Medicin*, for Aug. 13, 1892.

My first operation for stenosis was performed at a clinic and described in a clinical lecture given on May 31, 1892, at the Emergency Hospital, Chicago, for the Chicago Policlinic.

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