

## INJURY TO URETERS INCLUDING ACCIDENTAL LIGATION DURING PELVIC OPERATIONS

BY QUITMAN U. NEWELL, M.D., F.A.C.S., ST. LOUIS, MISSOURI

*(From The Department of Obstetrics and Gynecology, Washington University  
Medical School and Barnes Hospital.)*

I WAS prompted to make a study of this important subject, because recently I operated upon a patient who had carcinoma of the fundus uteri. I performed an abdominal complete hysterectomy and thirty-six hours after operation the patient died from an acute dilatation of the heart. The autopsy showed, in addition to the heart condition, I had ligated the left ureter about 5 cm. from the bladder. The right ureter was in normal condition, although the patient did not pass any urine following the operation. In this presentation I wish to report the history of the patient in question, also a brief report of other cases in which the ureters were either ligated or injured during pelvic operations in the gynecological service of Barnes Hospital, from January 1, 1915, to July 1, 1932.

From the knowledge gained by an analysis of these cases, together with a careful study of the cases correlated in the literature, I shall state my impression how this important problem may be handled.

From January 1, 1915, to July 1, 1932, in the gynecological service of Barnes Hospital, 1,784 hysterectomies were performed for various reasons. Of this number 519 were abdominal complete hysterectomies, 63 were vaginal complete hysterectomies and 1,202 were abdominal supra-vaginal hysterectomies. During the course of these operations, one or both ureters were knowingly injured by clamping, cutting, tying or interfering with the circulation in some manner in eight cases. This is an unusually small number of injuries as compared to the number of hysterectomies performed when one considers the relation the ureters bear to the pelvic organs, also that the pelvic organs are sometimes so distorted by new growths that the ureters are pushed or pulled from their normal bed and are in the field of operation. It is not surprising that the ureters are not injured more often than they are during gynecological operations. In fact, I am sure one ureter is occasionally ligated and the condition is unrecognized and the kidney on the corresponding side dies before the ligature around the ureter is absorbed.

During the postoperative course there are no definite symptoms to cause one to determine that only one kidney is functioning. Of course, if both ureters are ligated, the patient has an anuria and by cystoscopic examination the diagnosis is easily established.

Practically all gynecologists and surgeons of note regard operative injury of the ureter as exceptional and nearly all are in accord in believing unilateral injury fairly common and bilateral injury exceedingly rare. They describe ureteral injury as the most common accident in pelvic work.

The eight cases of ureteral injury here reported occurred in the gynecological service of Barnes Hospital.

#### CASE REPORTS

CASE I.—Mrs. A. P. R., age sixty-seven years, was admitted to the Gynecological Service December 26, 1929, for vaginal bleeding. Complete physical examination revealed the following positive findings: A very large obese patient weighing 198 pounds, chronic myocarditis, hypertension with blood pressure—systolic 176, diastolic 98—carcinoma of fundus uteri. A medical consultation was obtained to determine operative risk, which was said to be fair, so an abdominal operation was considered the treatment of choice. Before performing the abdominal operation a diagnostic dilatation and curettage was performed and the laboratory reported adeno-carcinoma of the fundus uteri.

On January 4, 1930, an abdominal operation was performed and immediately on opening the abdomen it was found that the patient had two uteri and two cervixes. This was not made out before the operation, as the cervix on the right side was not seen in speculum examination. However, a lot of scar tissue was made out extending the entire length of the anterior vaginal wall. This was thought to be the result of extensive vaginal lacerations during childbirth. A small mass was palpable in the right side of the pelvis in apposition to a normal uterus which was felt in a forward position. The mass was thought to be a prolapsed adnexa or some parametrial infiltration. There was a band of peritoneum extending from the sigmoid forward and attached to the central part of the top of the bladder. It was ligated and severed. The two uteri were fully developed; the one on the left side was slightly larger than the one on the right. They were attached to each other at about the internal os and continued into the vagina. Attached to each fundus was one tube and one ovary. Complete hysterectomies with removal of both tubes and both ovaries were performed in the usual manner. All the clamped pedicles were ligated; the tubo-ovarian and upper broad ligament pedicles were ligated before the uteri were removed. There was insufficient bladder peritoneum to close over the ligated pedicles, so some raw surfaces were left exposed. At no time during the operation were the ureters visible. The appendix was not removed. The abdomen was closed; routine closure. Retention catheter was placed in position. The operation was fairly difficult due to excessive fat in the pelvis.

*Postoperative Course.*—The patient returned to the ward in fair condition and immediately was given 1,500 c.c. normal saline solution subcutaneously and 500 c.c. 10 per cent glucose solution intravenously. Six hours after operation the patient was fully conscious and had no unusual complaint. The blood pressure was 152 over 98. No urine had passed per catheter. She passed a fairly comfortable night and the next morning seemed to be in good condition, with no unusual abdominal pain, no distention, no pain over either kidney region. No urine had been obtained per catheter since the operation twenty hours previous. It was then realized that the patient had an anuria and more saline and glucose

were given, also forced fluids by mouth and other treatment to bring on diuresis were instituted. Thirty hours after operation the patient began showing signs of uremia with evidence of myocardial failure. No urine had been passed up to this time. Thirty-six hours after operation the patient expired. An autopsy was performed and the cause of death was given as acute dilatation of the heart, chronic myocarditis, chronic nephritis and arteriosclerosis. During the course of the autopsy it was found that the left ureter was ligated about 5 c. m. from the bladder. The right ureter was in good condition. There was no marked difference in either of the kidneys. They did not show evidence of hydronephrosis, etc., as one would expect in a case of obstructed ureters. The anuria, no doubt, was the result of constitutional causes and not the result of ligation of the left ureter.

CASE 2.—Mrs. A. H., aged thirty-five years, on May 11, 1916, was operated upon for myoma of the uterus. A supravaginal hysterectomy and double salpingo-oöphorectomy were performed. The postoperative course was stormy and on the fourth postoperative day the patient showed signs of uremia. No urine had been obtained since operation; cystoscopic examination revealed both ureters blocked a short distance from the bladder. It was then decided to open the abdomen and attempt to deligate the ligated ureters.

A description of the operation is as follows: The abdomen was opened through an old incision. Much fibrin and clear serous fluid were present. The right kidney was enlarged and the ureter was distended to about the size of the small finger, and about 2 cm. below the pelvic brim a ligature was found around it. A second ligature was around the ureter at about the position of the internal os of the uterus. The ligatures were cut and the ureter freed. The left ureter apparently was not definitely ligated but was edematous and enlarged and over it was drawn the stump of the cut adnexa and ligaments of the uterus. These sutures were cut and the ureter freed. The abdomen was closed hurriedly with drainage. The patient returned to the ward in poor condition. She died from general peritonitis thirteen days after the operation. There is no history of any passage of urine since operation.

CASE 3.—Mrs. B. F., aged sixty-six years, on September 22, 1919, was operated upon for cancer of the cervix uteri. A complete vaginal hysterectomy and double salpingo-oöphorectomy were performed. The postoperative course was stormy and thirteen days after operation urine dribbled from the vagina. Cystoscopic examination revealed a left uretero-vaginal fistula. She was discharged from the hospital after thirty days with uretero-vaginal fistula present. She re-entered the hospital later and reported that the dribbling of urine from the vagina ceased after eight months. Cystoscopic examination at that time revealed no function of the left ureter with a dead left kidney. The right kidney was in good condition. The patient also had diabetes mellitus.

CASE 4.—Mrs. B. S., aged forty-two years, on April 16, 1920, was operated upon for retrodisplacement of the uterus, chronic cervicitis, cystoma of the right ovary. A complete abdominal hysterectomy and double salpingo-oöphorectomy were performed. The postoperative course was stormy and twelve days after operation a recto-vaginal fistula, also a uretero-vaginal fistula developed. She was discharged from the hospital twenty-eight days after operation with uretero-vaginal fistula present. The recto-vaginal fistula closed spontaneously. She re-entered the hospital two months later complaining of dribbling of urine from the vagina. Cystoscopic examination revealed no function from the right ureter into the bladder; the

catheter met obstruction about 3 cm. from the bladder. The left catheter passed easily and function was normal. The right kidney was large and filled with pus, so a right nephrectomy was performed. The postoperative course was uneventful and the patient was discharged from hospital twenty days after operation.

CASE 5.—Mrs. M. W., aged forty-four years, on June 8, 1920, was operated upon for myoma of uterus (large). A complete abdominal hysterectomy and double salpingo-oöphorectomy were performed. The postoperative course was stormy and four days after operation a uretero-vaginal fistula developed which persisted throughout her stay in the hospital. She was discharged from the hospital forty days after operation with uretero-vaginal fistula present. Cystoscopic examination made before discharge from the hospital revealed the bladder normal; right catheter passed easily to kidney; left catheter met obstruction 3 cm. from the bladder. The patient was advised to go home and come back later for treatment for uretero-vaginal fistula. She never returned and nothing further was heard from her.

CASE 6.—Mrs. W. M., aged thirty-nine years, on July 14, 1921, was operated upon for early carcinoma of cervix uteri. A complete hysterectomy and double salpingo-oöphorectomy were performed. During the operation both ureters were isolated and apparently not injured. The postoperative course was moderately stormy and eight days after operation a uretero-vaginal fistula developed. She was discharged from the hospital thirty-four days after operation with uretero-vaginal fistula present. She re-entered the hospital four months later and cystoscopic examination revealed a normal bladder; left catheter passed easily to the kidney; right catheter met obstruction 2.5 cm. from bladder; the kidney apparently was in good condition. She was discharged from the hospital to return two months later for operation for the uretero-vaginal fistula. She re-entered the hospital at the appointed time and the operation was carried out by making a right inguinal incision. The ureter was isolated and found to be greatly distended and led from the kidney to the upper part of the vagina. It was freed and transplanted into the bladder without tension. Three days after operation urine flowed from the abdominal incision and it was plainly seen that an abdomino-ureteral fistula had formed. After thirty days urine ceased to flow from the wound and it healed nicely. The patient was discharged from the hospital without doing a cystoscopic examination. January 1, 1931, nine and one-half years after the first operation, cystoscopic examination and X-ray plate showed a dead right kidney. Function of the left kidney was normal.

CASE 7.—Mrs. A. C., aged twenty-nine years, on September 4, 1928, was operated upon for myoma of the uterus. A supra-vaginal hysterectomy and double salpingo-oöphorectomy were performed. During the course of the operation the right ureter was severed near the bladder. It was immediately transplanted into the bladder without tension. The post-operative course was stormy and the patient complained of great pain in the right kidney region. No fistula developed. A few days after operation it was discovered that the patient had a right pyonephrosis and the transplanted ureter was not functioning. Thirty days after operation a second operation was performed and the right kidney was removed. The postoperative course was uneventful and the patient was discharged from the hospital nineteen days later in excellent condition.

CASE 8.—Mrs. D. C., aged forty-nine years, on August 13, 1931, was operated upon for chronic subinvolution of the uterus and chronic salpingitis. A complete abdominal hysterectomy and double salpingo-oöphorectomy were performed. The

postoperative course was markedly febrile; she was discharged from the hospital August 31, 1931, eighteen days after operation with some temperature present. On the seventeenth postoperative day a dribbling of urine was noticed coming from the vagina; after being discharged from the hospital this condition persisted, necessitating the patient's wearing a vulval pad. On October 16, two months after the operation, she began having severe pain in the lower abdomen, chills and temperature. She urinated often, passing small quantities. On October 22, 1931, she returned to Barnes Hospital, complaining of urine passing from the vagina. She was admitted to the Genito-Urinary Service and a diagnosis was made of uretero-vaginal fistula. Cystoscopic examination revealed a good functioning left kidney and ureter. The right catheter met an obstruction about 2 cm. from the bladder. On November 11, 1931, a right nephrectomy was performed. The kidney was enlarged twice its normal size and the pathological report showed an acute hydronephrosis with chronic pyogenic nephritis. The postoperative course was uneventful and the patient was discharged from the hospital November 27, 1931, in excellent condition.

Much of the literature dealing with ureteral injury and ligation is in the form of case reports. However, in the past few years the subject is receiving more attention, a few investigators have attempted to correlate the cases and some few large series have been reported. P. Brooke Bland has collected 441 cases; 361 were unilateral and eighty-one bilateral injuries or ligations. Of these Leon Herman reported twenty-four cases, all bilateral. Barney has reported sixty-two cases including thirty-two presented by Sampson in 1902, and Oeconomos has collected a series of 159 cases. The additional 196 cases were from several investigators in various parts of the country. Forty-two surgeons reported 125 cases ranging from one to eight. H. Kayser reported the cases in the clinic of Professor Franz, Charitè Hospital, Berlin, for a five year period. He listed twenty-nine instances of injury or ligation of the ureters and quotes Wertheim as having had forty-nine injuries among 500 hysterectomies for uterine carcinoma. T. S. Burr refers to 630 hysterectomies for cancer of the uterus in which a single ureter was injured thirteen times and both ureters once.

From a study of the cases reported, it is evident the greatest percentage of ureteral injuries followed radical hysterectomies for uterine carcinoma and the most common sequelæ were uretero-vaginal fistulæ.

Most of the text-books in gynecology outline the treatment for ureteral fistulæ following injury in which the ureter may be cut or crushed with a clamp, or the blood supply interfered with to such an extent that necrosis and sloughing follow. Very little is said about the treatment when one or both ureters are ligated.

From an analytical study of the eight cases reported in this presentation, together with a careful consideration of the several hundred cases reported in the literature by numerous excellent investigators, I simply offer my opinion as to what method of treatment seems to be best in handling this most perplexing problem.

In presenting the treatment phase of ureteral injury, I should like to sound the warning note of prophylaxis. I am quite sure many cases of ureteral injury can be avoided if modern technic is followed when performing an extensive pelvic operation. I am sure every gynecologist is conscious of the fact that the ureters may be injured during the course of almost any pelvic operation. The radical abdominal hysterectomy operation for uterine carcinoma tops the list of ureteral injuries, with vaginal hysterectomy next, then abdominal complete hysterectomy for myoma, and so on. Therefore, when performing any of these operations, or any other extensive pelvic operation, I would suggest, as a prophylactic measure, that the ureters be isolated according to the technic familiar to all of us. As an additional safeguard, catheters should be inserted into the ureters before starting the operation as suggested by Kelley many years ago.

*At the time of operation*, if it is discovered that one or both ureters have been ligated, the proper treatment is to deligate as soon as the condition is recognized. Ordinarily, the ligature around the ureter is not sufficient to cause permanent injury. If one or both ureters have been severed, a uretero-ureteral anastomosis should be performed by one of the various methods that have been described. Transplanting of the ureter into the bladder is only fairly satisfactory, as the contraction of the wall of the bladder constricts the ureter, eventually causing a pyonephrosis and death of the kidney. Some few cases of ureteral transplant into the bladder successfully have been reported. Of course, if the patient is in bad shape and only one ureter is damaged, a ligation may be done, which will cause death of the kidney. This is a sacrificial operation and should be considered only as a last resort. The uretero-ureteral anastomosis operation is the one of choice.

Peterson in an analysis of seventy-two cases of uretero-ureteral anastomosis has shown it is usually successful, claiming that the different methods are equally successful in the hands of different operators. He shows that in twenty-nine cases of the end-to-end operation, leakage occurred in nine. In twenty-five end-in-end operations leakage occurred in five, and in fifteen end-in-side operations leakage occurred in only two. As to final results one must consider in all these operations that in a small percentage of the cases there will be contraction of the scar at the site of the ureteral repair with complete occlusion of the ureter and death of the kidney on that side, but as a whole this is negligible.

A. H. Curtis has described a simple and practical method of end-to-end ureteral anastomosis. A ureteral catheter is passed into the cut ureter and the lower end brought out through the bladder and urethra, the two ends of the ureter are sutured together, taking care not to penetrate the lumen of the ureter with the sutures. A second ureteral

catheter is placed into the ureter above the point of the anastomosis through a small slit and passed up to the pelvis of the kidney so as to divert the passage of the urine away from the regular course. This catheter is brought out through a stab wound in the flank. After ten days both catheters are removed. Warner S. Bump and Stanley M. Crowe of the gynecological department of Northwestern University Medical School worked out the technic on dogs and the operation was successfully performed six times. In not a single case did a urinary tract infection take place and necropsy of the animals showed perfect function of ureter and kidney. Curtis has performed the operation once upon a woman with complete success. He has made no other attempts.

Such a technic is both practical and simple. Heretofore, many failures of end-to-end anastomosis have been due largely to infection following the leakage of urine around the end-to-end contact, causing peritonitis or adhesions about the ureter, later resulting in contraction of the ureter at the site of the anastomosis, hydronephrosis and death of the kidney. With the use of the ureteral catheter as a splint, the operation need not necessarily be water-tight. Coaptation of the two ends over the catheter with enough of fine sutures to make them fast is all that is necessary, as the catheter which has been passed up to the pelvis of the kidney and brought out through the flank reroutes the urine and thus allows epithelization of the ends of the severed ureter to take place.

If it is discovered that the ureter has been crushed by a clamp, the injury should be carefully examined and, if it is determined to be severe, end-to-end anastomosis should be done in order to prevent a uretero-vaginal or uretero-abdominal fistula. If the injury is not severe, circulation may be restored and healing take place without fistulae formation. Furniss reports two cases in which clamps were on the ureters from seven to eight minutes and in both instances fistulae developed, one in eight days, the other after twenty days. Crossen in a personal communication informed me he had placed a clamp on a ureter for several minutes and a ureteral fistula followed. Kayser mentions seven cases in which only the sheath of the ureter was injured and of these, two developed fistulae. Harrington crushed the ureter in dogs with a forceps from one to thirty minutes and noted no fistulae formation, but at the point of crushing scar tissue formed with constriction and dilatation of the ureter, thus leading to hydronephrosis and degeneration of the kidney.

*Several days after operation*, if both ureters have been ligated and no discovered until two to four days after operation, the condition is a serious one. The patient ordinarily has a complete anuria with uremia and something very urgent must be done. Two things are to be considered: (1) Deligation of the ligated ureters; (2) nephrostomy. Not enough cases have been handled by either method for one to draw any

definite conclusion. Of course, deligation is the operation of choice, if the patient's condition is such she can endure a serious operation. It must be remembered that uremia is present and ordinarily the patient is a poor operative risk. Searching for the ligated ureters is not easy, also after locating them, the question arises whether the patient can stand a uretero-ureteral anastomosis or whatever sort of operation one deems fit and proper. On the other hand, is nephrostomy the choice? Certainly, it seems to be the best operation when the patient's condition is grave, as it can be quickly carried out and relieve the condition. When the patient's general condition improves, if necessary, then deligation may be attempted. As regards double nephrostomy, Caulk has made the following statement:

"In double ligation, your only chance is to do a double nephrostomy as quickly as you can. The ideal method would be immediate deligation, but this is attended with considerable difficulty, as searching for a tie on a ureter deep in the pelvic cavity several days after an extensive resection is difficult. Even in animals it is difficult to untie without cutting the ureter. In several instances in which I have known of its being done clinically, the ureter has been incised with a resulting fistula or a uretero-vesical anastomosis performed at the time. Caulk and Fischer's experimental work on ureteral ligation on the dog is very interesting and deserves considerable thought. They have shown that No. 2 plain catgut when tied around the ureter was never absorbed before the end of three weeks, and that 20-day and 40-day chromic catgut, which is the most commonly used in pelvic work, is not absorbed for a much longer time, so it is useless to wait for the absorption of the catgut."

I cannot fully agree with Caulk and Fischer as to the length of time catgut lasts in the human pelvis. In the dog the absorption of the catgut may be very slow and extend over a period of many days, but in the human I am quite sure catgut is more readily absorbed and the time of absorption is in proportion to the kind of catgut used. My opinion is based on the fact that I have had occasion to open a few abdomens seven to twelve days following pelvic operations and have in some instances found the No. 2, 20-day chromic catgut practically absorbed.

Caulk's conclusions were no doubt drawn from this piece of experimental work on the dogs and the successful management of a case of double ureteral ligation in a patient who came under his care. The patient on whom both ureters had been ligated during the course of an abdominal complete hysterectomy for fibroids had passed no urine for eight days. It was recognized early that the ureters had been tied but the surgeon awaited developments, thinking that possibly the catgut would loosen and the ureters would open spontaneously. At the end of the eighth day the patient became uremic. A double nephrostomy was performed and during the next twelve hours 3,000 c.c. of urine were secreted. Drainage through the nephrostomy tubes was free until the fifty-eighth day, when the patient voided. Ten days later the urine was



passed entirely by the bladder and the wound had healed. In a personal communication, Dr. Caulk informed me the patient is now living and enjoying good health.

This brings up the question of how long a patient can live with complete anuria. Caulk's patient had anuria for eight days. Myers reports nineteen cases of complete anuria lasting from twenty to twenty-nine days. Farlow reports a case lasting thirty-five days, Parr forty-two days and Baily fifty days. However, these cases did not follow double ureteral ligation.

The arguments for bilateral nephrostomy as advocated by Caulk are most convincing, but when one searches the literature carefully he finds that Caulk's cases of double nephrostomy are the only successful cases reported. E. S. Judd reports a case of double nephrostomy in a patient who had an anuria for three days and seven days after the operation passed urine from the bladder. This case does not seem to be one of double ureteral ligation but rather one of urinary suppression.

Herman cites twenty-four cases of bilateral occlusion, fifteen of which were due to encircling ligatures. The other nine were from various causes. Of these twenty-four cases, one patient died without operation and the remaining twenty-three were operated upon. Seven died immediately following operation, a primary mortality of 30.4 per cent. The primary mortality among the ten nephrostomy cases was 50 per cent. Among the eight cases of deligation it was 25 per cent. All of the patients, six in number, who recovered from the operation of deligation were cured permanently.

In dealing with bilateral ureteral ligations the following conclusions are drawn:

1. The method of treatment selected for the relief of bilateral ureteral obstruction will depend upon the cause of the obstruction, upon the individual choice of the operator, upon the time that has elapsed since the receipt of the injury, also upon certain factors that were present at the time of the primary pelvic operation.

2. Delay in operative treatment is dangerous and will eventually result in death.

3. Deligation is the treatment of choice provided the patient's general condition can stand the strain of a serious operation, and if not, nephrostomy with drainage.

*Ureteral Fistulae.*—Ureteral fistulae, which are the most common sequelae of ureteral injury, usually occur from three to twelve days after operation and may be either vaginal or abdominal, the former more common than the latter. Ureteral fistulae occur in three ways: (a) when the ureter is severed, either partially or completely, or (b) the blood supply so injured by clamping, and so forth, that necrosis occurs, or (c) the

result of stripping the ureter of the blood supply so necrosis follows. A cystoscopic examination with ureteral catheterization should be performed in order to locate which ureter is not functioning into the bladder, also determine the condition of the other kidney. It is probably best to wait from one to six months after the primary operation before attempting operation for the cure of the ureteral fistula, as sometimes from the scar tissue contraction the fistula is cured spontaneously. What usually happens in such cases is that a hydronephrosis develops with infection and death of the kidney. It is true, this is sacrificing a good kidney, but if operation is attempted too early after the formation of the fistula, the patient is not in a suitable condition to stand the operation, whereas, after one to six months much better results would be obtained.

In selecting the type of operation for the cure of this condition, one must consider uretero-ureteral anastomosis, ureteral vesical anastomosis and ureteral transplant into skin, bowels, and so on, also ligation of ureter and nephrectomy. The aim of any operation should be to preserve the kidney and not destroy it unless nothing else can be done. Several vaginal operations have been recommended for uretero-vaginal fistula correction, colpocleisis, uretero-vesical anastomosis, but none of them seems to be satisfactory. It seems to me that the best plan to follow in dealing with uretero-vaginal and uretero-abdominal fistulae is to put the plain facts of the condition to the patient, state the chances of a failure if anastomosis is attempted and that it might be necessary to undergo a second operation for removal of the kidney on the affected side, after the other kidney had been pronounced normal, and, if the patient desires, a nephrectomy may be performed outright and thus avoid the possibility of two serious operations.

In considering the treatment of ureteral injury whether from ligation, clamp, or from any other source, the subject deserves serious consideration. So rarely does the gynecologist meet with these cases that he must rest content with a knowledge of the experience of others and bide that time when this knowledge will aid in the difficult solution of the problem presented by the ureteral injury occurring in his own practice.

#### CONCLUSIONS

1. From the large number of cases of ureteral injury reported, it is evident that the accident is a surgical complication far more common than one would suspect.

2. No doubt some unilateral ligations occur during the course of pelvis operation and are unrecognized, the ultimate result being death of the kidney on the corresponding side.

3. The accident is liable to follow almost any pelvic operation. By far the greatest number that have been reported followed radical abdominal and vaginal hysterectomies.

4. In most cases the injury is unilateral. In a certain number of cases both sides are affected.

5. The most common sequelæ of ureteral injury are vaginal and abdominal fistulæ.

6. As a surgical complication, ureteral injury is responsible for a certain number of deaths.

7. Prophylaxis is the best form of treatment.

8. Should a ligature or clamp be placed on a ureter and serious damage inflicted, immediate repair should be done in the form of uretero-ureteral or uretero-vesical anastomosis.

9. In case of bilateral occlusion discovered a few days after operation, one should deligate if the patient's condition can stand the strain of a serious operation. If not, a nephrostomy with drainage should be performed.

10. Nephrostomy should be done in all cases of double ureteral obstruction when the patient's condition is grave. It is a life saving operation.

11. Vaginal correction of uretero-vaginal fistula is unsatisfactory. Abdominal operation for correction is the choice in the form of ureteral anastomosis or nephrectomy.

12. Any operation designed to correct a damaged ureter should be for the preservation of the normal ureteral and kidney function.

411 WALL BLDG.

#### BIBLIOGRAPHY

1. BAILY, T. L. W.: *Charlotte Med. Jour.*, 1895, 7:537-540.
2. BARNEY, J. D.: *Trans. Amer. Assn. G.-U. Surg.*, 1912, 7:201-228.
3. BARNEY, J. D.: *Ann. Surg.*, 1910, 51:362-381.
4. BARNEY, J. D.: *S., G. and O.*, 1912, 15:290-295.
5. BLAND, P. B.: *Atlantic M. J.*, March, 1924, 27:341-356.
6. BUMP, W. S., and CROWE, S. M.: *S., G. and O.*, September, 1929, 49:346-351.
7. BURR, T. S.: *Physicians and Surgeons*, Detroit, Mich., 1902.
8. CAULK, J. R., and FISCHER, R. F.: *S., G. and O.*, 1920, 343-349.
9. CAULK, J. R., and FISCHER, R. F.: *Trans. Amer. Assn. G.-U. Surg.*, 1915, 10:72-81.
10. CROSSEN, H. S.: Personal communication.
11. CURTIS, A. H.: *S., G. and O.*, March, 1929, No. 3, 48:320-322.
12. FARLOW, J. W.: *Boston Med. and Surg. Jour.*, 1889, 120:330-334.
13. FURNISS, H. D.: *S., G. and O.*, September, 1918, 27:339-342.
14. HARRINGTON, S. W.: *Arch. Surg.*, May, 1921, 2:547-592.
15. HERMAN, LEON.: *Jour. Urol.*, February, 1923, 9:151-179.
16. JUDD, E. S.: *Journal Lancet*, 1912, 31:543-547.
17. KAYSER, H.: *Med. Press and Circ.*, n. s., 1915, 99-106.
18. KEELY, H. A.: *Jour. A. M. A.*, 1900, 24:860-864.
19. MYERS, W. A.: *Jour. A. M. A.*, 1925, No. 1, 85:11-13.
20. OECONOMOS, SP. N.: *Gaz. d'hôp.*, Paris, 1921, 94:197-204.
21. PARR, B.: *London Medical Dictionary*, 1819, 1:836.

22. PETERSON, R.: S., G. and O., August, 1920, 31:132-142.  
23. SAMPSON, J. A.: Amer. Medicine, 1902, 4:693-700.

## DISCUSSION

DR. B. Z. CASHMAN, PITTSBURGH, PA.—It is easier to keep out of trouble than to get out of trouble and nowhere does this apply more than in ureteral injuries, so I want to sanction what Dr. Newell said about prophylaxis. In extensive pelvic dissections, in case of intraligamentous tumor and particularly bilateral intraligamentous tumors, if there is doubt as to the location of the ureters, they should be exposed and kept in the field of vision at all times. The use of radium in the treatment of carcinoma of the cervix, instead of the Wertheim operation, should undoubtedly decrease the incidence of ureteral injury, but I am afraid that this will be counterbalanced by the present tendency to do total hysterectomy for benign conditions of the uterus. I was interested in Dr. Newell's figures as to this and find that in his series ureteral injury occurred almost six times as often in total hysterectomy as in supravaginal hysterectomy. If the malignant conditions are excluded, the incidence is still almost four to one. I looked up our cases in the Magee and St. Francis Hospitals in Pittsburgh and will give you the figures for comparison. Dr. Newell reports 1,202 supravaginal hysterectomies with two ureteral injuries. We had 1,419 supravaginal hysterectomies with two ureteral injuries—practically the same. He reports sixty-three vaginal hysterectomies with one ureteral injury, while we had 110 vaginal hysterectomies with no ureteral injury. But in total hysterectomy he reports five ureteral to our one. However, on examining the figures, I find that total hysterectomy was done four times as often in his series as in ours, and therein lies the story.

The principle of total hysterectomy is correct in that it removes a diseased cervix, but this can be accomplished in a much more simple manner. Our procedure is to cauterize the cervix thoroughly and do supravaginal hysterectomy. If one is going to do hysterectomy, stenosis of the cervix need not be considered, and as thorough cauterization can be done as is necessary to destroy all infection. It has been stated that, as most of the carcinomata of the cervix are of the squamous cell type, carcinoma develops from the squamous epithelium and, therefore, it is necessary to remove the entire cervix. We maintain that carcinoma develops from the squamous epithelium only because of the adjacent chronic infection, inflammation and irritation, and that if this is thoroughly destroyed with the cautery, it heals over with squamous epithelium and there is no more danger of carcinoma arising in that cervical stump than in the squamous epithelium of the vagina. There has been no development of carcinoma in the cervix of our 1,419 supravaginal hysterectomies, all of which were treated in this manner. On the other hand, in a series of 150 cases of carcinoma of the cervix analyzed a few years ago, we found that four had developed in the cervix after supravaginal hysterectomy, in which the cervix had not been cauterized nor was any method used for eradicating the infection in the cervix.

In the very obese patient, in the deep narrow pelvis, or when the cervix is fixed by deep tears or by contraction of parametrial tissue from long standing inflammation, total hysterectomy is a much more difficult procedure, exposure is difficult and it is in this type of patient that the ureter may be damaged. If one then decides to do supravaginal hysterectomy, a diseased cervix is left behind, thus defeating the very purpose of this operation. In our method, the diseased cervix is cared for in every instance. I believe that this question of ureteral injury is a serious argument against total hysterectomy in every case.

I have nothing to add to what Dr. Newell has said as to the treatment of ureteral injuries except to say that in bilateral ureteral injury, while deligation would seem to be the ideal treatment in that it permanently corrects the trouble, it is much less certain and, therefore, is not always the practical operation. The condition of the patient and the nature of the original operation will help one to decide. If it is felt that the ureters were severed, nephrostomy is the procedure of choice. To re-open the abdomen and go down through recent post-operative exudate and find the cut ends of the ureters, which may be very difficult, and then to anastomose the ureters or implant them into the bladder seems to me like too much surgery for a patient who has just undergone a serious abdominal operation. On the other hand, bilateral nephrostomy is a certain method of relieving the back pressure on the kidney, the emergency which confronts the patient. The mortality of 50 per cent for nephrostomy as given by Dr. Newell is too high, I believe, and is due to delay in operating. In a patient who has anuria the next day after pelvic operation, the passage of ureteral catheters will quickly determine whether it is suppression of urine from malfunction of the kidneys, or anuria due to ureteral obstruction. If it is the latter, operation should be done at once and not after three, four, five, or six days.

DR. JAMES R. MILLER, HARTFORD, CONN.—I wish to report a case which is unusual in some respects. The patient came to me in May, 1926, with a small fibroid uterus and a large cystadenocarcinoma of the ovary, the size of a thirty-two weeks' pregnancy. At operation about 2 inches of the right ureter were removed accidentally. The bladder end of the ureter had been ligated at the time of hysterectomy. The sigmoid was fortunately movable and was sutured to the right brim of the pelvis and, not knowing at that time what the Coffey method was, I implanted the ureter into the right sigmoid practically with the same technic. This patient has survived six and a quarter years, and, aside from a single attack of pyelitis on the fourth day, has been entirely free from symptoms. Her bowels move three or four times in the morning without discomfort and she never has to resort to a cathartic. This spring I had her come into the hospital and was able to visualize both kidneys.

(Slides shown.) This shows a somewhat different method of handling the cut ureter. The pelvis of the left kidney is of normal size, that of the right has a slight hydronephrosis, and the ureter is slightly dilated.

There you can see the uroselectan in the rectum as well as in the bladder. This slide shows simply the cystadenocarcinoma.

DR. QUITMAN U. NEWELL, St. LOUIS, Mo. (closing).—I think Dr. Cashman is perfectly right about the proportion of total hysterectomies in relation to the supravaginal operations. Of course, this is a topic that is discussed quite often. I am more and more frequently doing the supravaginal, cauterizing the cervix, but I cannot feel that it is good judgment to leave the cervix unless it is in good condition. Our teaching is to leave the cervix if possible but to remove it if the conditions warrant at the time of operation.

There have been eight ureteral injuries by six different gynecologists. We feel that the observation of finding it injured only eight times is rather a small percentage.

This is a very serious matter and I have given it a great deal of thought. I have studied the literature and correlated the opinions of different men, for I think it is worth knowing what other men have observed. I do not think any one has had more than a few experiences but after one has followed eight of

these cases and also studied the literature, some conclusions may be drawn that I think we should try to follow.

There is much discussion regarding the choice of deligation or nephrostomy. I have felt that nephrostomy is the better operation, having seen only one case where deligation was tried. It is a most difficult thing to deligate a ureter even if it is as large as your finger, and I do not think it is wise to do so if nephrostomy will be beneficial.

I have quoted a good deal from the work of Caulk and Fischer. I have disagreed with them in some respects because I have seen at autopsy that the ligatures are absorbed more rapidly than experiments on dogs would indicate. I am quite sure that in fifteen or twenty days the ligatures are absorbed.