

The Management of the Ureters in Abdominal Pelvic Operations.*

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THE history of the ureters in surgery practically begins in the middle of the nineteenth century, when Simon, by extending the armamentarium of the gynaecologist, made their lesions visible. The year 1865, in which Semmelweis died, may serve as a landmark. In it Simon published, in Scanzoni's *Beiträge*, a further paper on uretero-vaginal fistula, whose recognition he had made possible; and in it, too, Beatty communicated his paper on what he calls "A rare and hitherto unnoticed form of death in Cancer of the Uterus," illustrating with a beautifully coloured plate the tendency of uterine cancer to obstruct the ureters, which is the ultimate expression of the pathological relation that may be said to be the reason for this paper. At this period lesions of the ureter were all of puerperal origin. The obstetric operation was too much a thing of terror to be called in before the prolongation of labour gave rise to the pressure necroses for which it is the prophylactic, and the gynaecological operation which, by its boldness, was, in its turn, to bring the ureter into danger, was not conceived. Though the eternal truth of Semmelweiss's doctrine was slowly carrying conviction, and though Pasteur was at work in Paris, the antiseptic system was as yet unparented, and without it the obstetric operation was impracticable as prophylactic as truly as the gynaecological operation was as cause.

In the early days of major gynaecological surgery, when the clinical conditions were still all matter for observation, and technic a matter for experiment, the ureter was found inadvertently to be the subject of injury. When a massive tumour burrowing into the broad ligament and disturbing the relations of the parietal structures was removed the ureter might be found divided, and when rapidity of operation was still urgent, so that tissues were dealt with in mass, the ureter was at times included in the clamp or ligature which closed the uterine artery or tied off the tissues at the cervix, or if not included was so distorted that its lumen was no longer patent or so compressed that its necrosis followed. But it is during the last ten years, when the gynaecologist has been endeavouring to apply to cancer of the uterus the lesson taught by the experience of operations for cancer of the breast, that the ureter has been found so closely

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associated with the tissues to be removed that it is to-day no exaggeration to say that the proper management of the ureter is the key to the solution of the surgical problem which determines the operability of a case of uterine cancer.

It would serve no useful purpose to compile statistics of the recorded ureteral lesions, but two illustrations of the frequency of their occurrence may be given. In Johns Hopkins Hospital, up to 1902, in 143 operations for cervical cancer, 17 showed unintentional injury to a ureter; in 7 post-operative fistula developed, and in 10 the ureter was clamped, ligatured or cut. In Wertheim's first series of 200 cases, 8 had necrotic ureteral fistula, and 8 other injuries; and in the second series of 200 cases, 16 developed fistula, and 3 were otherwise injured. The importance of these figures is emphasized when we remember that the specific difference of the Wertheim operation lies in the deliberate demarcation of the ureter in its whole course through the pelvis. The change of incidence in Wertheim's two series is also of interest, inasmuch as it indicates, on the one hand, increasing technical skill, and, on the other, by the doubled number of necroses, the widening range of the operation.

The extended range of operation is a matter of great importance. The curability of cancer is the product of three factors. The first is the proportion of those offering themselves for treatment who can be accepted as treatable; in other words, the operability. The second is the proportion of those operated on, who survive the primary risk of the operation. The third is the proportion of those surviving the operation, who remain free from recurrence after a selected interval (five years). Operability depends on the readiness with which women seek assistance, and is primarily determined by the local folklore of cancer and the menopause which prevails in the clientèle of the individual clinic; and it is, secondarily, dependent on the skill of the individual operator and the method which he favours. Mortality and recovery rates are largely affected by the severity and duration of the operation, and the final cure rate is determined by the efficiency of the operation in getting beyond the cancer limits in the individual patient. The operability and the recovery rates may both improve with the increasing skill and experience of the operator, but the cure rate is a measure of the scheme of operation itself.

Various efforts have been made to secure the presentation of cancer cases in earlier stages of the disease. These have not escaped adverse criticism, but it is noteworthy that in clinics where the action has been most persistent there has been a distinct increase in the proportion of women presenting themselves within a month or two of their first symptom. The operability of cases has, however, improved much more distinctly since the systematically extended abdominal resection has come into competition with vaginal hysterectomy. The introduction of Schuchardt's method of paravaginal

incision and, even more, Staude's bilateral vaginal incision, gave vaginal hysterectomy a wider range, but even the highest values reached by expert surgeons with this method are considerably lower than those of the abdominal operation. In the experience of individual surgeons the change to the abdominal operation has been followed by the doubling of the rate of operability. Staude, with the double vaginal incision and vaginal hysterectomy, has, with 104 operations in 156 cases, reached an operability of 72·3 per cent., but with a primary mortality of 21 cases; Krönig, with the abdominal method, has now reached an operability of 84 per cent., with a mortality of 3·8 per cent. Wertheim, in his last 158 cases, had an operation mortality of 7·5 per cent. Staude, with 58 cases of five years' standing, had a cure rate of 23 per cent. (Winter). Wertheim, with 120 cases, had, on the same standard, 24·7 per cent. Mackenrodt, who, with vaginal igni-extirpation, had a primary mortality of 17 per cent., and a cure rate of 31 per cent., reports, from his abdominal operation a primary mortality of 19 per cent., and a cure rate of 69 per cent. of the cases operated on, and his operability rate is 90 per cent. Recurrence after an interval of five years is rare, and as yet few extensive statistics reach this limit. Wertheim, of 120 cases, had only 58·6 per cent. free from recurrence within five years, *i.e.*, a cure percentage of 19·16 (Waldstein). Thus, even in his hands, the prospect of cure for cancer patients as they present themselves is about one in five. In the last ten years cancer of the cervix has been removed from the list of incurable diseases, but the present results leave much to be desired and striven for.

The desire to improve the final result has led to systematic inquiry into the causes of failure in the individual cases. The tissues removed have been examined in serial section, and much information as to the mode of spread is now at our disposal. I have left to Dr. Leitch the task of describing the pathological evidence, but a few practical conclusions must be stated here. It is necessary to remove the whole cellular tissue of the parametrium. It is difficult to secure the last condition without risk of injuring the ureters. The ureters may be inextricably involved in the spreading cancer by contiguity and also by lymphatic infection. The question of whether a case in which the lumbar glands are enlarged is incurable is still an open one. Wertheim reports that three out of his four cases of cancer infected glands are recurrence free after five years. If a case is set down as incurable it should probably also be regarded as inoperable. In every case that is to be regarded as operable all the cellular tissue below the pelvic brim that is in continuity with the uterus should be removed, and the ureter is the key to the problem.

One of the cardinal points of Wertheim's technique is that the ureter must be in evidence during the whole of its course through the pelvis. In spite of this the proportion of operations in which the

ureter is obviously injured during the operation or latently injured so that it later develops fistula is considerable, the average frequency of such injuries being about 10 per cent. The study of these injuries and the desire to remedy them and other analogous conditions has given rise to a considerable experience of the fact that the ureter may be implanted into another viscus, and it is the influence which this knowledge should exercise on the technique of pelvic operations that invites our discussion.

The conditions of ureteral necrosis are now fairly well known. The circulation is a plexus in the wall of the ureter itself and is continuous from the kidney to the bladder, receiving feeding branches from any artery passed on the way (Sampson). The ureter lies and moves in the loose cellular tissue under the peritoneum, and may be lifted out of this without injury to the plexus. Any part of the ureter where the plexus is locally injured may necrose, and such local injury may arise from manipulation during operation, and has frequently arisen from the pressure of gauze used to drain the pelvis. When the parametrium is infiltrated the surroundings of the ureter, and even the ureter itself, may be cancer-invaded near the bladder. Under this condition it becomes impossible to remove the cellular tissue without also removing the corresponding part of the ureter. The attempt to do so has greatly added to the difficulty of carrying through the operation in individual cases, and in the light of our present knowledge has probably been one cause of unsuccessful operation. In any future case, therefore, where the ureter cannot with ease be laid bare right down to the bladder it should be divided above the infiltrated tissue and dealt with later by implantation.

If this contention be admitted the sequence of the operation within the abdomen is: incision of the peritoneum from the round ligament up to the suspensory ligament of the ovary; isolation of the ovarian vessels; incision of the peritoneum across the pouch of Douglas; division of the round ligament; incision of the peritoneum of the utero-vesical fold; clearing of the lateral wall; recognition of the ureter on the mesial fold (there are several pale-coloured cords which may be found at the pelvic brim, but the ureter is the only one that has vermicular movement, and the vermicular wave may be elicited by pressing the ureter lightly with the blunt side of forceps). The next step is the freeing of the ureter down to the bladder, or if the parametrium is infiltrated, division of the ureter above the infiltrated area, the end being for the time laid away in gauze. The bladder is now freed in front and the uterine artery ligatured, and then the whole tissue may be removed down to the pelvic wall, leaving the muscles with the nerves and vessels coursing bare over their surface. The other side being similarly prepared, the separation of the bladder from the vagina is now completed, and the organs removed from the vagina up. Once the ureter is put aside the tissue

may be removed from the brim of the pelvis downwards in a continuous piece. (When the upper limit of operation is at the pelvic brim the upper peritoneum may be shut off by stitching the anterior parietal layer to the posterior before the rest of the operation is undertaken.)

The management of the divided ureter may, to a certain extent, be dependent on the length of the stump. If the division has been accidental the ureter may be so short that a typical implantation into the bladder is impracticable. This is a contingency to which I shall return later. At present it will be better to deal with those cases in which bladder and ureter can be brought into easy reach of each other. To secure this it is at times necessary to pull the bladder upwards and fix it to the pelvic wall. The retraction of the divided ureter and its vermicular movement compel us to have the point of its entrance so accessible that there is no tension. If this is not secured, either by leaving a sufficiently long end of ureter within the bladder or by mobility of the point of insertion, there is danger of the stitches pulling out or being so tight as to injure the wall of the ureter. Mackenrodt insists also on the dangers of kidney dislocation when the ureter is tense.

Vesical implantation of the ureter developed historically as a method of dealing with ureteral fistula, and questions arose as to its performance, extra- or intra-peritoneally, which do not concern us in the consideration of it as the final step in an abdominal operation. The operation took its rise in Italy. After some preliminary experimental work had been done on dogs both Novaro and Bazy operated on patients in 1893. Novaro laid his implantation extra-peritoneally, and Bazy intra-peritoneally. At this time the operation was an anastomosis rather than an implantation. A little later Witzel made implantation, insisting on the importance of bringing the bladder up to the ureter and applying the oblique canal method which he had already used for gastric and other anastomoses.

The appreciation of the various points in the technic of implantation will be best reached by taking them successively. The peripheral ureteral stump may at once be put aside as it needs no treatment. Experience has shown that when the ureter is divided the peripheral part does not leak, and this has been explained by the experimental investigation which has shown that no regurgitation occurs from the bladder into the ureter unless the ureter is in active vermicular movement.

The preparation of the end of the ureter for implantation has been made in various ways. It has been cut square across or obliquely, or has been split on one side or on two. With each method cases have been successful, but on the general principle which teaches that stenosis is more frequent with a transverse section

it is preferable to select one of the other methods, the question of which being decided by the method of suture adopted.

The opening into the bladder may, on occasion, be one that has been made accidentally in the course of the operation, but as a rule the requirement that it should be within easy reach of the ureter will determine that any such accidental fistula be closed and a new opening specially made. Various forms of opening have been employed—circular, (Leitch), H-shaped (Sampson) or rectilinear, the last being usual. The opening is usually made on an instrument introduced through the urethra and used subsequently to guide the ureter into the bladder. The opening should not be too small, since the introduction of the ureter into a small hole costs more time than subsequent suture of the bladder.

In guiding the ureter into the bladder the first step is to secure the edges of the vesical mucosa which may otherwise be separated from the rest of the wall and carried in front of the ureter. With these held in forceps the opening is like a funnel and the ureter can be inserted on a ureteral probe or by pulling it in with a guide thread. The use of a guide thread was at one time extended by carrying it through the urethra and fixing it to the tissues somewhere outside to act as a bridge from which the ureter would have difficulty in slipping out of the bladder. Now it is more usual to make the guide thread a suture, which, before insertion into the cavity of the bladder, is armed at each end with a needle. These are then pushed outwards through the bladder wall about a centimetre from the opening and used for fixation of the ureter. In suture the theoretically desirable continuity of mucosa is not necessary as the outer wall of the ureter heals quite well into the muscle of the bladder wall (Kroenig). All modes of suture have been employed, continuous, interrupted, three layer and others. Silk and catgut are the concurrent materials, but some operators have had to remove vesical calculus after the use of silk. The bladder opening may be sutured down to the size of the ureter, and the wall may, according to Witzel's method, be sutured into an oblique channel round the ureter. Kroenig, however, criticizes Witzel's method as hindering the prompt functioning of the ureter. Owing to the readiness with which the ureter wall may necrose it is desirable to restrict the sutures in it, and it is of interest to note that from a short report of a discussion it would seem that Latzko simply fixes the bladder to the stump of the suspensory ligament of the ovary, inserts the ureter into a not too small hole and does not suture it at all.

The covering in of the denuded ureter is desirable, but not essential, and its practicability in any case will depend on the extent of the peritoneal removal. The root of the uterine artery may be used as a support of the ureter.

The retention catheter is essential and affords the best safeguard

against leakage. When combined with the raised trunk position it should afford absolute security provided the ureter is sufficiently inserted.

Drainage is best secured by gravitation. If gauze is employed it must not lie in contact with the ureter.

Where the ureter has been merely divided, and not in part resected, the case offers the possibility of suture of the divided ends. For this a considerable variety of methods has been described. These will be found in detail in a report by Sharpe in the *Annals of Surgery*, 1906, vol. xlv, p. 687. They are applications to the ureter of the methods of intestinal anastomosis, and, apart from the danger of subsequent cicatricial obstruction, they all seem likely to take a longer time than a bladder implantation should. For this reason when the ureter is found to have been cut but not resected it is better to implant the renal end in the bladder when the point of division is within easy reach of it.

The management of the ureter in a case where the bladder or the other end of the ureter cannot be brought within reach raises somewhat different and more difficult problems. Such cases are more frequent where the ureter has been adherent but unnoticed during the removal of an intraligamentous myoma or ovarian tumour, or where, ureteral necrosis having occurred, the ureter is found so involved in cicatricial tissue that its end cannot be dissected out. Failing the bladder, three other implantation sites are possible—the intestine, the other ureter and the skin. A good many cases have now been treated by implantation of the ureter into the intestine, but the difficulty of avoiding an ascending infection of the kidney has led to its abandonment where bladder implantation was possible. It is, however, worth mention that Chaput reported one patient alive and well thirteen years after this operation. (I have a patient who is now in the third year after implantation of both ureters into the rectum, and she is well and at work. Two months ago an unusual incident occurred. After an attack of severe pain on the right side of the abdomen she had a discharge of urine from the vagina. The fistula closed spontaneously in a fortnight.)

Insertion into the other ureter has only been performed experimentally in dogs, with the exception of a case of my own, where, owing to the complication of a cancer of the cervix uteri with a myxosarcoma of the left ovary, I had to resect the left ureter with the sarcoma. Finding a free stump about 14 cm. long I pushed it across under the peritoneum and aorta and planted it in the other ureter at the level of the pelvic brim. The patient died after three weeks, and Dr. Leitch found that suppuration in the pelvic cavity had extended upwards over the denuded area to the point of ureteral insertion, and that the union had broken down, but the rest of the ureter had soundly healed into its track under the aorta. Implantation

on the skin is, while the kidney functions, a source of great discomfort, but in most cases the fistula closes spontaneously from atrophy of the kidney.

Spontaneous closure is a relatively frequent issue in ureteral fistula, whether the communication be with the vagina or skin. The mechanism may be either a cicatricial contraction of the ureter or an atrophy of the kidney, but it is worthy of note that Weibel reports from Wertheim's Klinik that of the 16 cases which arose in the second 200 cancer operations, 11 healed spontaneously, and that none showed signs either of renal atrophy or of hydronephrosis. From Wertheim's first series of cases, one, where uretero-vaginal fistula had healed spontaneously, was alive five years after the operation, and both her ureters were soundable. This is a result not so certainly attainable as to relieve us of the duty of implanting an injured ureter when we discover it during the original operation.

If the implantations are put aside the only methods left for dealing with a divided ureter are ligature of the divided end and excision of the kidney. The ligature leads to a temporary hydronephrosis with subsequent atrophy of the kidney, and thus in both methods the patient is left dependent on the other kidney. This seems too great a risk to be justifiable where a better method is available, and with our increasing experience of implantation is likely to disappear from the list of sequels possible to a cœliotomy.

Up to this point the argument has been stated in such a general way that the objection might be made that the feasibility of the method advocated has not been demonstrated. The results experienced, however, are now sufficiently numerous to establish its claim for systematic adoption. Latzko, whose simple technique has been mentioned, reports 23 cases with only two failures. From Kroenig's Klinik are reported thirteen cases where the result could be tested, and of these two had developed stenosis, but ten had healed with good functional result, and in one the result was indeterminate. Franz reports on 20 cases, of which five died as the result of extensive carcinoma operations; and of the others, seven healed with good function, one developed surgical kidney, six broke down, and in one the result could not be ascertained. Stoeckel has reported in all eleven cases, of which ten gave a fully successful result. When it is remembered that these reports come from a period when the technic was in course of development the results attained must be pronounced good. The fact that some of the cases were treated for accidental injury during an already long operation is of little moment against a claim that the deliberate section of the ureter may actually shorten the time required for the abdominal operation for uterine cancer. With an increasing individual experience we may greatly reduce the time spent in our operations, even if we cannot all attain the facility which enables Wertheim to complete an

abdominal hysterectomy for cancer in an hour, or of Mackenrodt, who needs only half of that period.

In conclusion, briefly stated, the theses I have endeavoured to sustain are:—

1. In those cases where a tumour is burrowing into the broad ligament the ureter should be looked for, and if accidentally injured should at once be treated by implantation.

2. In cases of cancer of the cervix uteri where the parametrium is infiltrated the ureter should be divided above the infiltrated region and treated by implantation in the bladder.

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