While pyelotomy is applicable only for the comparatively small group of aseptic and moderately infected cases, primary nephrectomy ought to gain more and more ground as the simplest, safest and quickest curative method for advanced pyonephrotic stone-kidneys in which the other organ is found to be functionally and anatomically intact. By being able to formulate pre-operative indications for nephrectomy, the possibility arises of removing a pyonephrotic sac without opening it during the operation for inspection; thus quick closure of the wound is obtained and rapid convalescence and complete cure ensues. Bevan¹² reports improved results in his work on infected stone-kidney because he has recognized more than formerly the necessity of doing a primary nephrectomy. Kümmell¹⁹ reports twenty primary nephrectomies for pyonephrotic stone-kidney without death, and among twenty-four nephrotomies for the same condition three fatalities and eight secondary nephrectomies. At Israel's clinic²⁰ the operative mortality for nephrotomy in infected cases was doubly as large as that of primary nephrectomy, 11 against 22 per cent. The indications for primary nephrectomy can, moreover, under certain conditions be extended to bilateral stone-kidney, especially in cases in which the burden of renal function is known to be carried by one organ only and in which the patient through a quicker and simpler operative procedure is at once relieved of an anatomically and functionally useless organ.

CONCLUSIONS

1. Nephrolithotomy is connected with serious immediate and remote untoward results.
2. It should be, wherever feasible, replaced by posterior pyelotomy.
3. Nephrectomy is the simplest, quickest and safest curative method for pyonephrotic stone-kidney, provided the function of the other organ is satisfactory.

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THE IMPLANTATION OF THE URETERS INTO THE LARGE BOWEL *

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During recent years the problem of implanting one or both ureters into bladder, ureter or bowel has repeatedly been the subject of theoretical discussion and practical experiments, and conclusions have been drawn from the success obtained as to the possibility and expediency of this method.

The first one to undertake an implantation of the ureters into the intestinal tract was Simon, who in 1851 operated for an ectopy of the bladder by uniting the ureter with the rectal wall through a tight knot, which cut through and produced a communication between ureter and rectum. For two months the patient passed urine through the rectum, but then the anastomosis became very narrow, the urine escaped through the fistula, and the patient died.

In 1879 Theodore Smith of St. Bartholomew Hospital published in the hospital reports an account of a case in which he implanted both ureters into the colon; the patient, however, died. In 1891 Kuester of Marburg

resected the whole bladder for a cancer and implanted the ureters into the rectum, also with fatal result. The first successful operation of this kind was performed by Chaput, whose patient lived for thirteen years. Gluck, Zeller, Bardenheuer and Novarro made experiments on animals. Morestin, Harvey Reed, Boari, Peterson, Martin and Zeit have all devoted a great deal of study to these questions in experimenting on lower animals as well as in operating on human beings.

There is, however, a great difference in operating on the lower animal and on man, since in the dog, for instance, the ureter is very small and thin and the bowel quite coarse, so that a union is not so easy as a similar union in a human being. Nevertheless a comparatively large number of good results have been obtained in animals and, though not a large number, several cases have been recorded in which the results of such transplantation in human beings have been successful. Chaput in 1910 records besides his own case, in which the patient lived for thirteen years, the case of Chalot's patient who lived for one year, of Guinard's who lived for five years, Michaud's who lived for two years, Auvray's for fifteen months, Boari's for six months, Fowler for three and one-half years, Peterson's for ten months, Beck's for seven months (which is, however, a mistake, since he lived eighteen months) and Martin's for eighteen months.

The indications for performing such an operation are rather rare. The principal indications are (1) injury of the ureter, in which it cannot be sutured again or implanted into the bladder, (2) fistula of the ureter, (3) painful cystitis (cystitis dolorosa, Trendelenburg), (4) total cystectomy (Kuester) and (5) ectopy of the bladder (Simon).

After Simon, Maydl has done more than anybody else to popularize the operation for the last indication, since he has had a number of successful results. But, on the whole, these operations have not gained an enthusiastic following on account of a great many drawbacks, principally the infection of the kidneys secondary to the operation and the difficult control of urination. Guyon and Albarran have shown, however, that an infection of the kidney does not necessarily follow an ascending infection of the ureters.

The methods of implantation of the ureters which have been used are mainly four:

1. After the first discovery of the bad consequences of the ordinary implantation and after Maydl's experiments a part of the bladder was taken along with the ureter for implantation, and good results have thus been obtained. This method, however, is not possible except in case of exstrophy and perhaps cystitis dolorosa.

2. The method of Chaput is the direct union of the wall of the ureter to the wall of the bowel. This method has been successful, but it is the one which endangers the union most of all. Peritonitis may follow this method very easily, since it is difficult to prevent a pulling out of the sutures by the action of the bowel or by infection.

3. Boari's method makes use of a small button, which is very similar to the Murphy button in its principle. A case in Giordano's clinic has shown, however, that concretions can form in that button.

4. The last method consists of the oblique implantation of the ureter into the bowel by a procedure such as Witzel has described for the oblique gastrostomy, sewing a catheter into the stomach-wall. Krinsky has described a method of oblique implantation of both ureters into the rectum with a flap-operation which is done by sewing

19. Kümmell: *Ztschr. f. Urol.*, 1908, II, 340.

20. Israel: *Chirurg. klin. d. Nierenkr.*, 1901, p. 308.

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a flap of peritoneum and external muscle over the implanted ureter. Fowler has given us a method for flap-operation, in which the flap is made of the wall of the bowel.

The oblique method is one which I have used in my cases of implantation with this difference, however, that I have allowed the ureter to dangle with its free portion into the lumen of the bowel. I had the idea that the infection would be prevented by such a procedure, and,

Fig. 1.—Ureter anastomosed with appendix.

furthermore, that the lumen would not be included in a cicatrix of the bowel and therefore would remain patulous. I must say, however, that my first case showed that only one lumen remained patulous and that the other was very much constricted. It seems, nevertheless, that the portion of one ureter hanging down into the bowel has either become gangrenous or has retracted.

The records show that the results obtained by various surgeons differ widely, and therefore the question, whether or not this operation is possible and expedient, is not yet solved. Each case bearing on the subject, whether successful or not, ought to be reported in order to give sufficient material for a decision as to whether implantation should be made use of or dropped. We have to consider this matter from two different points of view: first, with regard to the technical part and then with regard to the pathologic changes following the operation. If the ultimate result is unfavorable, we can call this operation only a palliative one which ought to be rejected, if the danger connected with it is in disproportion to the benefit which might be derived from it. In this case, though the operation be ever so simple technically, it will not acquire a place in surgery.

Unfortunately the above-mentioned consideration is often neglected, and a success is reported before the process of healing has ended. This, of course, perplexes the critical observer. Maydl's experiments were made years ago and certainly are the most important ones, because they were made by so careful and competent a surgeon. But his cases are throughout cases of exstrophy of the bladder of a particularly simple nature, his patients having been in good health in every other respect.

I will not enter into the details of the literature, but the description of two typical cases, which have been closely watched, may be welcome.

CASE 1.—Patient.—A. F., aged 27, cigar-maker by trade came to me for the first time fourteen years ago in order to be treated for an obstinate disease of the bladder. He came from a family predisposed to tuberculosis (I had oper-

ated on his brother for a tuberculous fistula of the rectum) and had been weak from infancy. In early childhood he suffered from poliomyelitis, which caused a paralysis of one leg. When 20 years old he was operated on radically by Dr. J. B. Murphy for a pararectal abscess; a high dissection alongside the intestine, between bladder and rectum, had been necessary. It is not certain, but possible, that the affection of the bladder which I am going to describe originated from the rectal tuberculosis.

Present Illness.—Fourteen years ago the patient was troubled with a permanent strangury, which from time to time caused hematuria. The intervals between such attacks were sometimes but a few minutes. The examination of the urine showed a small amount of albumin and a great many pus-cells and led to the conclusion that there was a tuberculous cystitis. The cystoscopic examination gave a positive result. The bladder-wall was entirely covered with tuberculous ulcers. After a thorough reflection I advised drainage of the bladder above the symphysis, which was then done. When the cystotomy was made, the bladder proved to be badly infiltrated and without any active contractility; the walls were rigid and covered with tuberculous ulcers. I curetted the tuberculous masses thoroughly and drained the bladder for some time through a tube. The patient recovered visibly and for some months was in good condition. Gradually, however, all the bad consequences of a long drainage of the bladder appeared. The urine produced an obstinate eczema of the abdominal wall and of the scrotum, and the patient asked urgently for relief. I could not decide on recommending exclusion of the bladder, and I sent him for three months to the county hospital, where through rest and lying on the back he was cured of the eczema but retained his fistula. Finally I advised him to have the bladder excluded and the ureters implanted into the bowel, and this operation was done Jan. 10, 1899.

Operation.—I shall not enter into the particulars of a technical description, but I wish to state that I used a method which I had devised especially for this operation. I put the patient in Trendelenburg's position, isolated both ureters, cut

Fig. 2.—Ureter passing obliquely into the large bowel hanging with its free extremity into the cavity.

them across not far from the bladder and on the right side implanted the ureter into the cecum, on the left side into the sigmoid flexure. The peritoneal covering of the bowel was removed with a flap of the muscular coat of the bowel, then the bowel was opened obliquely and the ureter was drawn far enough into the lumen with a thread to insure its dangling there. The opening of the ureter was made wide by slitting it open to one-quarter of an inch, then the peritoneal flap was carefully sutured over the implanted ureter. I

imagined that I could in this way avoid the two main drawbacks observed after all implantations, namely, stricture of the orifice of the implanted ureter and infection from the bowel; for the free ureter-end, the orifice of which had been obliquely split, could not shrink, and infection starts from the granulation at the spot of the implantation of the ureter into the bowel or at the stitch-holes.

Postoperative History.—My patient recovered after a rather long illness and was perfectly well from this time on to the day on which he entered the hospital again, that is, during a period of eighteen months. It was of great physiologic interest that the periods during which he could control the urine gradually grew longer and longer, that he did at times separate the discharge of feces from the urine, that he was able to hold the urine in the bowel during a whole night, and that the urine discharged was at times absolutely clear. During these eighteen months he had no trouble whatsoever which would point to an affection of the kidneys until precisely the time when he came back to the hospital, and even then the lung-trouble outweighed the kidney-trouble, so that till the end I was not sure whether he died from tuberculosis of the lungs or from tuberculosis of the kidneys.

The pathologic changes have been carefully examined, the case itself has been closely observed clinically and post mortem, and the observations made might be of use for the determination of the question, when, if ever, a transplantation of the ureters is indicated.

Necropsy.—Patient is emaciated; his panniculus has disappeared almost entirely. An opening of the head has not been permitted. Mouth and pharynx are absolutely normal; so are the larynx and the trachea; in the trachea masses of bloody, colored mucus are found. Both apices of the lungs are emphysematous and the pleurae of both sides are totally adherent to the chest-wall. The right lung is permeated with old tuberculous scars and callosities and the left lung shows many symptoms of a recently rapidly progressing tuberculosis. Some of the caverns are connected at points. The abdominal viscera show the most interesting changes. The liver is hypertrophied and amyloid, the gall-bladder very much dilated but otherwise normal. Stomach and intestine show no sign of tuberculosis, not even in the part through which the urine was flowing. In the region of the sigmoid flexure are hard peritonitic adhesions, which date from the operation. The kidneys show the worst changes. Neither of them can be palpated, because the entire fatty capsule is badly infiltrated, and even after a slight dissection it is evident that both kidneys are surrounded by an extensive peritoneal exudate with multiple abscesses. The pus is yellow and thick and shows the signs of a cold abscess. The right kidney is partly normal; on other parts it shows macroscopic changes of acute and chronic inflammation. On this side the ureter and the pelvis of the kidney are fairly normal. The left kidney is almost entirely transformed into necrotic tissue, so that the normal borders of the kidney and the pelvis can no longer be discerned. The ureter of this side is much distended and following it up to the bowel we see that the orifice is almost obliterated. The sigmoid flexure is open in the region where the ureter has been implanted, and, besides a few very small tuberculous and cheesy degenerated lymph-nodes, does not show any symptom of tuberculosis or any sign of irritation. The mucous membrane of the bowel is not normal in appearance; in color and luster it

looks rather like the mucous membrane of a bladder. The right ureter is still dangling free down into the lumen by one-quarter of an inch. The projection of the left ureter has disappeared and the opening can be found only with difficulty with a fine sound. At its orifice are concretions of urates. The bladder seems to have shrunk entirely and is contracted to a small nodule almost without any lumen. The microscopic examination of both kidneys, so far as the tissue could be plainly discerned, shows, besides an amyloid degeneration, a bad infiltration of the interstitial tissues with quantities of bacteria and cocci. The microscopic examination of the ureter shows no tuberculosis. The microscopic examination of the bowel below the place of the implantation shows a strange transformation of the epithelium into a pavement epithelium very much broken up on the surface.

Fig. 3.—Implantation of ureter into intestine. AA, ureters; BB, kidneys; C, large bowel; D, bladder. About 3/16 actual size.

I waited many years for a chance to repeat this interesting operation for a similar indication. Last year the following case in my practice seemed to me to indicate at least a temporary transplantation of the ureters.

CASE 2.—Patient.—Mr. S., 60 years of age, was a packer in a crockery house. For the last sixteen years he had suffered from bladder-symptoms, which indicated either a stone in the bladder or an enlarged prostate. He had frequent urinations; occasionally his stream was interrupted suddenly and he had to strain; he also had to get up nights frequently; he suffered pain. The examination showed the prostate not much enlarged but a chronic hyperplastic cystitis; there was no stone in the bladder. But a roentgenogram revealed distinctly a stone of the size and shape of a nickel either encysted or in the left ureter.

First Operation and Results.—I decided to make a suprapubic cystotomy, and I found that the stone was contained in the left ureter about one inch above its orifice in the bladder. The ureter had to be split for that distance, and the stone was removed. It was noticed that a good deal of granulating tissue formed the bed of the stone. The patient did not make a very good recovery. It was interrupted by chills and fever and suppuration of the *cavum retzii*. He did not pass any urine in the natural way; the fistula had no tendency to close. During the following months several attempts were made to close the fistula and lead the urine the normal way but without success.

Second Operation and Results.—I decided, therefore, that the prostate, though it was not very much enlarged, must be the cause of this trouble and removed the prostate by an infrapubic cystotomy, draining the bladder downward and hoping for closure of the fistula of the abdomen. For a short while it seemed as if we would succeed, but only for a short while. Suppurations came again on the abdomen and the sinus caused the patient a great deal of trouble. Again I tried an excision of the sinus and closure of the bladder, but without success. In this time—about two years since the first operation—the bladder had become rigid and hard and could not retain regularly more than one ounce of urine, though at times, with much pain, the patient could distend it to hold several ounces.

Third Operation and Results.—I decided to make a last attempt; but when I had dissected down to the mucosa I found it so covered with ulcers and stony concretions that I thought the wiser plan would be to transplant the ureters, temporarily at least if not permanently, into the bowel and give the bladder a chance to heal out and to close, and, if it should do this and make a permanently closed viscus, to reimplant the ureters afterward. The man was in good health but unable to endure the flowing of urine over his abdomen or to wear a tube for drainage.

The operation was performed in a similar manner to that in the first case, except that the right ureter was implanted into the appendix. The man recovered promptly and has so far been able to control his urine for a couple of hours at a time. He is at least free from the molesting constant discharge of urine and the eczema. The fistula of the bladder is closing down at the time of writing this paper, and the bladder seems to be healing.

CONCLUSIONS

I considered this process of temporary transplantation analogous to temporary gastro-enterostomy for an ulcer of the stomach or duodenum.

Though only the short period of a few months has elapsed since the implantation in the second case, I am inclined to believe that this patient also will in course of time develop pyelitis; but his bladder may have a chance to recover and become a healthy viscus, and a reimplantation of the ureters may be made into the bladder, if he does not prefer the present tolerable condition.

In cases of tuberculosis of the bladder a permanent implantation made into the bowel is only palliative, but the method of free-end implantation of the ureter or the implantation into the appendix insures a longer period of freedom from pyelitis than any other. I think that it is even possible to implant both ureters into the appendix.

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Ureteric or Vesical Calculus.—Now it is a fact which has long since been accepted that a stone lodged in the ureter just near the bladder evokes all the symptoms of stone in the bladder, in addition to those symptoms which arise in the kidney from ureteric obstruction. There is the same frequency of micturition, the same tenesmus, the same meatal pain in juxtavesical ureteric stone as in vesical stone.—Hurry Fenwick, in (London) *Clinical Journal*.

THE REPAIR OF DEFECTS OF THE URETER *

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The surgeon is often confronted with a case in which a normal functioning kidney might be saved if a portion of the diseased ureter could be removed and the defect corrected either by some form of anastomosis of the severed ends or by substituting another structure for the removed segment of the ureter.

Anastomosis of the two ends has been seldom successful in the human being, when the ureter was divided either accidentally during operation or by injury or intentionally during the removal of a diseased segment. The various methods which can be employed for an anastomosis of the severed ends are (a) end-to-end, (b) end-to-side (Van Hook), and (c) invagination methods (D. Antona). Of these the ingenious method of Van Hook seems the most rational. It is superfluous to quote the technic here, since it is so well illustrated and described in all of the standard text-books of surgery. Owing to the tortuous course and elasticity of the human ureter, it is possible to unite the ends even though there is a gap of 3.2 inches (Von Bergmann). Experiments on dogs and results in human beings show that the Van Hook method of invaginating the proximal end into a slit on the lateral wall of the distal end gives the most satisfactory results of any method of anastomosis.

I have not considered, in this paper, the various methods of reimplantation of the proximal end of the cut ureter into the bladder or bowel. It is a well-recognized fact that one can resect the ureter close to the bladder or to the kidney and reimplant the corresponding end into another portion of the bladder or into the renal pelvis and thus save the kidney with perfect maintenance of its function. Reimplantation of the ureter into the bowel is impracticable on account of the irritant action of the urine on the mucous membrane causing persistent diarrhea and on account of the frequent occurrence of ascending infection.

The thought has occurred to many surgeons who have been obliged to resect a ureter either on account of its involvement in malignant disease or owing to a stenosis that, if some structure could be transplanted, the vitality of which would be maintained until union had occurred, the ureter could be resected and the corresponding healthy kidney saved. The structures which have thus far been employed with this object in view are (a) segment of an artery, (b) segment of a vein, (c) segment of the horn of the dog's uterus (fallopian tube), and (d) segment of the bowel or vermiform appendix. One fact favors the implantation of a segment of other structures, namely, that the ureter has within its own walls a rich vascular supply and that, although it is completely separated from surrounding structures, the vitality of the ureter is readily maintained. I shall briefly enumerate the names of those who have attempted to solve this problem and the structures employed as grafts between the two ends of the severed ureter.

1. Floercker, Melchior, Domenici and Tietze employed segments of arteries and veins.
2. Fenger and Bacon, Poggi and Tizzoni, D'Urso and DeFabi, Esou and Moskowicz employed loops of intestine, excluded

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* From the Department of Experimental Surgery of the Morris Institute for Medical Research, Chicago.