ments of the knee joint may be begun by the surgeon himself—this should never be delegated to any one else. When a case so treated is ready to get up and walk, his leg will not show the atrophy, the stiff joints, the contracted tendo achilles and swollen, stiff toes so often observed after the customary treatment.

The use of apparatus during and after treatment. Often some special form of apparatus may be required to maintain a fracture in the best position. Any one will admit that the orthopedist is the best one to look after these cases. In the after-care of some fractures as, e. g., Pott's fracture of the ankle, a brace should be worn to prevent the development of deformity after the fracture has healed. Also cases of fractured femurs may be allowed to walk sooner if a brace is used.

So it seems to us that we have reached a stage in the progress of the treatment of fractures and dislocations when the most satisfactory results may be obtained by putting these cases, from the very beginning, in the care of competent orthopedic surgeons.

DIVERTICULUM OF THE URETER*

BY JOHN H. NEFF, M.D.,
University, Va.

Search of the literature of the past twenty years would seemingly indicate that diverticulum of the ureter is quite a rare clinical or anatomical finding. We have been able to discover records of only two such abnormalities. In both instances the defect was discovered after death and apparently had caused no harm during life. We desire to add another case and briefly discuss the etiology of this condition.

CASE REPORT

Mr. E. L. G., age 32, admitted to University of Virginia Hospital March 19, 1920, was referred by Dr. J. M. Melton, Crozet, Va.

At varying intervals during the previous eighteen years, the patient had had some twenty or thirty typical attacks of right-sided renal

colic. Many of these attacks had been quite mild in character; others had been extremely severe, sufficiently so to require repeated administration of morphin for relief. In no attack had he had any elevation of temperature or a chill, nor had he passed blood or calculi. Moderate bladder irritability had been noted during most attacks.

General physical examination was negative save that the lower two-thirds of the right kidney was palpable, the kidney feeling slightly enlarged. X-ray plates of the urinary tract were reported clear. Repeated urinalyses showed neither blood nor pus.

On cystoscopic inspection, the bladder everywhere appeared normal. A catheter advanced up the right ureter met an obstruction, 10 cm. above the bladder, which was passed after considerable manipulation. Five or six centimeters further, the catheter again encountered resistance. That, too, was overcome, and the catheter was then readily introduced to its full length.

Differential functional test showed an output of 16 per cent phenolsulphonophthalein from each kidney in fifteen minutes after intravenous injection.

X-ray picture (Fig. 1) with the right catheter in place showed it making a complete loop itself at the level of the lower portion of the sacro-iliac joint. In making a pyeloureterogram, the injection of 60 c. c. of thorium solution was required to cause discomfort. The picture (Fig. 2) showed quite marked hydronephrosis, a gentle S-shaped curve of the ureter just below the pelvis, and dilatation of the ureter down to the level of the lower portion of the sacro-iliac joint, at which point there seemingly was a cul-de-sac formation on each side of the duct. The urine from the right kidney contained no pus, and the culture was negative.

Operation June 1, 1920. Through a rectus incision the lower portion of the right ureter was exposed after division of the overlying peritoneum. A most interesting condition was found. About 8 cm. above the bladder a diverticulum came off from the posterior lateral aspect of the ureter, ran slightly to the right, then curved inward under the duct, and ended blindly in the presacral retroperitoneal fat. No mass nor tissue thickening was felt about the blind ending. Below the level of the diverticulum the ureter was of normal caliber; above it, at least three times normal size (Fig. 3). The diverticulum was removed and the opening in the ureter repaired with interrupted sutures of catgut. Extraperitoneal drains were placed at the site of ureteral closure.

The diverticulum (Fig. 4) measured 13 cm. in length and 2 cm. in diameter at the point of its ureteral attachment. Near the mid-point it was constricted till the lumen was of filiform size. Proximal to the constriction, the structure of the wall was grossly the same as that of the adjacent ureter; distally, the wall thinned out to a rather sheer membrane at the blind ending.

The post-operative course in this case was uneventful save for some leakage of urine along the drainage tract. This gradually decreased till it stopped entirely on the twenty-eighth day. The patient was seen four months after opera-

*Read in Section on Urology, Southern Medical Association, Fourteenth Annual Meeting, Louisville, Ky., Nov. 15-18, 1920.

tion. There had been no further renal colic. He complained only of a dull ache at the site of his wound after much physical work.

Uretrogram portrayed the right ureter in practically normal alignment, though a catheter could not be passed beyond the point of ureterotomy.

The 'phthalein output of each kidney was again 16 per cent in fifteen minutes after intravenous injection.

We have here, then, a clinical case of diverticulum of the right ureter with a resulting hydronephrosis, but without decrease in renal function.

A rather careful review of the literature of the past two decades apparently reveals this deformity to be extremely rare. In fact, during this period we have found no

This saculation explained his inability to catheterize the ureter, as his catheter had invariably entered the small diverticulum just within the orifice. In neither of these reports is mention made of secondary obstructive renal changes.

The etiology of diverticulum of the ureter as presented in our case above seems to us quite readily explainable as a perversion of the normal embryological development of the kidney and ureter. It will be recalled that the ureter is first represented in embryo at three or four weeks as an evagination from the Wolffian duct (Fig. 5). This budding gradually grows, becomes bulbous at its blind extremity, which in turn is capped by a tissue mass, the so-called metanephric blastema. Quite

Fig. 1.

record of any other such case coming to operation, though almost surely this uniqueness is not real. Herbert reports a very similar anomaly in a cadaver. He describes a diverticulum 32 mm. in length arising from the left ureter 3 cm. above the bladder and running upward and outward. Guiteras cites the autopsy observation of a shallow cul-de-sac coming off from the intramural part of the right ureter immediately above the ureteral meatus.

Fig. 2.

early the bulbous enlargement becomes bilobed and so gives the first evidence of calices in the primary renal pelvis. By a continuation of this dichotomous growth the calices and collecting tubules are formed. In the adult kidney the ureter, pelvis, calices and collecting tubules have had their derivation from the Wolffian duct bud, whereas the secreting portion of the kidney has developed from the capping mesodermal tissue. Early in its life history the kidney is opposite the second sacral vertebra, but by the fourth or fifth

month has ascended and partially rotated to rest in the position normally found in the full term fetus.

One of the commonest anomalies of the kidney is the presence of two pelvis with

in degree upon the extent of the split down the ureteral stalk (Fig. 6-A). In fact, various writers consider complete double ureter as due to the very early branching of the ureteral anlage near the Wolf-

Fig. 3.

partial duplication of the upper portion of the ureter, or, as frequently termed, a cleft ureter. It has just been stated above that the initial change in the primary

Fig. 4.

fian duct, the two limbs attaining separate openings into the urogenital sinus by the later dilatation and down-growth of the lower end of the Wolffian duct.

Fig. 5.

renal pelvis is a bifurcation. Where this first pelvic division or branching is unusually developed there results a double pelvis with a proximal bifid ureter depending

A much less frequent anomaly than double pelvis is duplication of the kidney on one side with two ureters or, more commonly, a single ureter proximally bifid.

Fig. 6.

Embryologically such an abnormality has essentially the same origin as pelvic duplication, the difference being one of degree, since division of the capping metanephritic blastema is the only additional process required.

Diverticulum of the ureter, then, represents the incompletely developed on one side of two pelvises, or possibly two kidneys. Were one branch of the first bifurcation of the ureteral bulb not surrounded with mesodermal tissue, this branch would remain as a cul-de-sac coming off from the duct. Such we believe has happened in our case, and that further the second primitive calyx has progressed normally, along with ascent of the kidney to its usual position, whereas the uncapped branch for some reason has remained low down in the pelvis (Fig. 6-B).

This explanation is in accord with that given by Wilhelmj for a somewhat similar deformity found by him in an anatomical subject. He reports an anomaly of almost complete duplication of the left ureter with the upper duct fused with a mass of fibrous tissue partially attached to the upper pole of the kidney. Histological study indicated the fibrous mass to have arisen from the ureteral bud and not from the renal blastema. The lower duct ended in a normal pelvis. The two ureters joined one another just as they penetrated the bladder wall and had a common vesical orifice. His interpretation of the finding is that there had been an embryological attempt at pelvic duplication with failure of one branch of the primary pelvis to secure a nephrogenic capping, in spite of which fact, however, the blindly ending upper duct had ascended normally along with the properly developed kidney.

If duplication of the lower end of the ureter were a recognized anatomical variation, one might assume one limb of the bifurcation could fail of communication with the bladder or other structure and thus form a diverticulum. The generally accepted embryology of the ureter, however, offers no explanation of this type of partial duplication and one is, therefore, not surprised at the absence in literature of authentic instances of such deformity. We have found record of only one case under title of "bifurcation of the lower ureter." This is a case report by

Bugbee and Losee in a most interesting article on congenital anomalies of the kidney and ureter. Their diagnosis was based upon the reappearance of ureteral catheter through an unsuspected second left orifice after the catheter had advanced 2.5 cm. As the ureter was probably tuberculous and might, therefore, have ulcerated into the bladder above the meatus, and as furthermore, bifurcation was not demonstrated by operation or autopsy, we feel that the diagnosis can not be accepted as proven.

BIBLIOGRAPHY

- Guiterns, R.: *Urology*, 1913, i, 621.
 Delmas and Delmas: *Ann. d. Mal. d. Org. Genito-Urin.*, 1910, i, 769; 865; 984.
 Bucher and Lasec: *Surg., Gyn. and Obstet.*, 28: 97, February, 1919.
 Young and Davis: *J. Urology* 1: 17, February, 1917.
 Pohlman, A. G.: *Bull. Johns Hopkins Hosp.*, 1905, xvi, 51.
 Hurlett: *Ann. d. Mal. d. Org. Genito-Urin.*, 1905, 150.
 Wilhelmj, C. M.: *Anat. Rec.*, 18: 2, March 20, 1920, 179.
 Kelly and Burnam: *Diseases of the Kidneys, Ureters and Bladder*, 1914.

DISCUSSION

Dr. Albert Goldstein, Baltimore, Md.—The literature speaks practically nothing at all of any similar case. I have been studying the same thing for some months and have come across a case somewhat similar to Dr. Neff's. The history is also somewhat similar, a history of ureteral colic attacks. The general and cystoscopic examinations were negative except in the region of the left ureter. In that region there was a definite bulging which was cystoscopically about the size of a large walnut. It would fill up and remain there. If the catheter was put in, the dilatation would relieve itself, but upon removal of the catheter it would refill. It was impossible at first to get a catheter into the ureter, so I put it as far as I could get it, just under the opening at about this point (indicating on picture), and got this picture showing no dilatation of the pelvis, but a distinct bulging here (indicating). This is not the same as in Dr. Neff's case, for this comes directly in front of the ureteral opening, thus obscuring the opening of the ureter. I called this a ureteral diverticulum. It was in the intramural portion of the ureter, and just whether it was a diverticulum or a ureterocele is questionable. Perhaps Dr. Neff can straighten me out on it.

The patient refused an operation; put it off till some other time. He came to me on account of albuminuria, on account of which an insurance company had turned him down. I have not operated upon him and, therefore, can not say whether the same condition exists as in the case of Dr. Neff, but there was this very distinct bulging in front of the opening and the catheter would go up so far and no farther; but above the dilatation I was able to pass the catheter into the kidney pelvis.

Dr. Neff (closing).—It would seem to me that Dr. Goldstein's case suggests an ureterocele rather than a diverticulum of the ureter.