THE CLINICAL SIGNIFICANCE OF THE FORM AND CAPACITY OF THE RENAL PELVIS.*

With Lantern Demonstrations.

By HENRY WADE.

THE primary object of this communication is to demonstrate, with the aid of the lantern, photographs that will illustrate certain aspects of the clinical significance of the form of the renal pelvis.

The diagnosis of renal disease from the surgical standpoint is now able to be carried out with great accuracy, and of the various methods employed those that are used to demonstrate the form and capacity of the renal pelvis have contributed largely to this result. The form of the renal pelvis is determined by what is known as pyelography, a pyelogram being obtained by injection through a ureteral catheter into the renal pelvis of a solution which, being opaque to the X-rays, outlines that cavity when a photograph is taken. When this is being carried out the amount of fluid which the pelvis will hold can be estimated, or this calculation can be made independently when washing out the renal pelvis while carrying out renal lavage.

In examining a renal case the stage at which pyelography and renal lavage are practised may be mentioned. In such cases a careful and exact clinical examination is of course first made. From the history the patient gives and the findings thus revealed, data are obtained which indicate the necessity of further and more elaborate investigation. This latter having been determined on, and the facts obtained from the customary clinical examination of the urine being forthcoming, the patient is taken to the special examining theatre where a preliminary X-ray examination is carried out of the entire urinary tract. In the great majority of cases, the findings thus revealed will be negative, but in probably about 10 per cent. of the cases the X-ray photograph will reveal definite signs of disease, such as the presence of stone, or the outline of a kidney, the site of old-standing tuberculous disease. At a later date the patient again returns to the examining theatre, and as on this occasion a cystoscopic examination and probably a pyelogram will be

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made, he is suitably prepared for this. A general anæsthetic is very seldom necessary when the former is being done, and when pyelography is being practised the assistance of the conscious patient is required to indicate when the limit of safe distension of the renal pelvis has been reached. The patient having been arranged on the examination table, a catheter is passed and a sample of urine for bacteriological and cytological examination obtained. Thereafter the bladder is filled with a suitable clear fluid medium prior to the introduction of the cystoscope. When the bladder is being filled its capacity is estimated and recorded. After the cystoscopic examination both ureters are catheterised, the catheters which are opaque to the X-rays being passed up into the renal pelvis and the urine from both kidneys thus segregated. While the samples are being obtained, another X-ray photograph is taken with the catheters *in situ*. Thus, in addition to demonstrating the course of the ureters and the relationship that exists between them and any shadow in their vicinity, the possibility of such an occurrence as a unilateral fused kidney is excluded.

When the circumstances of the case indicate, a pyelogram is now taken. The fluid injected is 20 per cent. sterile sodium bromide solution, which is to be preferred to 10 per cent. collargol or thorium solution which were previously used. The fluid may be introduced into the renal pelvis either by gravity or by means of a syringe. The latter is preferred, but the utmost care must be exercised not to over-distend the renal pelvis, and the patient is warned to intimate when the slightest discomfort is felt in the loin. This sensation, combined with the pressure felt in the smooth moving piston of the syringe, tells when the time has come to stop the injection. An X-ray photograph is now taken.

In interpreting the appearances seen in the pyelogram, a knowledge of the normal outline of the renal pelvis is necessary, and the congenital abnormalities and deformities—the result of disease, must be known. In order to demonstrate the outline of the normal renal pelvis and certain of the abnormalities met with, casts in fusible metal were made of kidneys obtained from the post-mortem room and the operating theatre. These will be demonstrated with the lantern.

The form of the renal pelvis is, fortunately, like nothing else in the human body. Minor variations in its structure are of almost constant occurrence, but these are not such as to render

difficult the recognition of a pelvis as healthy, normal in structure, situation, capacity, and contour.

When the ureter is traced up towards the kidney at a point about half-way between the lower pole of the kidney and the lower edge of the hilus it begins to increase gradually in transverse diameter. This dilatation is the commencement of the renal pelvis, which, when distended and viewed from the front, is funnel-shaped, or may be compared to the bowl of a pipe, the pipe bowl being turned outwards through the hilus of the kidney into the renal sinus which has thus an upper convex border and a lower concave one. When well within the renal sinus the pelvis divides into an upper and lower branch, each of which being known as a calyx major. The upper is usually smaller and the more direct continuation of the ureteric passage. The upper calyx passes upwards and outwards, the lower downwards and outwards. After a course of from 2 to 3 cm. in the upper, and 1 to 2·5 cm. in the lower, these major calyces terminate by giving off minor calyces. In a typical pelvis the total number of calyces minores is about 9. It is usual to find a smaller number of calyces attached to the upper than to the lower major calyx—say 4 to the upper and 5 to the lower. These minor calyces pass outwards and terminate around one or two renal papillæ. They are shaped like the calyx of a flower, or may be compared to an acorn cup whose stem is attached to the major calyx and whose cup-like extremity collects the secreting urine. Certain of these minor calyces are not stalked but sessile; whereas the major calyces are usually in the same vertical plane, the minor calyces pass dorsally and ventrally, the larger number being on the ventral aspect.

As has been already mentioned, variations in minor structural detail are very commonly met with in health, a common type being where, strictly speaking, no pelvis exists and the major calyces each have passing from them a narrow tube which unites to form the ureter close to the hilus of the kidney. Sometimes this point of union may be situated closer to the bladder, or quite commonly two ureters may be present opening independently close to each other into the bladder. Not infrequently between the upper and the lower calyx another cavity is found, thus forming three major calyces in this type.

Certain of the congenital abnormalities met with will be referred to now.

The single functionating kidney.—From the information

revealed at the post-mortem examination of approximately 2000 cases, a single functionating kidney is met with once in 120 subjects. The profound clinical significance of this fact, especially to the operating surgeon where the question of nephrectomy arises, is obvious. There will be demonstrated on the screen a specimen showing this abnormality which is chosen from several, as it clearly shows that a kidney may, by congenital atrophy, be no larger than the size of a bean, and have passing from it a ureter of normal size and situation and such as would permit of the passage of a ureteral catheter. The absence of secretion from this side would suggest the possibility of such a congenital abnormality, but its presence can only be demonstrated accurately by the taking of a pyelogram. Pyelograms from such a case met with clinically will be shown.

The horse-shoe kidney is slightly less frequently met with. All the various forms of disease that occur in the renal organs may involve one or both limbs of it. It is only by means of pyelography that its presence can be demonstrated. The appearances thus seen are characteristic, and these are the direction of the lower calyces medially and the rotation of the others so that they are situated on a more antero-posterior plane.

Congenital cystic disease of the kidney gives a characteristic pyelogram.

A pelvic kidney can be easily demonstrated by this means also, but when examining such a case it is important to remember that the pelvis has not a normal contour but is always deformed.

The unilateral fused kidney is fortunately of rare occurrence, but the possibility of its presence has always to be borne in mind, as when it is diseased and operative treatment is undertaken, disaster may possibly follow. In such cases, although the ureters may be coming from a single organ situated on one or other side of the body, it is usual for them to enter the bladder in the normal situation. If X-ray catheters be used and a pyelogram taken the presence of this condition is immediately recognised.

Acquired deformities.—When the ureteral catheter enters a hydronephrotic sac and drains this cavity, the renal residual urine liberated, instead of being the customary few drops, may amount to from 80 to 200 c.c. or more. A pyelogram of such

a case shows the expanded renal pelvis and the deformed and blunted calyces.

Renal infections.—Chronic pyelitis is frequently associated with a certain degree of dilatation of the renal pelvis. A pyelogram reveals this and may with great advantage be taken, for not only is further clinical knowledge thus obtained, but the renal lavage with which it is associated is frequently immediately curative even where the disease is of long standing.

Tuberculous disease.—In diagnosing renal tuberculosis various investigations are made. The taking of a pyelogram is not the most important, but when made usually presents a characteristic appearance. Renal tuberculosis that has proceeded to cavity formation shows the outline of this cavity along with the outline of calyces more or less normal in the uninvolved renal tissue. In no other disease is such an appearance met with.

Renal calculi.—In investigating a case of suspected renal calculus where the preliminary X-ray examination shows a suspicious shadow, there has first of all to be determined whether this be a stone or not. The X-ray ureteral catheter acting as a pointer will indicate this. Thereafter the degree of damage the stone is producing has to be found out, and to do this a pyelogram is taken. This may show the outlet of the pelvis to be totally occluded, or where the stone has acted as a ball valve hydronephrosis may be revealed.

Kidney tumours.—The early recognition of malignant disease of the kidney is of great clinical importance, and in achieving this pyelography promises to be of great assistance. The characteristic features of the pyelogram in such a case is the destruction of certain of the calyces in the portion of kidney involved in the growth and the drawing out and flattening of others in this vicinity. The appearance of this characteristic picture is such as to warrant immediate operation, so that if the presence of a malignant tumour is confirmed it may be treated by radical removal of the disease.

Discussion.

The President (Sir David Wallace) thanked Mr Wade for his singularly interesting demonstration, and pointed out that this type of work was of a pioneer nature in Edinburgh in this special branch of renal surgery. Mr Wade had demonstrated how necessary these newer and more elaborate methods were in connection with diagnosis.

Some conditions of the kidney and ureter could only be differentiated by this elaborate technic, and he hoped Mr Wade would extend his work and be given facilities for investigating such cases, so that data might be got by which earlier conclusions could be drawn as to the nature of these more obscure cases.

Dr Chalmers Watson said Mr Wade's address recalled to his mind his first experience of the practice of "renal lavage," when he had the pleasure, some years ago, of seeing one of his surgical friends apply, with great skill and success, renal lavage to a series of three cases, the pelvis of both kidneys in each patient being washed out, the whole operation extending little over one hour. Since that time he had been profoundly interested in the local evolution of this branch of surgery, and still more in its yet unexplored regions in connection with a large group of cases which were not essentially surgical. In connection with the size and shape of the renal pelvis, as illustrated by Mr Wade's slides, one could not but be impressed by the marked variations in size and form which suggested that there may be proportionately as marked individual variations as there are in the external characteristics of the individual, but the point which he wished more particularly to refer to was the value of renal lavage both as a diagnostic and therapeutic measure. Perhaps, at a later date, Mr Wade would give the results of his experience in this direction in a very large group of common disorders, in which pyelitis is a prominent accompaniment. At the outset it would, however, be useful to know Mr Wade's definition of chronic pyelitis. Mr Wade's communication recalled an experience of the speaker's a few years ago when, in a communication to the Society, he drew attention to and discussed the clinical significance of the associated bacteriuria which was such a frequent accompaniment. The views which he ventured to express at that time did not much commend themselves to the subsequent speakers on that occasion. Mr Wade's present communication is very valuable, and still further emphasises the need for further investigation of the problems as they were then presented. It would be interesting to hear from Mr Wade the conclusions he would draw as to the sterile or non-sterile condition of the urine when drawn off at a single examination. This comment was suggested by the speaker's experience of a case some years ago, in which he had the advantage of Mr Wade's co-operation, a young girl who presented all the characteristic clinical features of acute pyelonephritis. The clinical history, confirmed by the enlargement of the kidney and the condition of the urine, made the diagnosis apparently clear both to the speaker and to Mr Wade. After the subsidence of the acute condition, the urine as drawn off from the left kidney was found to be sterile, yet, in a few days, there was again a free bacteriuria and a discharge of pus. This investigation

was repeated later, and the identical results again obtained, the bacteriological examination on this occasion being carried out in another laboratory. These findings raised points of great moment both as regards diagnosis and treatment of disease on the lines advocated. It was to be hoped that Mr Wade would get opportunities for extending his investigations on these wider lines, and that we might have the advantage, at a later date, of a fuller presentation of the results and advantages of these modern methods from the point of view of the surgeon and the physician, and also the consideration of certain difficulties which presented themselves as to drawing conclusions from too limited an angle.

Sir Harold Stiles said that the evolution of Mr Wade's work in this special line of surgery showed clearly the value of approaching such a subject through the anatomical facts in the first instance, and then passing to the pathological findings which founded the basis for the later clinical investigations. Sir Harold also referred to the importance of a thorough training in general surgery, through anatomy and pathology, before any special line of surgical work was adopted. He emphasised the importance of giving every facility to a general surgeon to specialise in the particular line he desired to follow.

Dr W. A. Alexander spoke of the incidence of developmental anomalies of the urinary tract and stated that in a series of 500 autopsies he had noted—(1) The presence of a *bifid ureter* on six occasions. The condition was bilateral in two cases, right-sided in two and left-sided in two. The double ureters joined a short distance above the uretero-vesical junction in all cases, so that the ureteric orifices in the bladder were not increased in number. (2) *Complete absence* of the right kidney and ureter on one occasion, the left kidney being healthy but for hypertrophy. (3) One example of a *rudimentary right kidney*. The organ was as large as a haricot bean. The right ureter was patent and the left kidney hypertrophied. (4) One case of *failure of development* of all but the upper pole of the right kidney. This portion of the ureter and the left kidney were healthy. (5) One example of complete and one of incomplete *horse-shoe kidney*. In the latter, the right kidney had a medical prolongation of its lower pole, in a groove on the anterior aspect of which the ureter lay. (6) A *pelvic kidney* on the right side in one case. (7) Two examples of large single *congenital cyst*, one occupying the upper pole of the right, the other the upper pole of the left kidney. Both were as large as a cricket ball. (8) Four cases exhibiting *congenital cystic disease*. In three of these, there was present also a cystic condition in the liver. All these abnormal findings were in adults.

Mr Wade replied and referred to certain cases of multiple abscesses in kidneys in relation to the line of treatment he would adopt.

Election of President

PRIVATE BUSINESS.

Meeting—7th November 1923.

The following were elected Members of the Society:—Henry Hilton Brown, M.B., Ch.B., D.P.H.; Allen Thomson Sloan, D.S.O., M.B., Ch.B.; Alastair Fraser Lee, M.C., M.D.; Ernest H. Cameron, M.B., Ch.B., F.R.C.S.; W. E. Hudleston, M.R.C.S. Eng., L.R.C.P.Lond.; Wm. Alexander Cochrane, M.B., Ch.B., F.R.C.S.; James Walker Dawson, M.D.; J. B. Cunningham, M.B., Ch.B.

ELECTION OF PRESIDENT.

Sir David Wallace thanked the Society most heartily for the honour they had done him in electing him President of the Society. He assured the members he would do his best to fulfil the trust they had placed in him.

He then proposed a cordial vote of thanks to Sir Robert Philip for the address he had just given them. He was sure no one could have given a more excellent Valedictory Address when vacating the Chair, which he had held with so much distinction during the past two years. Sir Robert Philip had a *flair* for conducting meetings. Sir David remembered a memorable meeting of the Society, many years ago, when Sir Robert, in a very able address, brought tuberculin to the notice of the medical profession in Edinburgh, shortly after his return from Germany, where he had been working with Koch. The room was crowded to overflowing, and the audience listened with rapt attention to Sir Robert's lucid exposition. Since then the retiring President had demonstrated to Britain and the world at large his extraordinary organising power and long vision in dealing with tuberculosis. The Society had been fortunate in having these powers at their disposal during the past two years.

Professor William Russell cordially seconded this vote of thanks.