OBSERVATIONS ON UNILATERAL DIURESIS.

BY

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At the Clinical Congress of the American College of Surgeons held at Boston in October, 1922, I had the honour of presenting an account¹ of what for convenience I termed unilateral diuresis, based on a study of 448 cases, in which both ureters were simultaneously catheterized and the specific gravity of the specimens recorded. Since then 50 further observations have been added; these do not materially affect the statistics then given, but tend to confirm the view I have so often expressed—namely, that diminution of the specific gravity of the urine on the affected side is of such frequent occurrence in certain disordered conditions of the kidney as to be of considerable assistance in diagnosis.

A small irritating stone in the pelvis of the kidney may give rise to a unilateral diuresis so definite and striking as to impress even the most casual observer, affording strong confirmatory evidence of renal disturbance in the absence of such gross signs as pus or blood in the urine. The following is an example.

A woman, aged 34, had had frequent attacks of pain in the left lumbar region, radiating to the lower extremity. The right kidney was movable. Although there was a history that in one of these attacks the urine had been dark in colour, repeated examination subsequently failed to discover blood or pus. A small amount of albumin was occasionally present. Pressure in the left renal region gave rise to pain in the right. X rays, which at that time were less reliable than at present, failed to demonstrate any abnormal shadow. The patient was advised by her medical attendant to have the right kidney fixed in position, on the supposition that its mobility might be responsible for referred pain in its fellow of the opposite side. Ureteral catheterization, however, showed that the left ureter was discharging more rapidly than the right, and that the specimen from that side had a specific gravity of 1005 as compared with 1015 on the right. There was albumin in small quantity on both sides, but the amount was greater on the left. Blood and pus were absent on both sides. Acting on this evidence, notwithstanding the negative x-ray findings, I explored on the left side and found a small calculus in the pelvis of an otherwise healthy looking kidney. The calculus was rough and irregular in shape, weighed half a gram, and was composed of calcium oxalate.

This observation was made in the year 1908, and impressed me so much that I began to keep a record of all cases in which simultaneous catheterization of the ureters had been carried out. In most of these the catheter was passed only a few centimetres into the ureter so that the rhythm and volume of the jets might be the more easily observed. The results have been described in the paper referred to.

As I have already said, a small renal calculus will produce in certain cases a rapid flow of pale, limpid urine of low specific gravity on the *affected* side. The flow from the *sound* side may be correspondingly diminished, and the specimen so concentrated that a copious precipitate of urates is rapidly deposited. The relative specific gravities may be 1005 or less on the affected side, as against 1015 to 1030 on the sound side.

When a renal calculus has long been present other complications are introduced, such as pyelitis, hydronephrosis, etc., and in these conditions also the specific gravity will often be found lower on the affected side, possibly from a different cause. In tubercle of the kidney an exactly similar state of affairs is present. Lowered specific gravity was present in practically every case examined. In a large proportion it was 1005 or less, as against 1015 to 1025 on the sound side. A localized focus of tubercle communicating with the pelvis of the kidney may produce a diuresis on that side strongly resembling that caused by a renal calculus, as in the following case, recently under treatment.

A man, aged 35, who had had hip-joint disease when a boy, began to suffer from frequency of micturition three months before I saw him. Two months later a deposit appeared in his right epididymis. Tubercle bacilli were found in his urine. Specimens were obtained from both ureters. On the right side the flow was sluggish and the specimen was deep amber in colour, sharply acid, had a specific gravity of 1020, and was free from abnormal constituents. The flow from the left side was rapid, and the specimen was pale amber in colour, cloudy, acid, had

a specific gravity of 1010, and contained a small amount of pus and albumin. The percentage of urea on the right side was 1.94 as against 1.25 on the left, and that of sodium chloride 1.67 on the right as against 0.766 on the left. Tubercle bacilli were found in the specimen from the left. The amount of urine passed in the twenty-four hours varied from 40 to 50 oz. The left kidney was explored. Nothing abnormal could be seen on outward examination, except a little thickening of the ureter. On removal and section a small cavity about the size of a cherry stone was found in the upper pole, communicating with a neighbouring calyx. One grey tubercle was found in the cortex of the upper pole on stripping the capsule. The remainder of the kidney appeared perfectly normal to the naked eye. Microscopical examination showed a caseous area in the upper pole, surrounded by small round-celled infiltration. Portions of the remainder of the kidney were examined and found to be normal.

As in calculus, the later manifestations of tubercle produce changes in the kidney which seriously affect its structure and function, and are again associated with lowered specific gravity on the affected side.

A further example of the type of diuresis we have been considering is afforded by unilateral pyelitis. In cases with little involvement of the parenchyma of the kidney the picture closely resembles that of stone or early tubercle—namely, increased flow of urine of low specific gravity on the affected side, as in the following case.

A woman, aged 36, was examined six weeks after the onset of her illness. She had frequency of micturition with pain during the act and occasional small quantities of blood in the urine. X-ray examination was negative, and coliform bacilli were found in the urine. The flow from the right side was more rapid than that from the left. The specimen from the right side was pink-coloured, contained pus and blood, and had a specific gravity of 1005. That from the left was free from pus, contained a few red cells, probably due to trauma, and had a specific gravity of 1015.

In cases of stone and pyelitis, on removal of the cause, the specific gravity and the flow soon become equal on the two sides, as in the following case, recently under observation.

A man, aged 34 years, previously healthy, was seized ten days before I saw him with severe pain in the left loin, radiating to the umbilicus. The pain was described as "terrible" and lasted until relieved by morphine two hours after its onset. He had a second more prolonged attack a week later, a third two days later still, and one shortly before being cystoscoped. In the later attacks the pain was described as lower down than in the first attack. Catheters were passed into each ureter. On the left side the catheter encountered an obstruction a short distance from the ureteral meatus, which was negotiated with a little difficulty. The flow from this side was vigorous and free, while that from the right was much more sluggish. The specimen obtained from the left side had a specific gravity of 1010, contained chlorides 0.304 per cent., urea 0.48 per cent., and was much greater in quantity than on the right. That from the right side had a specific gravity of 1030, contained chlorides 0.836 per cent., urea 2.16 per cent., and was discharged in drops, depositing urates on cooling. X rays showed a small shadow about the size of a large pin's head at the lower end of the left ureter. The patient was sent to a nursing home, where he remained for four days. During this time he only passed about 20 oz. of urine per diem. On the evening of the third day a small, spiculated calculus was passed per urethram, and all pain ceased. Four and a half days later his ureters were again catheterized, with the following result: There was no demonstrable difference in the rate of flow on the two sides. The specific gravity was 1015 on both sides. The specimen from the left side showed 1.45 per cent. of chlorides and 0.84 per cent. of urea, while that from the right showed 1.40 per cent. of chlorides and 0.78 per cent. of urea. In other words, the specimens on the two sides were now almost identical in composition, as regards chlorides and urea. On both occasions there were a few red blood corpuscles in the specimen from the left side, but no pus in either.

The cases just described illustrate a type of unilateral diuresis to which the term "acute" may be applied to distinguish it from the "chronic" variety in which more definite changes in the kidney are present. When the secreting structure of the kidney has been encroached upon by disease or new growth there is still a lowered specific gravity on the affected side, but the amount of urine secreted diminishes with the progressive involvement of the organ until most or all of the work is thrown on the sound kidney. This takes place in the later stages of calculus, tuberculosis, pyelonephritis, cystic kidney, hydronephrosis, pyonephrosis, and new growth. I have given examples of these in the paper referred to. The term "diuresis" as applied to these later stages, in which though the specific gravity of the urine is low the quantity is diminished, is obviously inaccurate. The following recent case is instructive.

A man, aged 58 years, had noticed for a period of about six months the occasional presence of blood in his urine. The attacks were very transient and repeated attempts failed to locate the

origin of the blood. The patient was fat and the kidneys could not be palpated. X-ray examination was negative. Ureteral catheterization showed a specific gravity of 1015 on the left side as against 1025 on the right. There was a little blood in the specimen obtained from the left side by the ureteral catheter, but no colour was seen in the efflux before the catheter was passed. The case was further complicated by the presence of a trace of albumin on the right side. The flow on the left side was scanty compared with that on the right. The chloride output was 0.33 per cent. on the left side as compared with 1.25 per cent. on the right. The question here was whether the small amount of blood in the specimen obtained from the left side was due to trauma inflicted by the ureteral catheter. I determined, however, to explore the left kidney, assuming that a diminished flow of non-purulent urine of low specific gravity on that side indicated much encroachment on the kidney substance, probably by tumour. At operation a large hypernephroma was discovered occupying almost the whole of the posterior surface of the kidney. A strip of kidney substance remained anteriorly and at the poles.

In the condition known as symptomless renal haematuria or essential renal haematuria there is less likely to be a diminished specific gravity on the affected side on account of the absence of gross changes in the kidney. A difference in specific gravity on the two sides is therefore in favour of new growth rather than the less serious complaint. The significance of this point in diagnosis, should it be substantiated by further observation, is obvious.

I am now engaged with Professor Milroy, of the Physiological Department of Queen's University, Belfast, in an investigation of the relative chemical composition of the specimens from the two sides in these cases of unilateral diuresis. Up to the present I have been chiefly concerned with the specific gravity test as a help in diagnosis. The following is a short summary of the statistics given in my previous paper with this point in view.

Renal Calculus.—Forty-one unilateral cases were examined. In 31, or over 75 per cent., the specific gravity was diminished on the affected side.

Tuberculous Kidney.—Thirty-eight unilateral cases were examined, and the specific gravity was diminished on the affected side in 37, or 97 per cent.

Unilateral Pyelitis.—Thirty-nine cases were examined, and of these 33, or a little over 84 per cent., showed a diminished specific gravity on the affected side.

Tumours of the Kidney.—Nine cases were examined, and in 7 of these, or 77 per cent., the specific gravity was lower on the affected side. A tenth case (quoted above) was lately examined and here again the specific gravity was lower on the affected side—1015 as against 1025 on the sound side.

Congenital Cystic Kidney.—Two cases were examined, both bilateral. In one the disease was more advanced on one side and the specific gravity on that side was 1005 as against 1010 on the opposite side.

Hydatid Cyst of the Kidney.—One case was examined, and the specific gravity on the affected side was 1005 as against 1015 on the sound side.

Hydronephrosis and Pyonphrosis.—Nineteen cases were examined, and all showed, as might be expected, a diminished specific gravity on the affected side.

Morbid Kidney.—Fifteen cases were examined, and 8 showed a diminished specific gravity on the affected side.

Renal Haematuria (including such diverse conditions as congenital haemophilia, Henoch's purpura, bilateral nephritis, and the condition known as "essential renal haematuria" or "symptomless haematuria").—Thirty-seven cases were examined, and in 9 only of these was there a diminished specific gravity on one side. It is quite possible that in these exceptional cases unrecognized stone, tubercle, or tumour may have been present.

Renal Pain.—I have examined 44 cases of what has been described in the notes as "renal colic." In 27 of these, or just over 61 per cent., there was a diminished specific gravity on the side of the pain. Further investigation of these cases might have revealed some of the conditions I have referred to above, but for various reasons I had not the opportunity of continuing my observations on them.

Wounds of the Kidney.—These cases were investigated while on service in France during the war.² In 19 bilateral catheterization was carried out, and of these 9 showed a diminished specific gravity on the affected side.

In my previous article I discussed the causes of the phenomena just described. It will be sufficient here to repeat what I said on the question of anuria and polyuria in renal calculus.

"While much has been written on unilateral and bilateral anuria, very little has been said of the occurrence of unilateral diuresis from whatever cause produced. My own experience is that unilateral diuresis is a much more common result of renal calculus than anuria. The explanation of both phenomena is afforded by a study of the nerve supply to the kidney and its influence on the blood flow. Through the splanchnic the kidney receives vaso-constrictor and vaso-dilator fibres. The stimulus of a calculus in kidney or ureter may cause vaso-constriction and reduction or cessation of the secretion of urine on that side, due to diminished blood flow through

the glomeruli. On the other hand it may cause vaso-dilatation, increased blood flow, and diuresis. My observations lead me to believe that the latter is the more common occurrence."

Unilateral diuresis may occur without any pain whatever. Cushny³ discusses "pressure diuresis" seen in animals when one ureter is slightly obstructed, and states that it is almost certainly due to reflex vaso-dilatation and disappears at once when anaesthesia is deepened. He suggests that a slight stimulus arouses a dilator effect, while a stronger one, such as the pain of a calculus, sets the more powerful constrictor in action and thus leads to anuria. My observations, however, tend to show that severe pain in renal calculus is much more commonly associated with diuresis than anuria.

In some rarer cases the specific gravity is increased on the affected side. These occur occasionally when some slight obstruction is present, as in cases of movable kidney, where a kink is presumably the cause. Cushny explains a similar phenomenon in animals by saying that the effect of the obstruction is to oppose the filtration pressure in the capsule. A low resistance may reduce the amount of the filtrate considerably. The smaller amount of filtrate passes more slowly along the tubules and more time is allowed for the reabsorption of water and sodium chloride. It is difficult to understand why the same cause should produce at one time reflex diuresis and at another diminished flow and increased concentration of the urine.

I have brought this subject forward to emphasize the value of a sign that may help in diagnosis where the surgeon is perhaps deprived of more accurate methods of investigation. I have myself been placed in circumstances where even a reliable x-ray plant has not been available, and have had to act on the information obtained by such examination of the patient as I could myself conduct.

The statistics just quoted and the cases here recorded seem to me to be sufficiently striking to warrant greater attention being paid by urologists to the value of diminished specific gravity of the urine on one side as a sign of diagnostic importance in certain unilateral affections of the kidney.

REFERENCES.

¹ *Surgery, Gynecology, and Obstetrics*, January, 1923, pp. 16-23. ² *British Journal of Surgery*, 1917, v, No. 18. ³ *The Secretion of Urine*, Longmans, Green and Co., 1917.

RESECTION OF RIBS, SPLENECTOMY, AND SUTURE OF THE STOMACH AND DIAPHRAGM: RECOVERY.

BY

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A CHINAMAN, who had in his possession one hundred rupees in notes, was walking at night along the local mountain railway track with a friend with whom he was discussing the ways and means of sending this money to China. As they sat down for a rest the friend stabbed him deeply in the left thorax. A fight ensued, during which the assailant made off, having been struck about the face. The wounded man, still in possession of his money, made his way to the station, where he collapsed in a Burman's hut. The distance he walked was about one and a half miles along a railway track.

The assault took place about 9.30 p.m. The engineer in charge of the station took down the dying declaration prior to the arrival of the police. Eventually the wounded man was transferred to the Namtu General Hospital about 2 a.m., when another ("official") dying declaration was taken by the Government magistrate in the presence of the accused, police, and Chinese interpreter. This ceremony (which involved the burning of paper when taking the oath) took place in the operating theatre, where everything was in readiness for operation.

The patient was a well built robust Chinaman, a Corporation Mine coolie, aged 22. There was an incised wound of the left chest wall, in the anterior axillary line, through which protruded a piece of omentum, and air whistled loudly in and out of the opening. The wound was 1½ in. long and vertical in direction. There were other wounds—namely, an incised wound in the scalp