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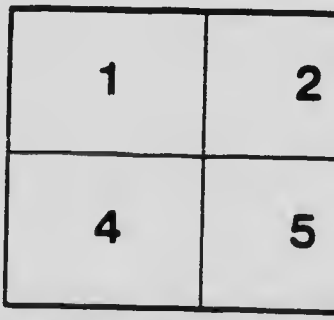

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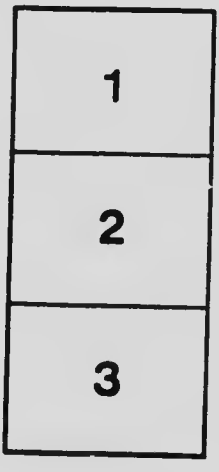

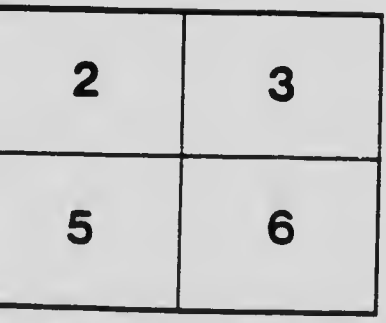

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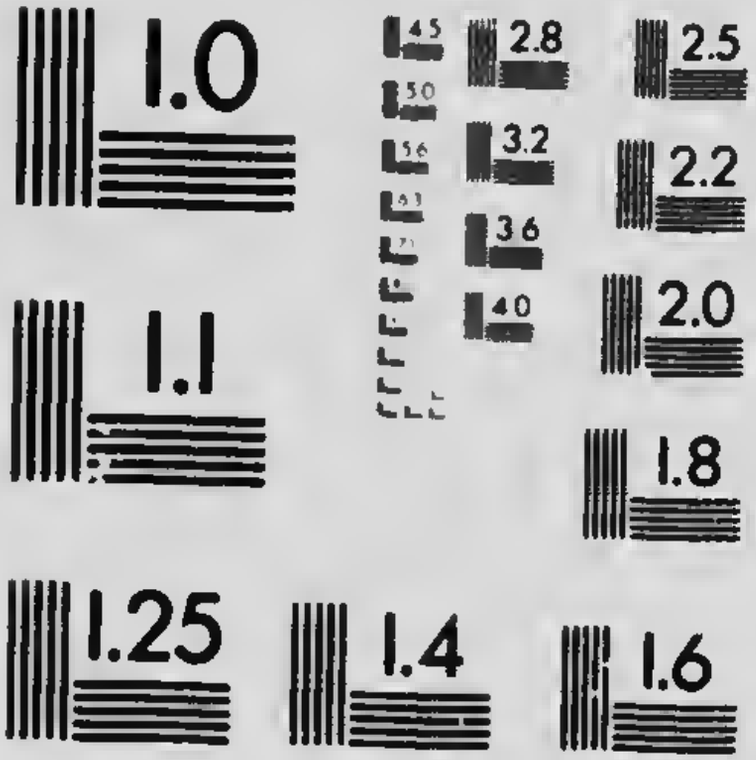

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(REPRINTED FROM THE ANATOMICAL RECORD, VOL. 19)

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SYMMETRICAL BILATERAL DYSTOPIA OF THE KIDNEYS, IN A HUMAN SUBJECT, WITH OUTWARD ROTATION OF THE HILUS, MULTIPLE ARTERIES AND VEINS, AND A PERSISTENT POSTERIOR CARDINAL VEIN

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TWO FIGURES

In the laboratory of the Department of Anatomy of the University of Toronto a very interesting series of associated anomalies relating to the kidneys and their vessels was discovered during the regular course of dissection. The specimen was at once put aside for investigation, and on further study has been considered worthy of a detailed description.

The body was that of a well-proportioned but somewhat emaciated male, aged twenty-seven, who died of pulmonary tuberculosis. Apart from the abnormalities associated with the kidneys, no other gross anomalies were noticed in this subject.

THE KIDNEYS

Shape and size (fig. 2)

The outline of the kidneys is that of a long, narrow oval. The ventral surface is quite convex, the dorsal surface flattened. Of the two poles, the lower is much thicker than the upper. A shallow groove winding spirally from the ventral surface laterally and caudally on to the dorsal surface forms the hilus, and notches the outer border where it crosses it. Except for the presence of the hilus, the surface is smooth, and shows no special lobulation.

The measurements taken are as follows:

	Right kidney	Left kidney
Greatest length	10.5 cm.	11 cm.
Width	3.5–4.5 cm.	3.5–4.5 cm.
Thickness	2.5–3.5 cm.	2.5–3.0 cm.

Position and relations (fig. 2)

The two kidneys exhibit a displacement which is quite symmetrical on both sides. Each lies close in against the psoas

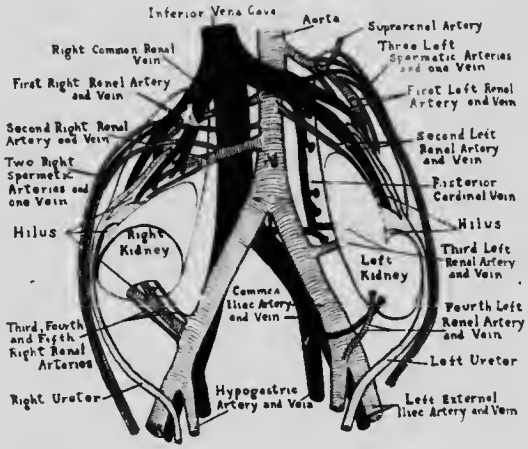

Fig. 1 Outline drawing of the kidneys and their vessels and ureters. Veins are solid black, arteries striped, and ureters stippled. Lower part of right kidney removed.

major muscle and shows the same degree of obliquity as the muscle. The upper pole of each kidney is about 1 cm. nearer the midline than the lower pole. The upper pole is opposite the middle of the second lumbar vertebra, the lower oposite the lower part of the fifth lumbar. The kidney thus lies with its upper portion in the lumbar region, on the quadratus lumborum muscle, the other portion in the iliac fossa, on the iliacus muscle.

The suprarenal glands were placed over the upper pole and slightly to the medial side of each kidney. The left gland was

situated in a small space with the kidney below, pancreas above, spleen laterally and vertebrae medially.

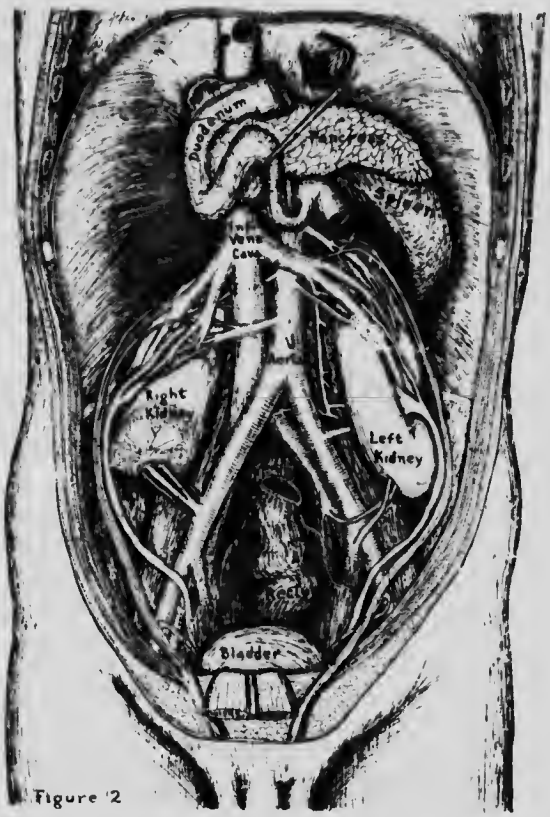

Fig. 2 Drawing of the kidneys to show their relations to the posterior abdominal wall and the viscera. The duodenum, pancreas, and spleen have been retained in position, the lower part of the duodenum being hooked up to expose the underlying vessels. The suprarenal glands have been removed to expose the upper pole of the kidney. Lower part of right kidney removed.

The pancreas was situated entirely above the left kidney and crossed right over the spleen. Owing to the downward displacement of the kidney, the spleen was displaced inward and

was in contact with the vertebrae medially for two-thirds of its length. The lower pole, however, had the upper pole of the kidney inserted between it and the vertebral column.

On the right side the kidney and suprarenal gland lay entirely below the level of the liver, which was thus allowed to come into contact with the diaphragm on its posterior surface.

The upper pole of each kidney and the common renal vein from each side were under cover of the duodenum at the flexure of the latter at the lower end of the descending limb.

The hilus (fig. 2)

The position of the hilus is most interesting, and is quite similar on both sides. Starting above, about three centimeters below the upper pole, on the anterior surface, it runs obliquely caudad to cut the lateral border of the kidney, forming a notch on it about two thirds of the way down. It then curves from here on to the posterior surface, ending about two or three centimeters from the lower end of the kidney.

The hilus is thus placed on the opposite border to the normal and forms a spiral with gradually increasing rotation about the polar axis as it proceeds caudad.

VESSELS

Arteries (figs. 1 and 2)

The renal arteries and also the spermatic arteries of both right left sides are multiple.

Right side. The right renal arteries are five in number. The first comes off the abdominal aorta at the level of the second lumbar vertebra and goes behind the inferior vena cava to the upper end of the hilus on the anterior surface of the kidney. The second renal artery also goes to this surface, coming from the aorta at the level of the third lumbar vertebra and running in front of the vena cava.

Off the right common iliac artery come the third renal artery, a very small one, the fourth, quite large and dividing early into

two, and the fifth, a small artery again. These three arteries running in close company pass behind the lower pole of the kidney and enter the lowermost part of the hilus on the posterior surface.

The right spermatic arteries are two in number. The higher one arises from the aorta between the first and second renals, and runs posterior to the inferior vena cava and both renal veins, but anterior to the upper pole of the kidney. The lower artery arises from the second renal, goes posterior to the inner renal vein, anterior to the outer vein, and anterior to the kidney. At the lateral border of the kidney the two spermatic arteries and the vein form a common bundle running in contact with this border and the ureter in the iliac fossa, and then turning over the psoas muscle to the internal abdominal ring.

Left side. There are four left renal arteries. The first is off the aorta at the upper limit of the second lumbar vertebra and runs down anterior to the upper pole of the kidney. The second artery is from the aorta, over the second lumbar vertebra, level with the highest artery on the right. It is also to the hilus on the upper part of the anterior surface of the kidney.

The third left renal artery is off the left common iliac, and is peculiar in that it runs across the upper part of the iliac fossa behind the kidney, to pass into the hilus just where it cuts across the lateral border.

The fourth artery is off the internal iliac, or hypogastric artery, just at its commencement, and runs anterior to the external iliac artery and psoas major muscle and penetrates the kidney on its medial border just near the lower pole.

On this side there are three spermatic arteries, the highest coming off a suprarenal branch of the first renal, the other two directly off the first renal. All three arteries and the spermatic vein form a common bundle coursing anteriorly along the lateral border of the kidney, then lateral to the ureter in the iliac fossa and down to the inguinal canal.

Veins (figs. 1 and 2)

Right side. There are two renal veins, both coming from the upper part of the hilus over the anterior surface of the kidney, and uniting at the level of the upper pole of the organ into a common vein which is about three-quarters of an inch in length and empties direc[illegible]nto the inferior vena cava.

The right spermatic vein, a single vessel, opened into the lateral of the two renal veins.

Left side. On this side are three renal veins. Two are quite similar to those on the right, arising from the anterior surface of the kidney on the upper part of the hilus and uniting into a common stem which crosses anterior to the aorta and empties into the inferior vena cava.

Just at the junction of the above two veins, there comes into the medial one, a longitudinal vein which lies over the front edge of the psoas musele, on the vertebral column, in the interval between the aorta and the left kidney. This stem starts at the level of the fifth lumbar vertebra, and communicates with the left common iliac vein below. As it ascends it receives astributaries four lumbar veins, one of which is double, and also a renal vein. This renal vein comes from the hilus where the latter cuts the outer border of the kidney, and runs medially posterior to the kidney, alongside of the third renal artery, and ends in this ascending vein. This longitudinal stem is interpreted as a persisting portion of the embryonic posterior cardinal vein of the left side, which lies exactly in the position occupied by this present vein.

The left spermatic vein, single in spite of the presence of three arteries, empties at the junction point of the two large upper renal veins into the common trunk.

Ureter (figs. 1 and 2)

The position and relations of the ureter are remarkably symmetrical on the two sides.

At its pelvis, each ureter is divided into two parts. One is a long, narrow, tubular portion which lies in the upper part of

the hilus, on the anterior surface of the kidney. The other is a broad, short, funnel-shaped portion communicating with the kidney in the hilus just before the latter cuts round the outer border of the organ.

The two parts unite at the lateral border of the kidney, which the ureter now follows to the lower pole, where it then crosses the iliac fossa, turns medially over the psoas muscle and external iliac artery into the pelvis, where its course into the bladder is normal.

The highest artery and the lateral vein accompany the upper branch of the ureter as it enters the kidney, the vessels lying behind. The other vessels enter the kidney mostly behind the lower branch of the ureter.

SIMILAR CASES

Multiple renal arteries and veins in all the locations found in this case have been previously described and discussed by various authors, and so call for no special consideration. Tonkoff ('03), for instance, describes and gives a figure of a right kidney slightly displaced downward and with an arrangment of its four renal arteries almost identical with those of the left kidney in this case.

Macalister ('83) and Morris ('85) both state that abnormal vessels occur in three individuals out of every seven.

The occurrence of a vena cardinalis posterior along with renal anomalies has been noted before. Melissinos ('11) found a case of pelvic kidney with a persistent right cardinal vein, and gives reference to a few other instances.

The presence of the rotation seen in these kidneys, on the contrary, is evidently quite a rare condition. Among the anomalies of position of the hilus, the particular one exhibited here is not even mentioned in the text-books on pathology or surgery. It is self-evident that such a position would be of great interest, especially to the surgeon.

Gerard ('05), in a review of 527 cases, states that the renal hilus, instead of lying medially, may be superior, inferior, ventral, or dorsal, but does not mention any instance of a lateral position.

Müllerheim ('02) describes a case where the left kidney was found in the pelvis, with its hilus not medial, but anterior, and he states that one of the characteristics of dystopia of the kidney is that the hilus is usually anterior in position.

Morris ('04), in a summary of displacements, states that the kidney may be rotated so that the hilus looks upward, outward, directly forward or backward, and mentions one case of the hilus occurring laterally. This case was described by Farquharson ('94) as a left kidney placed in the pelvis with hilus looking to the left.

Brown ('94) also describes a right pelvic kidney which had rotated till its posterior surface had become anterior and the hilus looked posteriorly to the right. Johnson ('14) described a case in the cat exactly similar to that of Brown's and Anitschkow ('12) describes and gives a figure of a left kidney in man displaced slightly back in the lumbar region and with a hilus which he describes as anterior, but which, in the illustration, appears to course around the lateral border, as there is a marked indentation shown there.

McMurrich ('98), considering a series of crossed dystopia of the kidneys with fusion, pointed out that in nearly all cases the position of the hilus was anterior.

This retention of an anterior position of the hilus in displacements and in fusions of the kidneys is the retention of the normal embryological position. Pohlman ('05) noted that until the kidney had ascended in the embryo to where it was approximately in the adult position, the hilus was ventral, and then a rotation medially of 90° occurred about the polar axis. Felix ('12) also states that this rotation occurs, but that a reverse rotation toward the ventral surface also occurs later, so that the hilus is finally ventromedial.

The kidneys in the present case have not reached the usual final level and so might be expected to have retained the hilus anteriorly. This is true of the upper part, but the lower portion exhibits the rare outward rotation through 90° to bring it laterally, and the lowest part goes even further than this to lie posteriorly. There is thus considerable torsion in the kidney, the hilus forming quite a spiral in its course.

The fact that the ureter lies ventral to the main renal vessels at the hilus at first sight appears as an anomaly. It will be seen, however, that if the hilus were to be rotated into its usual position the ureter would then lie posterior to the vessels. Thus at their entrance into the kidney these structures stand in their normal relations to each other, but the rotation makes them appear reversed.

The position of the suprarenal glands is interesting. McMurrich, Morris, Müllerheim, and others have all stated that the relation of these glands to the kidneys is merely topographical and that they are found in their usual places in cases where the kidneys are displaced. In this instance, however, they lie closely capping the upper pole of each kidney, and so are displaced somewhat caudally from their normal location.

What was the actual cause of all the anomalies shown above is open to conjecture. It must have been a force acting in early embryonic life. The displacement into the iliac fossa was probably due to lack of growth in the ureter and the torsion due to a twisting of the pelvis of the ureter. It is of interest to note that Felix ('12) states that in the lumbar region the ureter shows a dilatation accompanied by a spiral twisting. An exaggeration of this process might possibly account for the result shown here. Whatever the cause may have been, the result is most remarkable for instead of a symmetrical displacement of the whole organ, we have here the upper pole with the upper end of the hilus facing still in the old embryological position, while proceeding caudad there is an ever-increasing torsion evident, until finally at the lower end the hilus shows a displacement of 180° brought about by lateral rotation.

The position of the kidneys in the lower lumbar region and iliac fossa seems to be a much rarer condition than the position within the pelvis, as by far the greatest majority of cases of dystopia without fusion are reported as being in the pelvis.

The symmetrical degree of dystopia shown by these two kidneys seems to be almost as rare a condition as the lateral hilus. In all the cases quoted above and in many others not mentioned here, if the two kidneys are not fused to form the discoidal or the

horseshoe kidney, either there is a much greater degree of dystopia on one side than on the other or else only one kidney shows displacement, the other being in its normal position. Thus the kidneys in this instance are unique in several respects and have therefore seemed well worthy of description.

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