Observations on Aberrant Renal Arteries Curving Around and Compressing the Renal Vein

Possible Relationship to Orthostatic Proteinuria and to Orthostatic Hypertension

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Some conditions, considered idiopathic or of only partially known etiology, may have an anatomic basis. Among such conditions are possibly certain postural or orthostatic syndromes related to the kidney such as orthostatic proteinuria and orthostatic hypertension. In the present work some anatomic observations on the renal pedicle are presented that seem to give support to this concept.

DETAILED descriptions of frequent and multiform variations of the vascular elements of the renal pedicle are to be found in the literature. The subject has recently been well reviewed by Merklin and Michaels. Embryologic interpretations of such variations have been given by Broman, Jeidel, Felix, and Bremer.

It is the purpose of the present work to describe a type of aberrant renal artery, curving around the renal vein, which by its particular course may have some importance in the causation of certain pathologic conditions. The only reference found in the literature to an artery having such a course is that of Rupert, who recorded its presence in 2 out of 50 dissected bodies.

Material

The present report is based on the dissection of 400 renal pedicles in 200 dissecting-room cadavers.

Observations

In 7 cases (3.5 per cent) an aberrant inferi or polar renal artery, curving around the renal vein, was present in addition to the normal renal artery. Six of these were on the left side and 1 on the right. The vessel originated from the aorta (figs. 1 and 2) below the level of the corresponding renal vein, and proceeded upward and laterally behind the vein. At the upper border of the vein, the artery curved downward and descended in front of the vein, to reach the kidney near its lower pole. The artery thus described an arch over the renal vein. In all the left-sided cases the arch was lateral to the entrance of the suprarenal and testicular (or ovarian) veins into the renal veins. In 3 of these left-sided cases a testicular artery took origin from the aberrant arched renal artery.

In the single right-sided case the artery first passed posterior to the vena cava.

In all instances the artery was intimately related to the renal vein, which appeared constricted and angulated under the arch of the artery.

No cases were observed of superior polar arteries having a similar course.

Discussion

It is likely that an artery with the course just described is in a position to exert pressure on the renal vein, particularly in the erect posture. The deformations, constriction, and angulation of the renal vein appear to be the result of compression of the arch of the aberrant renal artery. The possibility also exists that the aberrant artery itself is compressed by the renal vein to some extent.

Instances of arteries acting as pathologic agents by compression have been described in various conditions. Thus aberrant renal arteries compressing the ureter have been considered to be etiologic agents in the production of hydronephrosis.
Testicular or ovarian arteries, compressing the renal vein and acting as possible agents in the production of varicocele and orthostatic proteinuria, have been described by the author.\textsuperscript{22, 23} In these cases the gonadal arteries followed an arched course around the renal vein, very similar to that of the renal artery here described. The fact that so frequently in the present study (in 3 cases out of 6 of the left side) a testicular artery took origin from the arched renal artery may point to a common embryologic origin of the 2 arteries.\textsuperscript{11, 13, 14, 23}

A case in which an aberrant renal artery simultaneously produced hydronephrosis and varicocele, by compressing the testicular vein and the ureter, has been described by Campbell.\textsuperscript{24}

A probable consequence of the compression of the renal vein by the aberrant renal artery described in the present study is the appearance of orthostatic proteinuria. It is generally accepted that increased venous pressure in the renal circulation is the cause of this condition. Among the etiologic factors considered as producing this increased venous pressure are compression of the vena cava by the liver (Bull\textsuperscript{25}), and compression of the left renal vein by the "aortic-superior mesenteric arterial plexures"\textsuperscript{26-31} by the arched testicular artery,\textsuperscript{22, 23} or by the ligament of Treitz.\textsuperscript{32}

If the aberrant renal artery here described is capable of compressing the renal vein, it is likely that the pressure in the vein would rise only in cases in which no collateral veins are present to drain the blood adequately from the renal vein. The presence of such collateral veins connecting the renal vein with the parietal lumbar veins spinal venous plexuses, and azygos systems was described by Lejars\textsuperscript{33} and later by Faragasanu,\textsuperscript{32} Anson et al.,\textsuperscript{34, 35} and others. They are absent in a variable percentage of cases.

Since the arched renal artery passed laterally to the entrance of the testicular or ovarian veins, no interference in the normal circulation of these veins could be expected; no cases of varicocele or dilatation, such as were described for the arched testicular arteries,\textsuperscript{22, 23} were recorded. Should a case oc-
cur in which the arch passes medially, then the development of varicocele may be expected.

The possibility of some degree of compression of the renal artery by the renal vein has been mentioned. Were this the case, a kind of "postural, intermittent Goldblatt mechanism" would be established. This might offer an explanation for some cases of orthostatic or postural hypertension described in medical literature. McCann and Romansky have described cases of orthostatic hypertension and attributed the causes to the effect of nephroptosis on the renal blood flow. If both nephroptosis and the arching of the renal artery around the renal vein should occur together, the possibility of twisting and compression of the renal artery would be greater and the probability of causing orthostatic hypertension would be increased.

Ruppert, in describing the 2 cases of renal arteries arching around the renal veins mentioned previously, discussed the possibility of such arteries, when combined with atypical floating kidneys, producing the symptoms of Dietl's crisis. He attributed these crises to twisting of the nervous plexuses surrounding the renal artery.

The importance of these variations of the vascular elements of the renal pedicle in surgery of this region as well as in the interpretation of renal angiograms requires no emphasis. The terminal character and segmental distribution of the polar renal arteries has to be borne in mind in any surgical intervention.

**Summary**

An aberrant inferior polar renal artery of aortic origin, arching around the renal vein, is described. This was found in 7 cases (3.5 per cent) of 200 cadavers (400 renal pedicles dissected). Six cases were located on the left side and 1 on the right.

This kind of artery could be the cause of compression of the renal vein, particularly in the erect posture. The possible consequences of such compression are discussed with special reference to orthostatic proteinuria.

The possibility is considered of the aberrant artery described being partially compressed by the renal vein, again particularly in the erect posture. Should this occur, an "intermittent Goldblatt mechanism" might be established that would offer an explanation of the etiology of some cases of orthostatic hypertension.

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**Summario in Interlingua**

Es describite un typo de aberrante arteria renal infero-polar de origine aortic que forma un arco circa le vena renal. Illo eseva trovate in 7 ex 200 cadaveres (3.5 pro cento) in le curso del dissection de omne le 400 pedicullos renal. Sex del casos eseva trovate al latere sinistre, le septime al latere dextere.

Iste typo de arteria pare capace de causar le compression del vena renal, specialmente in postura erecte. Le consequentias possibile de un tal compression es discutite con referentias special a proteinuria orthostatic.

Es etiam considerate le possibilitate que le arteria aberrante del typo hic describite es comprime le vena renal, de novo specialmente in postura erecte. Si isto occurre, il resultarea le establimento de un "intermittente mechanismo de Goldblatt" forniente un explication del etiologia de certe casos de hypertension orthostatic.

**References**

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