Renal Artery Variations, Hilar Arrangement and Its Distances to Ventral Branches of Abdominal Aorta: A Morphometric Study

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Citation

Abstract
Purpose: To measure the distance of origin of renal artery in relation to the ventral branches of abdominal aorta and also to study the variations in the number and the hilar branching pattern of renal arteries. Materials and methods: The present study was carried out using ten embalmed adult cadavers. The distances were measured bilaterally from the origin of renal artery to the origin of superior and inferior mesenteric artery and the bifurcation of abdominal aorta. Results: Out of ten cadavers studied, bilateral accessory renal artery was observed in two cases. The hilar branching pattern varied from a single artery to maximum of six branches. The mean and standard deviations of the measured parameters were calculated. Conclusion: Knowledge of variations of renal artery is important for surgeons in performing many procedures and may help to avoid clinical complications in the abdominal region.

Key Words: Renal artery, Superior mesenteric artery, Inferior mesenteric artery.

Introduction:
Renal arteries are a pair of lateral branches from abdominal aorta, which arises just below the origin of superior mesenteric artery. Normally each kidney receives one renal artery. However, accessory renal arteries can also exist. The normal renal arteries enter the kidney through its hilum whereas the accessory renal arteries might enter the renal artery through the hilum or through the surfaces of the kidney.(1) The relative position of the main hilar structures are the renal vein anteriorly, renal artery intermediate and the vessels of kidney posteriorly.(2) The kidneys begin their development in the pelvic cavity. When they are located in the pelvis, they are supplied by the branches of internal or common iliac arteries. While the kidneys ascend to lumbar region, their arterial supply also shifts from common iliac artery to the abdominal aorta. It is important to be aware that accessory renal arteries are end arteries; therefore, if an accessory artery is ligated or damaged, the part of kidney supplied by it is likely to become ischemic.(1)

With the advent of laparoscopic renal surgeries and donor nephrectomy, it becomes mandatory for the surgeons to understand the abnormality or variations in the renal vasculature, otherwise renal transplant may be jeopardized. Post-surgical complications and the risk of kidney loss is higher in the cases with multiple renal arteries when compared with the kidneys having a single renal artery.(6) The branches of abdominal aorta are described as anterior, lateral and dorsal. Coeliac trunk (CT), Superior mesenteric (SMA) and inferior mesenteric arteries (IMA) are the ventral branches of the abdominal aorta. CT is the first anterior branch and arises just below the aortic hiatus at the level of T12/L1 vertebral bodies. SMA arises one cm below the CT at the level of L1/L2 intervertebral disc. IMA arises at the level of L3 vertebra, 3 or 4cms above the aortic bifurcation. Abdominal aorta ends at the lower border of L4 vertebra.(7)
Aim of the present study was to measure the distance of origin of renal artery in relation to the ventral branches of abdominal aorta and also to study the variations in the number and the hilar branching pattern of renal arteries.

Materials and Methods

The present study was carried out using ten embalmed adult cadavers from the Department of Anatomy, Kasturba Medical College, Manipal. After removing the abdominal viscera, the abdominal aorta was identified and the origins of superior mesenteric (SMA), inferior mesenteric (IMA) and renal arteries (RA) were noted. The distances were measured bilaterally from the origin of RA to the origin of SMA, IMA and the bifurcation of abdominal aorta. In each side the number of renal arteries, arrangement of structures at the hilum and the hilar branching pattern were also noted.

Results

Out of ten cadavers studied, bilateral accessory renal artery was observed in two cases. There was one accessory renal artery in one cadaver and two accessory renal arteries in the other. The hilar branching pattern varied from a single artery to maximum of six branches. The frequency distribution of the hilar pattern is shown in Table 1.

The commonest pattern of arrangement of the structures at the hilum was vein, artery and ureter from anterior to posterior. Nine kidneys on right side and seven on left side displayed such arrangement. A pattern of artery, vein and ureter from anterior to posterior was observed in one kidney on right side and three on left side.

Discussion:

Knowledge of variations of renal artery is important for surgeons in performing many procedures and may help to avoid clinical complications, especially, during radiological examination and surgical approaches in the abdominal region.(8) Variations in the origin and course of the renal arterial supply occurs frequently and are of special interest to the urologists, nephrologists, surgeons and radiologists, with respect to the diseases associated with it. The incidence of accessory renal artery is also not uncommon. Multiple renal arteries are a common finding in renal angiograms and are more common in the aorta and renal vessels in the donor population subjected to angiography but do not pose any serious risk or contraindication to renal donation.(9) The various studies in the literature are displayed in Table 3.

Figure 1: Dissected specimen of posterior abdominal wall showing the ventral branches of abdominal aorta and the parameters measured. The distance from the origin of SMA to the origin of RA (a) and from the IMA (b) SMA: Superior mesenteric artery, IMA: Inferior mesenteric artery, RA: Renal artery

<table>
<thead>
<tr>
<th>Table 1: Frequency distribution of the hilar branching pattern</th>
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<tbody>
<tr>
<td><strong>Number of branches of renal artery</strong></td>
</tr>
<tr>
<td>One</td>
</tr>
<tr>
<td>Two</td>
</tr>
<tr>
<td>Three</td>
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<tr>
<td>Four</td>
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<tr>
<td>Five</td>
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The mean and standard deviations of the measured parameters were calculated and are shown in Table 2. Unpaired t test did not show any statistical significant difference between two sides.

<table>
<thead>
<tr>
<th>Table 2: Mean and standard deviations of the distances measured from the origin of renal arteries</th>
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<tr>
<td><strong>Distances measured (in cm)</strong></td>
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<tr>
<td>RA- SMA</td>
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<tr>
<td>RA- IMA</td>
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<td>RA- BAA</td>
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<th>Table 3: Comparison of prevalence of accessory renal artery (RA)</th>
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<tr>
<td><strong>Name of author</strong></td>
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<tr>
<td>Sampaio (Brazil, 1992)</td>
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<td>Cicekcibasi (Turkey, 2005)</td>
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<td>Ankolekar (India, 2013)</td>
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<td>Present Study (2014)</td>
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Knowledge of branching pattern of the renal artery is very important for the proper interpretation of radiographic interpretation of renal vasculature and planning surgical procedures in cases of renal trauma, renal transplantation, and partial nephrectomy.(9) In our study we have observed the branches of renal artery as it enters the hilum. Previous studies have observed the normal and early branching pattern.(10-12) The arrangement of renal artery, renal vein and the pelvis, antero-posteriorly exhibited great variation in their relation at the hilum. In majority of the cases (81%) renal artery divided into anterior and posterior divisions within one inch of the hilum.(13,14) A difficult hilar dissection may results in conversion of laparoscopic operation to an open procedure.(15)

In the present study nine kidneys on right side and seven on left side displayed such arrangement. A pattern of artery, vein and ureter from anterior to posterior was observed in one kidney on right side and three on left side.

In the present study the authors have measured the distances from the origin of renal artery to the superior and inferior mesenteric arteries. The literature seldom describes these findings.
References