Study of Accessory Renal Artery in Cadavers and Computed Tomography Angiography

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ABSTRACT

Background: The knowledge of accessory renal arteries is now becoming more important due to increasing number of renal transplants and various other urological procedures.

Aim: The present study was focused to know the origin, course and termination of accessory renal artery in Cadavers and in patients who underwent CT angiography for donor nephrectomy.

Methods: The present study was done in 43 dissected cadavers and 25 patients who underwent CT angiography.

Results: The results of the study showed that the accessory renal artery 1. Arises mainly from the abdominal aorta at the level of L3 vertebra (28%). 2. Most of it enters the hilum (64%) by passing below the main renal artery behind the renal pelvis.

Conclusion: The anatomy of the accessory renal artery is very important to the surgeons to prevent complications during renal transplantation and other renovascular procedures.

Keywords: Renal Artery, Accessory Renal Artery (ARA), CT Angiography, Renal transplantation.

INTRODUCTION:

Number of renal transplantation is increasing rapidly over the last three decades. The advanced renal surgeries like renal transplantation, urological, vascular, oncological surgeries and treatment of renal trauma increases the demand for the study of renal arteries and its variation by both anatomists as well as clinicians. A thorough knowledge of the renal arteries is helpful for the smooth conduct and interpretation of interventional radiological procedures and can avoid unexpected complications during surgery. Several studies have been conducted over the last few years correlating the CT Angiography, MR Angiography and conventional angiographic anatomy with the surgical findings; the cadaveric studies have shown vivid type of patterns. Although a number of studies were carried out in relation to the renal artery, to add more information, the present study was focused to study accessory renal artery in correlation with CT Angiography which will help the surgeons by providing the origin, course and termination of the accessory renal arteries in cadavers and in patients who underwent angiography for donor nephrectomy.

MATERIALS AND METHODS:

The present study was carried out in the Departments of Anatomy and Radiology & Imaging Sciences of Sri Ramachandra Medical
College and Research Institute, Chennai between 2006 to 2008, Departments of Anatomy in Annapoorna Medical College and Hospital, Salem in 2013-2014 and Velammal Medical College Hospital and Research Institute, Madurai in 2014-2016 for a period of 6 years. 43 dissected cadavers (25 in Ramachandra, 6 in Annapoorna and 12 in Velammal medical colleges) were used for research. In the Department of Radiology, it is a prospective non-randomized study involving 25 patients who came for renal angiography during the above period. The age of the patients studied ranged between 25-62 years (16 males and 9 females). Detailed information about the angiographic procedure and probable complications were explained and informed consent was received from all without additional interventions on the patients.

The patients studied had undergone angiography for the following reasons:
1) Willing for donor nephrectomy
2) Aneurysm of the abdominal aorta
3) Suspicion of Renovascular hypertension

METHODS:

Routine Dissection of the Cadavers:
During routine dissection of the cadavers for medical undergraduates, the kidney was approached through the anterior abdominal wall. The origin of renal artery from the abdominal aorta was traced and accessory renal artery if any was traced from its origin. Its vertebral level of origin, side, course and termination were noted. The entire main renal arteries, accessory renal arteries and renal veins were painted with red and blue acrylic paint and photographed.

CT Angiographic Study:
All studies were performed at VCT xt 64 slice scanners. The study was performed after 4 hours fasting in all patients and reviewing their basic reports especially renal function test. The unenhanced as well as the contrast-enhanced axial images were first viewed using cine paging for the arterial anatomical variants. The data was loaded for 3-D processing, surface shaded display and maximum intensity projection images were then generated. The following parameters were assessed as in the cadaver:

1. Origin of accessory renal artery and its vertebral level
2. Course of the accessory renal artery
3. Mode of termination of the accessory renal artery

RESULTS:

1. Origin of accessory renal artery and its vertebral level:

Source of origin:
The presence of accessory renal artery was observed in 12 (Cadaver- 4 and CT Angiogram-8) subjects out of 50 in Sri Ramachandra Medical College, Nil in Annapoorna medical College and 2 out of 12 in Velammal Medical College. Out of the 14 accessory renal arteries, 12 originated from the abdominal aorta and in 2 CT angiograms which showed origin from the right common iliac artery (Figs.7 and 8).

Vertebral level of origin:
The observations of vertebral level of origin of the accessory renal artery was (Table.1)

i. L1: 3 cases (2 on the right side, 1 on the left side).
ii. L1-L2: 3 cases on the left side,
iii. L2-L3: 2 cases,
iv. L3: 5 cases (Fig.7) (3 on the right side, 2 on the left side),
v. L4: 1 case on the right side (Fig.6),
vi. L4-L5: 2 case (Fig. 8) and 
vii. L5: 1 case (Fig. 7).

2. Course of the accessory renal artery in cadavers
The accessory renal artery arising from aorta reach the upper pole of right kidney above the main renal artery in 2 specimens (Fig. 3), below the main renal artery passing behind the renal pelvis to the hilum in 4 specimens.

3. Mode of termination of the accessory renal artery
Examination of accessory renal artery showed that in 14 cases the accessory renal artery entered the kidney through the hilum (64%) (Figs. 3 and 5), in 6 cases it was superior polar (27%) (Fig. 1) and in 2 cases it was inferior polar (9%) (Fig. 2) (Table 2) (Chart).

Table 1: Vertebral level of origin of accessory renal artery

<table>
<thead>
<tr>
<th>Vertebral level</th>
<th>L1</th>
<th>L1-2</th>
<th>L2</th>
<th>L2-3</th>
<th>L3</th>
<th>L4</th>
<th>L4-5</th>
<th>L5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right%</td>
<td>11</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>17</td>
<td>5</td>
<td>11</td>
<td>5</td>
</tr>
<tr>
<td>Left %</td>
<td>5</td>
<td>17</td>
<td>-</td>
<td>11</td>
<td>11</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 2: Mode of termination of accessory renal artery

<table>
<thead>
<tr>
<th>Mode</th>
<th>Number of Specimens</th>
<th>Number of Cases</th>
<th>Percentage %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hilar</td>
<td>4</td>
<td>10</td>
<td>64</td>
</tr>
<tr>
<td>Superior polar</td>
<td>2</td>
<td>4</td>
<td>27</td>
</tr>
<tr>
<td>Inferior polar</td>
<td>0</td>
<td>2</td>
<td>9</td>
</tr>
</tbody>
</table>

Fig. 1 - Right Accessory Renal Artery to the superior pole with cyst

Fig. 2 - Accessory Renal Artery (ARA) to the inferior pole

Fig. 3 - Accessory Renal Artery on both sides to the hilum
DISCUSSION:

Knowledge of the embryology of the renal vasculature and structural development of the kidney is essential for the understanding of the multitude of anomalies that may occur. The anatomical variations of the renal artery will have a lot of clinical importance in the cases of renal transplantation, which was studied in 43 dissected cadavers and 25 patients. The study reports were compared with the previous studies.
The term accessory renal artery in the present study follows currently accepted convention and is used to indicate more than one renal artery. The common variations in the blood supply to the kidneys reflect the manner in which the blood supply continually changed during embryonic and early fetal life. They are regarded as persistent embryonic lateral splanchnic arteries. Approximately 25% of adult kidneys have two to four renal arteries. It is important to be aware that accessory renal arteries are end arteries; consequently, if an accessory artery is damaged or ligated, the part of the kidney supplied by it will become ischaemic.

Accessory renal arteries are common, and usually arise from the aorta. Occasionally, they may arise from the coeliac or superior mesenteric arteries near the aortic bifurcation or from the common iliac arteries. When the kidneys are ectopic or fused, they may arise from the iliac, hypogastric and middle sacral arteries. In the present study, most of the accessory renal arteries originate from the abdominal aorta except in two which show its origin from the right common iliac artery.

Ozkanet al reported in a study observed that the origin of accessory renal arteries was between the upper margin of L and lower margin of L in 74% of the patients. In the present study the vertebral level of origin of accessory renal artery was observed mainly in L, vertebral level at 28%.

Alper Ataseveret al reported an unrotated left kidney associated with accessory renal artery reached the inferior pole of the kidney by passing posterior to the ureter. Bordeiet al reported that the course of the double renal arteries showed:

i. Retro ureteral passage of the supplementary renal artery in 6 cases
ii. Right supplementary renal artery passing anterior to the inferior vena cava in 5 cases.

In the present study, the accessory renal artery passed above the main renal artery in 2 specimens, below the main renal artery passing behind the renal pelvis to the hilum in 2 specimens. The clinical importance of the course of the accessory renal artery is if the accessory vessels to the inferior pole cross anterior to the ureter, it may obstruct the ureter, and causes hydronephrosis.

Accessory renal arteries may also enter the kidneys directly through hilum, usually into the superior or inferior poles. Bordei et al from a study stated that 28 cases of supplementary renal artery entered the kidney through the hilum, 16 cases it was inferior polar, 5 cases it was superior polar. The frequency of accessory renal artery at the lower pole was found to be more than at the upper pole stated by some authors. Cicekibasi et al in a study reported double hilar arteries in 11.1%, an inferior polar artery in 10.5%, and a superior polar artery in 3.3%. In the present study, most of the accessory renal artery entered the kidney through the hilum (64%).

**CONCLUSION:**

Advances in surgical and uro-radiological techniques dictate a reappraisal and definition of renal artery variations. In the present study, level of origin and termination of the accessory renal artery were studied in detail by dissection and CT angiography. Familiarities about the possible variations are important to a surgeon dealing with kidney retrieval and transplantation, various endourological procedures and innumerable interventional techniques.

**REFERENCES:**


