Variations in the aortic - common iliac bifurcation in man - a cadaveric study

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Abstract

Background and aims: The abdominal aorta usually terminates at the level of L4 vertebral body into common iliac arteries. With the present day advancements in vascular surgery and neurological surgeries involving approach to lumbar vertebral bodies, we need to know any variations from this normal course. So, the present study aimed at knowing the anatomical variations in the termination of abdominal aorta and in common iliac arteries which might prove to be of some help in some of such surgeries. Material and methods: The study was conducted on 35 adult (29 males and 6 females) embalmed cadavers obtained from anatomy departments of Govt. Medical college, Amritsar and Gian Sagar Medical college, Ramnagar, Punjab. The abdominal cavity was opened, peritoneum stripped off from aorta at its bifurcation, variations in its termination, common iliac arteries and their branches were carefully observed and recorded. Results: In 54.29% cases the level of aortic bifurcation was found opposite 4th Lumbar vertebra, in the rest it was variable between L3 and L5 vertebra. Conclusions: These variations may lead to some trouble during vertebral surgeries, making it essential to investigate and locate the exact position of great vessels before the commencement of surgery.

Key Words: psoas major, vertebral level, lateral branches, bifurcation.

Introduction

Vascular surgery is advancing day by day leading to increase in procedures on abdominal aorta and its branches. During these procedures, surgeon has to dissect common iliac artery and its bifurcation making it important to have precise knowledge of the variations of these vessels to avoid unnecessary blood loss. Vessel injuries are also the main complications of the anterior transperitoneal approach and anterolateral retro peritoneal approach to the lower lumbar vertebrae.

Abdominal aorta bifurcates at the level of L4 vertebral body with slight left deviation. Each common iliac artery passes downwards and laterally, ends into internal and external iliac arteries at the level of lumbosacral disc anterior to sacroiliac joint. Left common iliac artery is shorter (4cm) than right (5cm) with diameter ranging 7-14mm. Common iliac arteries may give small branches to the peritoneum, psoas major, ureter occasionally iliolumbar and accessory renal arteries.

The objective of the present study was to determine the position of aortic bifurcation, to know any other variation including the branches of common iliac arteries other than terminal branches, in order to set up a data indicating the frequency of such variations, which might be of help in some surgical procedures.

Material and Methods

The present study was conducted on 35 adult embalmed cadavers (29 males & 6 females) obtained from the department of anatomy, Govt. Medical College, Amritsar and Gian Sagar Medical college, Ramnagar, Punjab. Abdominal cavity was opened by a cruciform incision in anterior abdominal wall, coils of intestine pushed upwards and peritoneum stripped off. Vertebral level of aortic bifurcation was noted along with diameter of common iliac arteries and their length. The external diameter of the arteries was measured in mm at the origin with a divider and a graduated scale. Length was measured in cm by keeping a non-stretchable thread in the middle of the artery, marked with Indian ink measured by a graduated scale. The lateral branches of common iliac arteries were also observed and recorded.
Observations

The observations regarding the level of aortic bifurcation are depicted in table-1, the aortic bifurcation opposite L3 (figure-2) was observed in 11.43%, at inter vertebral disc (IVD) between L3/L4 -8.6%, opposite L4-54.29% (figure-1), at IVD L4/L5-14.29% and opposite L5- in 11.43% cases. The most frequent site of aortic bifurcation was at L4.

Length of common iliac arteries in the present study varied between 3cm to 9.7cm. Maximum length was 9.7 cm in females and 9.6 cm in males both on right side. On left side the maximum length was 8.3cm in males, 9.5cm in females.

Diameter of common iliac arteries at the beginning was between 0.9cm-1.5cm in males and 0.9-1.2cm in females. In 74.3% cases, the diameter of the arteries was between 1.0-1.2cm in the present study. In Table-2, the diameter and length of common iliac arteries in males and females have been depicted.

The lateral branches given off by common iliac arteries were iliolumbar arteries in 5 (7.14%) out of 70 arteries, a branch to psoas major in 4 (6%) cases shown in figure-2 and a branch to ureter in 2(3%) pelvic halves.

In one of the cases, the aortic bifurcation presented tortuosity (figure-3). Aorta showed deviation towards right where it bifurcated and common iliac arteries also were tortuous. In two cases (one male and one female) it showed right and left deviation before terminating. In another case, abnormal course of common iliac arteries at their origin was observed where left common iliac artery showed deviation towards right side then turning upwards and to the left and then followed the usual course. Right common iliac artery (CIA) also showed tortuosity at its beginning (Fig.4).

Discussion

Difficulty in laparoscopic approach at L4- L5 has been linked with prevertebral vascular anatomy especially at the level of aortic bifurcation. Access to this level requires careful dissection and vessel mobilization. Aortic bifurcation is at L4 vertebral body just to the left of midline. In the present study, the most frequent site of aortic bifurcation was at L4 (54.29%) in close agreement with the findings of Lakchayapakorn and Sirirakarn who noticed it in 63% and Chithiriki et al found it in 67% of all cases in MRI research, whereas in a radiological study by Lee et al, in 83% cases it was opposite L4 vertebra. Other workers observed it to be in 68.9% and 70.12%. The second frequent site of aortic bifurcation was IVD between L4 and L5 in the present study in 14.29%. The previous workers observed this level in 9%, 4%, and 12.30%. The present observations were in close agreement with the findings of Khamanrong et al who found it in 12.30% cases. The less frequent site of termination at L3 vertebral body was noted in 11.43% in the present work, whereas the previous workers found it in 3%, 2%, 13.5%. At L5, the aortic bifurcation was observed in 20% by Lakchayapakorn and Sirirakarn, in 17.6% by Khamanrong and in 1% by Lee et al, while in the present study, it was observed in 11.43% at the upper border of L5 vertebral body. The variation in aortic bifurcation is thought to be due to more caudal or incomplete migration of the ventral roots of umbilical arteries during intrauterine life.

Length of common iliac arteries in the present study varied between 3cm to 9.7cm. Maximum length was 9.7 cm in females and 9.6 cm in males both on right side. On left side the maximum length was 8.3cm in males, 9.5cm in females. Previous workers observed a maximum length of 7cm on left side in females and 9.5cm on right side in males. Shah et al also observed maximum length of common iliac arteries on right side both in males and females. In the present study, majority of the arteries (44 out of 70 i.e 62.8%) had length ranging from 4.1-6cm in consonance with a study conducted by Lipshtutz. The average length of left common iliac artery in the present study was 5.8cm in males and 5.7cm in females, whereas that of right common iliac artery was
Table-1 shows Vertebral level of aortic bifurcation:

<table>
<thead>
<tr>
<th>No. of arteries</th>
<th>Upper border of L3</th>
<th>Middle of L3</th>
<th>Lower border of L3</th>
<th>IVD L3/L4</th>
<th>Upper border of L4</th>
<th>Middle of L4</th>
<th>Lower border of L4</th>
<th>IVD L4/L5</th>
<th>Upper border of L5</th>
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<td>3</td>
<td>9</td>
<td>1</td>
<td>9</td>
<td>5</td>
<td>4</td>
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Table-2 depicting measurements of common iliac arteries

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<th>Range of measurements</th>
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<th>FEMALES</th>
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<tbody>
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<td>Right CIA</td>
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<td>Left CIA</td>
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<td>4.1-6</td>
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<td>17</td>
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<td>6.1-8</td>
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5.1cm in males and 5.4cm in females. These findings closely resemble those of Feller and Woodburne who observed an average length of 5.9cm in males and 5.5cm in females on left side and 5.6cm in males and 5.3cm in females on right side.

Diameter of common iliac arteries observed by previous authors was between 0.9-1.5cm in males and 0.8-1.6cm in females, 0.65-1cm in males and 0.9-1.4cm in males. In the present study it was between 0.9cm-1.5cm in males and 0.9-1.2cm in females. The difference in observed diameter in females in the present and previous studies may be because of the difference in the number of cases observed. So we need to study more number of females to reach to a conclusion. In 74.3% cases, the diameter of the arteries was between 1.0-1.2cm in the present study. Macchi and Catini reported an average diameter of 8.8mm of common iliac artery and also found it greater in males than females.

A study conducted by Mamoun and Demmel revealed that in 35% cases the common iliac arteries gave rise to lateral branches. These were found supplying iliopsoas muscle, ureter and adjoining lymph nodes. All these branches emerged from dorso-lateral aspect of common iliac artery. In the present study the lateral branches were noticed in 16.14% cases. In surgical procedures near aortic bifurcation, we must keep in mind the probability of finding lateral branches of common iliac artery.

Conclusion

The main aim of this study was to establish a data regarding the variations in level of the termination of aorta, any deviation from its normal position and dimensions, which could prove to be of help in cases which undergo vascular surgery in the region of aortic bifurcation. The number of female cadavers was less, so one can go for more number of female cadavers to improve upon the data.
**Figure-1** showing bifurcation of Aorta at the level of upper border of L4 vertebra.

**Figure-2** showing left deviation of terminal part of aorta and left common iliac artery almost in line with aorta. In addition branch to Psoas major can be seen arising on both sides from common iliac arteries.

**Figure-3** right lateral deviation of Aorta just before bifurcation at the level of L3 vertebra with slight tortuosity of left common iliac artery.

**Figure-4** abnormal course of common iliac arteries at their origin, left CIA showing deviation towards right side then turning upwards and to the left and then following the usual course. Right CIA also shows tortuosity at its beginning.

**Abbreviations**: RCIA-right common iliac artery; LCIA-left common iliac artery; IIA-internal iliac artery; EIA-external iliac artery; AB-aortic bifurcation; IVD-intervertebral disc; IMA-Inferior mesenteric artery
References


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