Anatomical study of the common iliac arteries

E. Panagouli*, I. Antonopoulos*, V. Protogerou, T. Troupis

Department of Anatomy, Medical School, National and Kapodistrian University of Athens, Greece

[Received: 2 July 2020; Accepted: 21 August 2020; Early publication date: 2 September 2020]

Background: The common iliac arteries (CIA) are the two terminal branches of the abdominal aorta which supply the pelvis and the lower extremities. The present study aims to examine the morphometric features of the CIA in a cadaveric sample and possible correlations between lengths.

Materials and methods: Seventy-six formalin fixed cadavers of Greek origin were dissected in the Department of Anatomy, School of Medicine, National and Kapodistrian University of Athens. In each cadaver dissected, the abdominal aorta and the CIA were identified and their lengths were measured. Also the torso length was measured and the height of each cadaver. All the statistical analysis was done by SPSS 15.0.

Results: The mean length of the left CIA was 6.12 cm (SD: ± 1.791, SE: 0.205) and that of the right one was 6.03 cm (SD: ± 1.607, SE: 0.184). The lengths of the CIA differed between the sexes, but no statistically significant difference was observed. Statistically significant differences regarding the torso lengths and body heights were found between the sexes, as well as a statistically strong correlation between the lengths of the left and right CIA in the cadavers dissected.

Conclusions: The knowledge of the anatomy and morphology of the CIA is of great clinical significance, given that abnormal course, length or branching pattern of these vessels are not uncommon and their clinical impact may be great. Mostly interventional radiologists and vascular surgeons should be aware of this knowledge. (Folia Morphol 2021; 80, 4: 845–849)

Key words: anatomy, morphology, morphometry, abdominal aorta, cadaver, measurements

INTRODUCTION

The course of each common iliac artery (CIA) begins just after the termination of the aorta, usually at the level of the lower 3rd of the body of the 4th lumbar vertebra. Afterwards, each CIA follows an oblique descending trajectory outwards to the pelvic margin, where it is terminated at the level of the intervertebral disc between the sacrum and the 5th lumbar vertebra; at this point each CIA is divided into external and internal iliac artery (99% of the cases), whereas in 1% of the cases the CIAs may be totally absent and the internal and external iliac arteries arise directly from the abdominal aorta (AA) [9]. The right CIA is slightly longer than the left and in most of the cases it follows a more oblique trajectory across the L5 vertebral body. The right CIA comes laterally in relation to the inferior vena cava, the right common iliac vein (CIV) and the ipsilateral Psoas Magnus muscle, whereas the left CIA is related laterally only to the left Psoas Magnus muscle and...
medially to the ipsilateral CIV [7, 17, 18]. The two CIAs give off normally no lateral branches except from a few cases described in which the testicular arteries originated from the CIAs (< 1%) [9].

The point, at which each CIA bifurcates, varies, but in most of cases the left CIA divides in a lower level than the right CIA. Also, the length of these arteries is subject to a non-negligible variety [7, 17, 18]. Hence, aim of the present study is to find and present patterns of this variety as well as to examine the existence of statistically significant correlations between distances or sexes regarding measurements on the CIAs of a Greek population. The present paper constitutes a continuation of a previous study [14] with greater sample and a special focus on CIAs.

MATERIALS AND METHODS

Seventy-six adult cadavers of Caucasian (Greek) origin, of which 39 were males and 37 females, were dissected for educational and research purposes by the authors. The anatomical dissection took place at the Hall of Dissections of the Anatomy Department, Faculty of Medicine, National and Kapodistrian University of Athens. A 10% formalin solution was used for the embalming procedure. All the 76 cadavers derived from body donation with informed consent, written and signed by the donator himself [11]. Approval for the present research’s protocol was obtained from the ethics committee of our institution. The age of the cadavers ranged between 39 and 98 years (average age 75.43 years, standard dimension [SD]: ± 11.23, standard error of mean [SE]: 1.288).

In every one cadaver, we identified and revealed the AA, as well as the right and left CIA according to the Clemente’s Anatomy Dissector [1] and the length of both the right and left CIAs was measured from the level of the bifurcation of the abdominal aorta to the level at which each CIA was divided into external and internal iliac artery (Fig. 1). The torso length was also measured in all 76 cadavers of this study, from the level of the hyoid bone to the pubic symphysis, whereas the total height of the body was measured from the bregma to the medial process of the calcaneus (the bodies were in supine position). Additionally, the length between of the AA, from the origin of the coeliac artery to its bifurcation was also evaluated in order to perform correlations with the studies lengths.

The collected measurements were subjected in statistical analysis, in order to calculate the average, maximum and minimum value, SD, and SE and finally the correlations between the discovered distances. For correlations we calculated the Pearson correlation coefficient (r) in each case and also examined the statistical significance of each resulting correlation (p < 0.05). All the statistical analysis was done by SPSS 15.0.

RESULTS

Both CIAs were observed in all the 76 cadavers (39 males and 37 females) without finding any anatomical variation.

The mean length of the left CIA was 6.12 cm (SD: ± 1.791, SE: 0.205), noticing a fairly wide range of values, with a minimum of 2.3 cm and a maximum of 13.9 cm (Table 1). The corresponding length in male cadavers was slightly longer, with a mean value of 6.37 cm (SD: ± 1.949, SE: 0.312) and a shorter range of values, from 4.1 cm to 13.9 cm (Table 1). On the contrary, in females the mean left CIA's length was 5.86 cm (SD: ± 1.534, SE: 0.262) and measurements ranged between 2.3 and 9.6 cm (Table 1). Nevertheless, no statistically significant difference between the two sexes was found (p = 0.222, p > 0.05).

The range of measurements on the length of the right CIA was shorter than the corresponding of the left CIA (min: 3.3 cm, max: 9.6 cm), and the mean length was 6.03 cm (SD: ± 1.607, SE: 0.184) (Table 1). The relationship of the CIA lengths observed between the sexes on the left side, was also found on the right side; the length of the right CIA was longer in male cadavers (mean: 6.10 cm, SD: ± 1.672, SE: 0.268) than in female ones (mean: 5.96 cm, SD: ± 1.555, SE: 0.256) (Table 1). Also in this category no statistically significant difference was found between males and females (p = 0.696, p < 0.05).

Additionally, no statistically significant difference was found between the lengths of the right and left CIAs (p = 0.746, p < 0.05), despite the small differences in measurements which were actually observed.

Regarding the torso length, the mean value was 62.27 cm (SD: ± 4.325, SE: 0.496) and the measurements ranged between 51.5 cm and 70.0 cm (Table 2). The torso length in males and females is presented in Table 2. Between the two sexes a statistically significant difference was found (p < 0.01).

The mean height of the cadavers dissected was 155.3 cm (SD: ± 10.124, SE: 1.161), with a minimum of 128.0 cm and a maximum of 174.5 cm (Table 2). Referring to the sexes, the height of men and women are shown in Table 2. Also, in this category, a sta-
Table 1. Measurements of common iliac arteries (CIA)

<table>
<thead>
<tr>
<th>CIA length (n = 76)</th>
<th>Mean</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Standard deviation</th>
<th>Standard error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left</td>
<td>6.12</td>
<td>2.3</td>
<td>13.9</td>
<td>± 1.791</td>
<td>0.205</td>
</tr>
<tr>
<td>Males (n = 39)</td>
<td>6.37</td>
<td>4.1</td>
<td>13.9</td>
<td>± 1.949</td>
<td>0.312</td>
</tr>
<tr>
<td>Females (n = 37)</td>
<td>5.86</td>
<td>2.3</td>
<td>9.6</td>
<td>± 1.534</td>
<td>0.262</td>
</tr>
<tr>
<td>Right</td>
<td>6.03</td>
<td>3.3</td>
<td>11.4</td>
<td>± 1.607</td>
<td>0.184</td>
</tr>
<tr>
<td>Males (n = 39)</td>
<td>6.10</td>
<td>3.4</td>
<td>11.4</td>
<td>± 1.672</td>
<td>0.268</td>
</tr>
<tr>
<td>Females (n = 37)</td>
<td>5.96</td>
<td>3.3</td>
<td>9.6</td>
<td>± 1.555</td>
<td>0.256</td>
</tr>
</tbody>
</table>

Table 2. Biometric features of the cadavers

<table>
<thead>
<tr>
<th>Parameters (n = 76)</th>
<th>Mean</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Standard deviation</th>
<th>Standard error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>75.43</td>
<td>39</td>
<td>98</td>
<td>± 11.23</td>
<td>1.288</td>
</tr>
<tr>
<td>Males (n = 39)</td>
<td>76.62</td>
<td>39</td>
<td>98</td>
<td>± 10.91</td>
<td>1.845</td>
</tr>
<tr>
<td>Females (n = 37)</td>
<td>74.27</td>
<td>52</td>
<td>92</td>
<td>± 10.97</td>
<td>1.804</td>
</tr>
<tr>
<td>Torso length [cm]</td>
<td>62.27</td>
<td>51.5</td>
<td>70.7</td>
<td>± 4.325</td>
<td>0.496</td>
</tr>
<tr>
<td>Males (n = 39)</td>
<td>64.78</td>
<td>59.5</td>
<td>70.7</td>
<td>± 3.249</td>
<td>0.520</td>
</tr>
<tr>
<td>Females (n = 37)</td>
<td>59.62</td>
<td>51.5</td>
<td>67</td>
<td>± 3.709</td>
<td>0.610</td>
</tr>
<tr>
<td>Height [cm]</td>
<td>155.3</td>
<td>128</td>
<td>174.5</td>
<td>± 10.124</td>
<td>1.161</td>
</tr>
<tr>
<td>Males (n = 39)</td>
<td>162.1</td>
<td>146</td>
<td>174.5</td>
<td>± 7.043</td>
<td>1.279</td>
</tr>
<tr>
<td>Females (n = 37)</td>
<td>148.1</td>
<td>128</td>
<td>162</td>
<td>± 7.571</td>
<td>1.245</td>
</tr>
</tbody>
</table>
and morphology in general of the CIAs seem to have
contralateral CIA. Also abnormalities in dimensions
the left CIV that abnormally passed anterior to the
lateral leg swelling, caused by the compression of
a 20-year-old female patient with persistent bi-
es. Fereydooni et al (2019) [5], described a rare case
variance with a resulting clinical impact in most cas-
no statistically significant difference in our
sample (76 adult cadavers), as well as differences in
other correlations resulted between the torso
lengths and the CIAs’ length, or between the last and
the height of the cadavers.

**DISCUSSION**

According to classical anatomical textbooks
[7, 17, 18], the length of the left CIA is approximately
4 cm and that of the right one is 5 cm. In our pre-
vious study in a smaller sample, the recorded mean
length was 5.9 ± 1.527 cm and 5.7 ± 1.427 cm
in the left and right side, respectively [14]. Greater
lengths were observed in the present study, with sim-
ilar mean lengths (6.12 cm left and 6.10 cm right).
Additionally, the lengths of both the CIAs appeared
to have a wide range, especially in the left side, which
was also a finding in our previous study [14]. Longer
lengths were observed in the male cadavers; never-
theless, the difference was not statistically significant.
The only statistically significant findings noticed, as
expected, were the difference between the height
and torso length among males and females. On the
other hand, a strong correlation between the lengths
of the left and right CIAs was found (observed also
in our previous study [14]). The other correlations
examined showed no statistical significance in our
sample (76 adult cadavers), as well as differences in
the resulting measurements. No anatomical variation
was recorded.

According to the available literature, the course
of the CIAs, Crisp et al. (2016) [2] measured the distance
between the sacral suture and the CIAs in 11 patients
that underwent sacrocolpopexy. According to the
findings of this study, the mean distance between the
sacral suture and the CIA was 13 mm (SD: ± 5),
whereas the distance between the right internal iliac
artery and the sacral suture had a mean value of
10 mm (SD: ± 5). In addition, Deswal et al. (2014) [4]
dissected 25 cadavers (16 males and 9 females) and
measured the length of the CIAs, their diameter as
well as the angle formed between the two CIAs. The
mean length of the right CIA in men was 6.09 cm
(SD: 1.889) and the contralateral corresponding was
5.776 cm (SD: 2.001). In contrast to our findings, the
mean length of the CIA of the female cadavers in the
aforementioned study was 4.865 cm (SD: 1.323) on
the right side and 4.663 cm (SD: 1.265) on the left
side. However, Deswal et al. [4] found no statistically
significant difference except that between the
lengths of the two CIAs in males.

Knowledge of the clinical and surgical anatomy of
the CIAs is of great significance not only for the differ-
etiation and treatment of cases as those aforemen-
tioned, but also for approaching the most common clinical entity regarding the CIAs, the aneurysms. As known, aneurysms of the CIAs occur as a result of the expansion of a massive aneurysm of the AA. However, there have been reported cases of isolated CIA’s aneurysm that extended from just distal to the AA’s bifurcation to the CIA’s bifurcation. In such cases the surgical intervention is the treatment of choice [6, 16].

CONCLUSIONS

Although there have been numerous morphological studies for other major arteries of the human and the pelvic vessels [8, 14], the corresponding literature for the CIAs is fairly poor, to the authors knowledge, despite the applications that morphometric features of the CIAs may have, mostly in vascular surgery and interventional radiology. Presumably, future studies with a larger sample may demonstrate the statistical significance of arterial length correlations attempted in the present study.

Acknowledgements

The authors would like to thank all those who donated their bodies to the advancement of medical and anatomical education and research.

Conflict of interest: None declared

REFERENCES