Arterial supply of the omentum majus – a preliminary study

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Abstract — Introduction: The omentum majus (greater omentum), a peritoneal duplicature, is stretched between the curvatura major gastri (greater curvature of stomach) and taenia omentalis coli transversi (omentalis taenia of transverse colon). Except its physiological function as an “abdominal policeman” it is used in the reconstruction and abdominal surgery. In the oncological surgery, it is checked by the pathologist at surgeries of stomach and colorectal cancer for tumor staging.

Aim: The omentum blood supply and lymph drainage is crucial for the above mentioned procedures and we wanted to complete this information by anatomical approach.

Materials and methods: Twenty omenta majora (age 52-96) were harvested during pathological sections, injected with the India ink, cleared and dissected.

Results: The tissue of the omentum majus is nourished by three arterial sources: the arteria hepatica communis and its successive branch, the arteria gastroomentalalis dextra; the arteria splenica and its branch, the arteria gastroomentalalis sinistra; and the arteria mesenterica superior and its branch, the arteria colica media. Most of the arterial blood is brought by the arteria gastroomentalalis dextra, which forms an arcade along the curvatura major gastri in 53% of cases. There is another arcade, located more peripherally within the tissue of the omentum majus, the arcus omentalis of Barkow (thinner but constant), located in various distance from the curvatura major. The veins accompany the arterial vessels as well as the lymph vessels. Conclusion: The various vascular pattern of the omentum majus draws attention to the surgical techniques during reconstruction and abdominal surgery.

Keywords — Arterial supply, Omentum majus

I. INTRODUCTION

Arterial supply of the omentum majus

Arcus gastroomentalalis is dissected, mobilized retrocolically into the lesser pelvis [1]). This technique is applicable to the treatment of the mediastinitis as well [2].

The omental lengthening is applied when the omentum majus is used extra-abdominally. After dissecting the omentum from the colon transversum and mesocolon transversum, it is separated successively from the curvatura major gastri (ligation of all branches supplying the stomach) and a large sample with one pedicle is harvested.

The free-flap transfer is the recently introduced technique, preferring the right pedicle – then it can used to cover any defect of the nearly whole human body.

Histologically, the omentum majus is formed mainly by the adipose connective tissue. However, there is a substantial ratio of the blood vessels and lymphoid tissue. In the oncological surgery, it is checked by the pathologist at surgeries of stomach and colorectal cancer for tumor staging. The omentum blood supply is crucial for the above mentioned procedures and we wanted to complete this information by an anatomical approach.

II. ANATOMY AND EMBRYOLOGY

The development of the omentum majus is started in 6th fetal week. It is closely related to the development of the stomach: in the middle of 4th fetal week the primitive gut in the site of the distal part of the preenteron initiates to enlarge to form a sac (future stomach). The ventral part grows more slowly (future curvatura minor gastri) than the dorsal one (future curvatura major gastri). Then, the origin of stomach starts to rotate and its axis changes from cranio-caudal to more horizontal. The curvatura minor gastri gets to the right side and the curvatura major gastri to the left one. At the end of 6th fetal week the final rotation reaches 90° along the longitudinal axis clockwise (when viewed from above).

The former dorsal part of the stomach is attached to the posterior abdominal wall by the mesogastrium dorsale (dorsal mesogastrium). As a consequence of rotation and quicker growth of the dorsal part of stomach, the curvatura major gastri is located horizontally and the mesogastrium dorsale grows caudally in front of the developing loops of the small intestine to change later into the omentum majus. The omentum extends successively, being 14-36cm long and stretched towards the lesser pelvis. The part of the peritoneal cavity is stuck behind the stomach and forms a cul-de-sac, denominated as the bursa omental (bursa epiploica; lesser sac). It has
three recesses (recessus splenicus, superior et inferior bursae omentalis). The last one directs caudally between the anterior and posterior layers of the omentum majus. Its depth is very variable. After the completion of the intestinal loops rotation, the posterior layer of the omentum majus approaches the mesocolon transversum but they never fuse.

The left margin of the omentum majus is continuous with the ligamentum gastroplenicum (ligamentum gastrolienale; gastrosplenic ligament), the right one reaches the level of duodenum [3].

III. MATERIAL AND METHODS

Twenty omenta majora (11 females and 9 males, age 52-96) were harvested during pathological sections in cooperation with the Pathological–anatomical Department of Nemocnice Jihlava, p.o., together with part of the curvatura major gastri, pylorus, duodenum, mesocolon transversum and colon transversum. Then, the main arterial trunks were dissected, cannuled, rinsed with lukewarm physiological solution and injected with a water solution of the India ink (ratio 1:1) in the laboratory of the Department of Anatomy of the Third Faculty of Medicine, Charles University in Prague. The injected samples were put into the clearing solution, consisting of methanolate, chloroform and acetate (ration 6:3:1) for several weeks. After this procedure, the samples were carefully dissected to visualize all the vessels. The results acquired were compared with accessible reference sources.

IV. RESULTS AND DISCUSSION

The omentum majus is fed prevalingly from the arteria gastroomentalis dextra et sinistra. These two arteries anastomoses by forming an arcade, called the arcus gastroomentalis, which is situated close to the curvatura major gastri. This arcade sent off caudally the both the rami omentales anteriores breves et longi. They anastomose at the caudal (peripheral) margin of omentum majus with the branches from the arteria colica media, denominated as the arteriae omentales posteriores.

Arcus gastroomentalis (Arcus gastroepiploicus; Arcus arteriosus ventriculi inferior; Arcus Hyrtl; Gastro-omental arcade; Gastro-epiploic arcade)

The arterial arcus gastroomentalis is located within the anterior layer of the omentum majus, approximately 0.5–4 cm caudally from the curvatura major gastri. It is composed of two source arteries and has a variable characteristic (it is not constantly present). The first source artery is the arteria gastroomentalis dextra (arteria gastroepiploica dextra; AGoD), which is the terminal branch from the arteria gastroduodenalis (branch from the truncus coeliacus by means of the arteria hepatica communis); the latter one is the arteria gastroomentalis sinistra (arteria gastroepiploica sinistra; AGoS), which is an inferior branch from the arteria splenica (arteria lienalis), which is derived from the truncus coeliacus as well. The dominant artery of the arcus gastroomentalis is the arteria gastroomentalis dextra. Following mainly selective angiographies of the truncus coeliacus, the diameter of the AGoD is larger than that of the AGoS [4]. According to our results and measurements, the external diameter of the AGoD is 3.3 mm (2.0–4.5 mm) and the AGoS 2.0 mm (1.0–2.5 mm). The AGoS can be even absent (Kachlik 6.7%, Hannoun [4] 6%). In such case the whole omentum majus is supplied by the arterial blood from the AGoD. As stated before, the AGoD is a successive branch from the truncus coeliacus. However, in 2.5% of cases is the AGoD branch from different arterial area: in 1.5% from the trunk of the arteria mesenterica superior and v 1% from the arteria colica dextra [5]. These data results in the preference of the right pedicle in the so-called „pedicle omentoplasty operation”; the advance of the right pedicle lies in the reliability of the arterial blood supply of the omentum majus used as „moveable flap”.


The most used classification of the arcus gastroomentalis was published by Yamato [10], including five types according to the stage of arcade completeness.

Yamata’s classification [10]
I - continuous arcade with the end-to-end anastomoses
II - both principal arteries ramifies into minute branches anastomosing in a plexiform way
III - distinct communication between both source arteries is missing
IV - communication via the arcus omentalis (see below)

Rami omentales anteriores

Rami omentales anteriores are branches sent off by the arcus gastroomentalis descending in the anterior layer of the omentum majus. Then can be classified according to their arrangement as the rami omentales anteriores breves (ROAB) et longi (ROAL). ROAB run 20–50 mm into the anterior layer of the omentum majus to feed it. ROAL descend as far as the caudal (peripheral) margin of the omentum majus under the surface of its anterior layer and form mutual anastomoses with each oter and with the rami omentales posteriores. Usually, there are four to six branches (see Table 2).

They can be described as the arteria omentalis dextra, branching from the AGoD, the arteria omentalis sinistra stemming from the AGoS, the arteria omentalis media, sent off by the arcus gastroomentalis and an inconstant arteria omentalis accessoria descending along the right margin of the omentum majus as a branch from the AGoD.

Arcus omentalis (Arcus Barkowi; Arcus epiploicus magnus; Omental arcade)

The arteria omentalis media bifurcates into the right and left horizontal branch at the caudal (peripheral) margin of the omentum majus. These branches then anastomose with caudal branches (ROAL) from the arteria omentalis dextra et sinistra. Such connections form a secondary arterial arcade, called the arcus omentalis (firstly described by Hans Karl Leopold Barkow (1798-1873) as early as 1866 [11]). Thanks
to the existence of this anastomosis there is an arterial network within the substance of the omentum majus which enables the blood supply of the omentum majus from one vascular pedicle only. This situation is crucial for surgical application of the omental lengthening [12].

Rami omentales posteriores

The posterior layer of the omentum majus is closely related to the mesocolon transversum, there can be present arterial communications between the branches from the arcus omentalisis and branches from the arteria colica media (which is a branch from the arteria mesenterica superior, or rarely from branches of the truncus coeliacus [11]). These small branches are called the rami omentales posteriores, due to their minute diameter they are not considered as significantly relevant vessels in the abdominal surgery. We have proved their existence with selective injection of the arteria mesenterica media, in which the India ink entered and colored some part of the posterior layer of the omentum majus. The arteries are accompanied by small veins and lymph vessels, which are clinically relevant, especially in the inflammation or/and metastatic processes spreading from/to the omentum majus.

V. CONCLUSION

The arterial supply of the omentum majus is a rich network of vessels. The most important source arteris are the arteria gastroomentalisis dextra et sinistra. The dominant one is the AGoD, which is present constantly and its diameter is larger than that of the AGoS. The AGoS can be absent in 6% of cases. The AGoD is a branch from the truncus coeliacus (in 2.5% of cases it can be branch from the arteria mesenterica superior or its branches). It can be concluded that the right pedicle is preferred for the pedicle omentoplasty. The AGoD and AGoS form the arcus gastroomentalisis, classified into four types (direct anastomosis is present in 53% of cases, indirect via the arcus omentalisis in 33% of case and no anastomosis was observed in 13% of cases). The rami omentales anteriores longi form at the caudal margin of the omentum majus the arcus gastroomentalisis, which can either complete or replace the arcus gastroomentalisis. Communications with the arteria colica media are not clinically relevant due to their small diameter.

Concerning the high variability of the arterial blood supply of the omentum majus, a selective angiography of the truncus coeliacus can be recommended before the planned surgical procedure involving the omentum majus on account of the prevention of the procedure failure. The same approach can be applied in case of the cardio-surgical procedure involving the AGoS for the planned by-pass for the diaphragmatic surface of heart.

ACKNOWLEDGMENT

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REFERENCES


Table 1. Percentage frequency of samples according to Yamato’s classification of the arcus gastroomentalisis [10]

<table>
<thead>
<tr>
<th>Type</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>34%</td>
</tr>
<tr>
<td>II</td>
<td>15%</td>
</tr>
<tr>
<td>III</td>
<td>44%</td>
</tr>
<tr>
<td>IV</td>
<td>6%</td>
</tr>
</tbody>
</table>

Table 2. Number of the rami omentales anteriores longi (ROAL).

<table>
<thead>
<tr>
<th>ROAL</th>
<th>Hannoun [7]</th>
<th>Kachlik</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROAL</td>
<td>2-3</td>
<td>60%</td>
</tr>
<tr>
<td>4</td>
<td>22%</td>
<td>27%</td>
</tr>
<tr>
<td>5</td>
<td>10%</td>
<td>27%</td>
</tr>
<tr>
<td>&gt;6</td>
<td>18%</td>
<td>47%</td>
</tr>
</tbody>
</table>

B. Figures
Figure 1. The injected omentum majus with the dissected vessels.


Figure 2. The absent arcus gastroomentalís = type III

AGoD – arteria gastroomentalís dextra, AGoS – arteria gastroomentalís sinistra CGM – curvatura gastrí major