**THE USE OF INJECTION-CORROSIVE METHOD IN THE STUDY OF EXTRAORGANIC BLOODSTREAM OF HUMAN INTACT STOMACH**

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**ABSTRACT**

**Introduction:** Functional and morphological state of the organs and tissues mainly depends on the adequate blood supply and lymph movement, function of which is integrated by the nervous system. A crucial link in the morphogenesis of the gastric lesions is the intensity of vascularization, as well as the fact that in its venous part the gastric bloodstream is almost entirely included into the portal vein system. Knowledge of the anatomy of the normal human stomach conditions is of indispensable practical value, since they are required for the proper interpretation of the pathological changes occurred in it.

**The aim:** To obtain the spatial visual information about the angioarchitecture of the extraorganic bloodstream of human intact stomach deep in the gastric wall.

**Materials and methods:** 10 post-autopsy adult total stomach specimens of patients, died for the reasons not associated with manifested gastrointestinal diseases have been analyzed. The specimens were extracted during the dissection together with portions of lesser and greater omentum, and segment of aorta with celiac trunk. To neutralize the acidic contents of the stomach, its cavity was washed by 4% sodium bicarbonate solution with subsequent wash in warm running water. The vascular injection method with subsequent corrosion of soft tissues was used in investigation of gastric bloodstream.

**Results and Conclusions:** On the basis of the investigations the advantages of the countercurrent-crossing method of injection of extraorganic vessels to fill the bloodstream of human stomach have been discussed. Positive results of the suggested technique for morphological study of blood vessels have been noted. The three-dimensional spatial organization of the extraorganic bloodstream of the intact stomach can be studied on the basis of the injection-corrosive casts. Thus, the use of the suggested method enables to obtain the fine three-dimensional reproduction of extraorganic bloodstream of the human stomach. The obtained high-quality casts, in turn, are used for the subsequent morphological studies of the intact stomach.

**KEY WORDS:** stomach, bloodstream, injection-corrosive method.

**INTRODUCTION**

The paper has been written within the research scientific work, carried out at the Department of Human Anatomy of Higher State Educational Establishment of Ukraine "Ukrainian Medical Stomatological Academy", entitled “Age-related aspects of the structural organization of the organs of the human immune system, glands of gastrointestinal and urogenital system in normal condition and pathology"; State registration number 0116U004192.

Both late and recent investigations made in the field of morphology of macro- and microcirculatory systems are still relevant to date [1, 2, 3, 4]. Nowadays, despite the development and implementation of the novel operational approaches and surgical techniques the study of extraorganic blood vessels is of significant importance [5, 6, 7, 8]. Notwithstanding the advanced techniques that provide with more detailed analysis of the structure of the vascular bed of the internal organs, the classical time-honored methods of investigations are not to be neglected. Therefore, despite the huge amount of scientific publications devoted to the issues of angioarchitecture of the vascular bed of human intact stomach [9], some aspects remain to be specified. Eventually, experimental morphological studies on this subject have not been fully elucidated.

**THE AIM**

The aim of the paper was to obtain the spatial visual information about the angioarchitecture of the extraorganic bloodstream of human intact stomach deep in the gastric wall.

**MATERIALS AND METHODS**

10 post-autopsy adult total stomach specimens of patients, died for the reasons not associated with manifested gastrointestinal diseases, have been analyzed. The specimens were extracted during the dissection together with parts of lesser and greater omentum and segment of aorta with celiac trunk. The obtained specimens were used for vascular injection with self-curing plastic material of the “Protacryl-M” type with subsequent corrosion in acid [10].
RESULTS
Fast-hardening dental material of the “Protacryl-M” type, including the liquid-monomer and powder-polymer, was used for the manufacturing of injection-corrosive casts of gastric bloodstream. The mixture of polymer and monomer gives semi-liquid syrup, which viscosity and rate of polymerization depend on the quantitative ratio of its components. We used polymer and monomer in the 1:2 ratio to make the casts. Once the gastric vascular injection was finished, the specimen was placed into lukewarm water for 24 hours for plastic mass polymerization. The cast was subsequently embedded into 20% sulfuric acid solution for complete destruction of organic tissues. Next day, the soft tissues were removed from the specimen by scattering water jet. Then, the cast was embedded into newly made sulfuric acid solution with subsequent similar washing out process. Within 5-10 days the corrosive cast of the gastric bloodstream was obtained [4, 10].

DISCUSSION
To describe the injection of extraorganic bloodstream of stomach, it is necessary to mention the common anatomical facts about the sources of blood supply and ways of blood outflow. According to numerous manuals and monographs, the gastric bloodstream together with the liver, spleen and pancreas is in the intermediate position between the source of the celiac trunk and confluents of the portal vein. In addition, the blood pool can be filled with blood in the cardiac and pyloric parts from the side of the esophagus and duodenum arteries. The homonymous arteries and veins, accompanying each other, lie on the lesser and greater curvatures of stomach, forming a closed (circular) coronal arcs.

It is noteworthy, that hydrodynamically, the architecture of the circular anastomosis is very effective, since it can optimally provide gastric bloodstream with blood filling under the necessary pressure due to several counter-current blood streams. Eventually, it becomes the cause of much trouble hampering the full-fledged injection, as in each individual case it can be difficult to foresee the options of blood anastomoses with adjacent areas, where the injection substance will leak, forming the extravasates. We hypothesize, that this fact can be the reason for the absence of adequate images of the bloodstream of human stomach.

Considering the circular structure of the primary links of the gastric bloodstream during the injection, we chose the cross-counter mode, based on the cannulation of two arteries and veins, selected in each individual case in such a way that they were cross-opposite to each other on the greater and lesser curvature of the stomach. For example, one of the options could be the right gastroepiploic artery and left gastric artery (Fig. 1). All the other opposite homonymous vessels were ligated with subsequent suturing of blood vessels in the area of the lesser omentum, gastrocolic ligament and short vessels of the fundus of the stomach [3, 11, 12, 13]. But even in this the most optimal, in our opinion, method it was not always possible to avoid extravasates with different extensive-ness, leading to the incomplete filling of bloodstream. It was especially clearly evident in the mucous membrane.

The second feature was in the significant variability of gastric bloodstream configuration depending on its functional condition. In this regard, two extreme states of the stomach had to be considered: stomach flattened antero-posteriorly (a condition similar to the empty or “hungry” stomach) and filled (“full”) stomach. Simulation of the latter state was achieved by simple filling it with air right after the injection, but before the polymerization of self-hardening plastic (Fig. 2). To do this, the plug with the appropriate diameter was introduced into the pyloric part in advance, and the cannula was inserted into the remainder of the esophagus and blocked after inflation. The subsequent polymerization of the plastic led to the creation of the vascular framework, preventing the collapse of its walls during the corrosion process.

The third difficulty in studying of the whole gastric bloodstream is associated with rapid and inevitable posthumous lysis of epithelial structures (superficial epithelium and gastric glands) of the mucous membrane under the influence, as we hypothesized earlier, of the acidity of gastric juice, which

Fig. 1. The bloodstream of the anterior wall of human intact stomach (male, 54 years old). Exterior view. Polychrome vascular injection with “Protacryl-M” plastic material with subsequent corrosion in acid.

Fig. 2. The bloodstream of the anterior wall of human intact stomach (male, 53 years old). Exterior view. One-way intravenous injection with “Protacryl-M” plastic material (stomach filled with air) with subsequent corrosion in acid.
invariably leads to the damage of the microvessels, located in close proximity to the covering epithelium. Anticipating this, we tried to prevent this phenomenon by prior gastric lavage using the sodium bicarbonate solution to neutralize the acidity of stomach contents. However, our attempts to obtain the expected result failed. Apparently, the post-mortem deleterious effect of gastric juice occurs due to both the increased hydrogen ion concentration in it, and proteolytic enzymes.

CONCLUSIONS

The injection-corrosive method, used in our investigations, enables to obtain the fine high-quality three dimensional reproduction of the extraorgan bloodstream of the human stomach, suitable for the subsequent stereomorphological studies. The suggested method is very convenient for the study of the vascular bed, since the obtained casts contribute to the morphometric analysis of individual vascular links of the superficial bloodstream of the human intact stomach. In this way, the researcher is provided with the whole view of the three-dimensional spatial interposition of the elements of the vascular bed: anastomoses, microvessels, the diameter of which corresponds to the diameter of the molecule of “Protacryl-M” plastic material. The injection-corrosive method allows tracking the vascular branching, angles of their bifurcation and length of vessels.

REFERENCES


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Received: 20.06.2017
Accepted: 28.08.2017