

## **The Methods of Improvement in the Results of Nissen's Laparoscopic Fundoplication for Hiatal Hernias**

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### **Abstract**

Minimally invasive techniques, namely laparoscopic fundoplication (LFP) by Nissen has been increasingly used for the correction of hiatal hernias due to a range of advantages. However, LFP is frequently associated with postoperative complications. As many authors noted, those complications might be related to wrong trocar placement as result of non-individual approach to patients. We aimed to determine the optimal trocar insertion zones for LFP by Nissen, considering the physique of patients.

All 44 patients were divided into two clinical groups. The control group included 21 patients who underwent standard treatment LFP by Nissen's technique. In the main group of 23 patients during the preformation of LFP trocar insertion points were determined according to the calculations of a computer program developed by us.

In the control group, duration of LFP in patients with normosthenic and asthenic physique was on average  $125\pm 15$  minutes, with hypersthenic -  $185\pm 27$  minutes (on average in the control group -  $170\pm 22$  minutes). The main duration of LFP was  $110\pm 10$  minutes, with hypersthenic – on average  $140\pm 14$  minutes (on average,  $125\pm 12$  minutes in the main group). In this case, the patients with BMI greater than  $30\text{ kg/cm}^2$  the operation duration reduced by 45 minutes. There were no intraoperative complications.

Thus, the effectiveness of the developed software for LFP was validated by decreasing the frequency of intra- and postoperative complications. It caused shortening the duration of surgery and postoperative hospital stay, especially in patients with morbid obesity.

**Key words:** hiatal hernia, laparoscopic fundoplication, trocar replacement, complications, obesity.

### **Background**

Recently, the frequency of visits of patients to doctors with hiatal hernia of diaphragm (HH) has been steadily growing. So, according to WHO [1,4], HH is the cause of pathological conditions in every second person in gastroenterological practice, especially it is significantly high in elderly.

Minimally invasive techniques such as laparoscopic fundoplication (LFP) by Nissen, Touper, etc. are increasingly being used for the surgical treatment of HH [2,5]. The advantages of

such interventions, as well as many other minimally invasive interventions, are obvious: the operation is performed through minimal incisions, which provides a cosmetic effect and low morbidity rate; thanks to optical magnification, precision work with tissues is improved and the patient's hospital stay is significantly reduced. Given these advantages, the number of such interventions has been performed by specialists is progressively increasing.

However, as many researchers note, frequent preformation of LFP for HH caused a number of unresolved problems related to recurrence of the disease, development of dysphagia and other complications during the postoperative period. In addition, it should also be noted that the accomplishment technique of LFP is not routine procedure, but requires a surgeon high qualification and to master the skills of endoscopic surgery. This problem becomes even more urgent when it comes to patients with a high body mass index (BMI). Thus, according to a number of researchers, the number of intra- and postoperative complications, recurrences of the disease after LFP in patients with such category of patients increases approximately two times and reaches up to 14-15% compared to patients with normal BMI [3].

One of the key points in solving this problem is to create a comfortable operating environment, which, in our opinion, will be provided, first of all, by correctly selecting the trocars placement, taking into account the physique of patients.

### **Purpose of the study**

Considering the above, the purpose of this study was to determine the optimal trocar insertion zones when performing LFP by Nissen, taking into account the physique of patients.

### **Material and methods of the research**

The results of the 44 patients with HH who were inpatient treatment at the multidisciplinary clinic of the Tashkent Medical Academy during the period from 2013 to 2020 that underwent LFP by Nissen were analyzed.

All patients were divided into two clinical groups. The control group included 21 patients who underwent standard treatment LFP by Nissen's technique. In the main group of 23 patients during the preformation of LFP trocar insertion points were determined according to the calculations of a computer program developed by us.

Among the operated patients, in 38 (86,4%) was axial HH (type I), in 3 (6,8%) paraesophageal (type II), in 3 (6,8%) – mixed (type III). There were 25 women (56,8%) and 19 men (43,2%). The age of patients ranged from 42 to 68 years (the mean age was  $55,2 \pm 8,6$ ). Medium BMI was  $32,2 \pm 2,5$  kg/cm<sup>2</sup>. There were no significant differences in the above parameters in the compared groups.

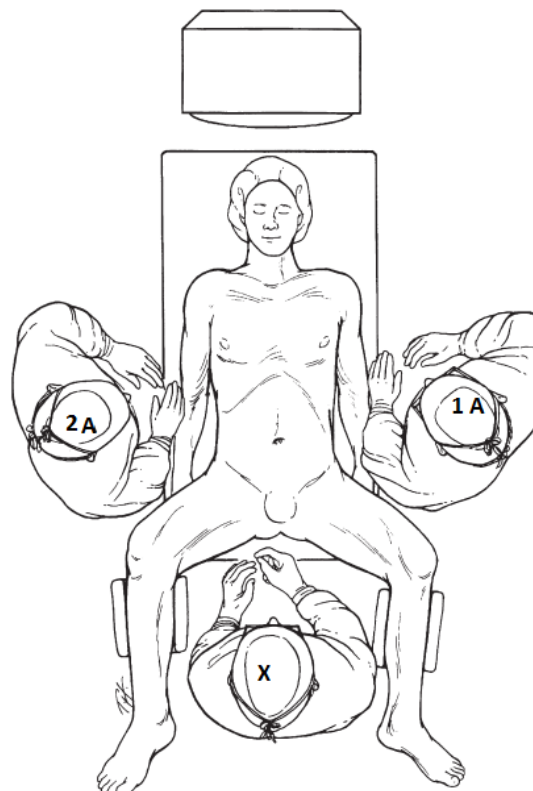
In the control and main groups, the number of patients with normosthenic physique was 7

and 8, respectively, with asthenic physique - 3 and 4, hypersthenic - by 11 in each group.

One of the execution features LFP in patients with high BMI is strictly control of the position of the patient on the operating table: it should be with the head end raised as much as possible, which was necessarily applied in the compared groups.

The surgeon stood between the patient's legs, the first assistant - on the left, the second assistant (camera operator) – on the right (Fig. 1).

Stages LFP in the compared groups was the same and had the following goals:



**Figure 1.** The patient's position on the operating table and the location of the operating team, monitor for LFP by Nissen.

1) Creating access to the esophageal opening of the diaphragm by dissecting the small omentum, preserving, if possible, the hepatic branch of the left vagus nerve.

2) Identification of important landmarks that lead to the esophageal opening of the diaphragm, i.e. the caudate lobe - on the right, the left leg-on the left.

3) Dissection of the esophagus and right pedicle in the vascular-free zone and identification of the right vagus nerve.

4) Visualization of the left pedicle from the right side (the left and right pedicles form a V-

shape).

5) Creating a retroesophageal "window" between the left pedicle and the posterior surface of the esophagus.

6) Dissection of the phrenic-esophageal ligament and angle of Giss, preserving the branches of the left vagus nerve.

7) Visualization of the left pedicle on the left side of the esophagus.

8) Completion of creating a window for holding a holder around the esophagus.

9) Dissection of short gastric vessels, starting from the middle of the bottom of the stomach in the upward direction to the angle of Giss. In this case, the allocation of the bottom of the stomach should be to such an extent that it can pass medially without tension.

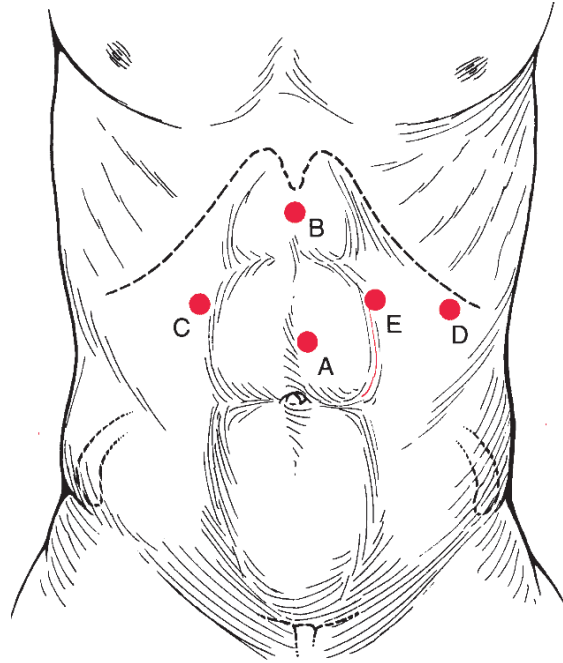
10) Restoration of the normal space between the legs of the esophageal opening of the diaphragm by stitching them, creating a coupling around the esophagus, into which a thick gastric tube is inserted.

In patients of the control group, the introduction of trocars for conducting LFP did not depend on the patients' body type.

The first trocar for optics was inserted paraumbilically at 2/3 of the distance from the xiphoid process to the navel and slightly to the left of the median line (point A). Manipulation trocars for the surgeon were located in the right and left hypochondria along the mid-clavicular line (points C and E). A trocar for the introduction of a hepatic retractor (point B) was installed in the subxyphoid zone. Additional manipulation trocar (point D) for the assistant, if necessary, was installed in the left mesogastric region (Fig. 2).

In the main group, the points of introduction of instruments for LFP depended on the body type of patients, which were determined on the basis of the program developed by us – "the software of «Hernioplasty.exe" for calculation of parameters of insertion of instruments in laparoscopic hernioplasty".

Based on the calculation results, the optimal trocar insertion points in normosthenics were triangular geometric images in the ABC position, located above the umbilical region at an angle of 45° in relation to A, and at the ABD position at an angle of 60°. In this case, E is 2 cm lower along the line drawn from A to D points and in relation to it they are at an angle of 120°. For this type of LFP was performed in 8 patients.



**Figure 2.** Trocar insertion points for LFP by Nissen in the control group.

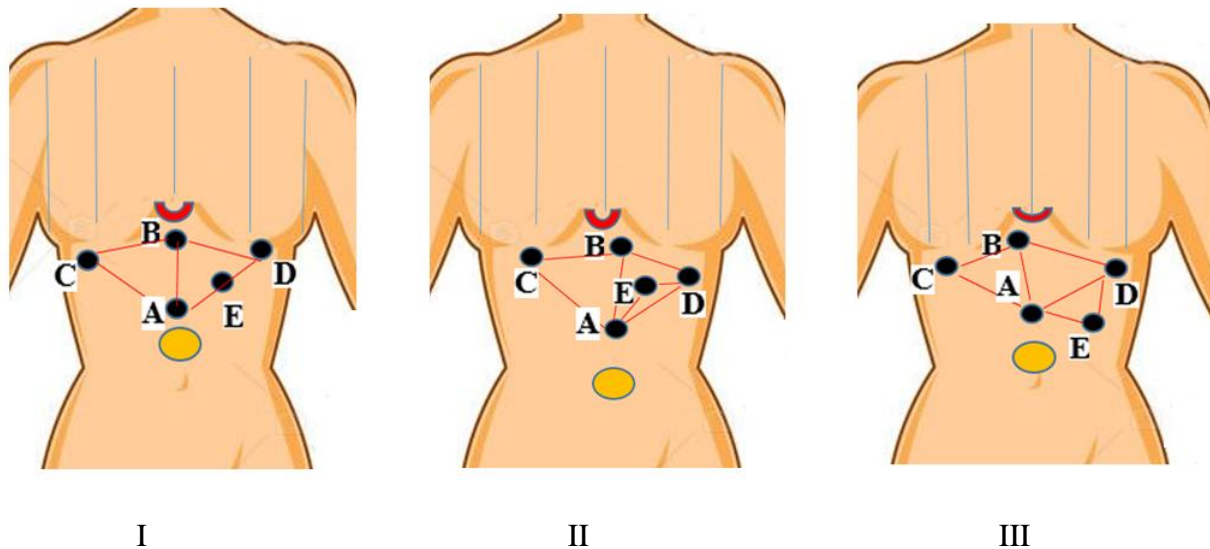
In patients with asthenic physique, triangular shapes of the geometric image in the ABC position and ABD with respect to A are located at an angle of  $60^\circ$ , i.e. in the form of two equivalent triangles. In this case, E is located at the center point along the line drawn from A to D. for this type of operation, LFP was performed in 4 patients.

In patients with hypersthenic physique, triangular shapes of the geometric image in the ABC position, relative to A, are located at an angle of  $110^\circ$ , and in position ABD at an angle of  $70^\circ$ . In this case, E is located at 2 cm above on the drawn line from A to D points and in relation to it they are at an angle of  $120^\circ$ . On this type of LFP was performed in 11 patients (fig. 3).

### **Results and discussions.**

In the control group, duration of LFP in patients with normosthenic and asthenic physique was on average  $125 \pm 15$  minutes, with hypersthenic -  $185 \pm 27$  minutes (on average in the control group -  $170 \pm 22$  minutes). The latter have a lengthening of the duration of LFP is associated with difficulties in creating a retroesophageal "window" and poor visualization of the fundal part of the stomach through previously installed trocars at standard points. Trocars were reinstalled intraoperatively in 4 (19%) cases in patients with hypersthenic physique. It should also be noted that, in our opinion, the incorrect placement of trocars was also the cause of a number of intraoperative complications, which also required additional treatment time. So, in two cases, when the gastro-phrenic and gastro-splenic ligaments were dissected, bleeding was noted, which were stopped by additional coagulation. In another case during preparation of the small omentum there was bleeding from the branch of the left gastric artery, which was stopped by clipping. In

the postoperative period, the following complications were observed: seroma wounds – in 2 patients, dysphagia – in 2, that were resolved by conservative methods.



**Figure 3.** Trocar insertion points for LFP in patients of the main group. I - normosthenics, II - asthenics, III - in hypersthenics.

Thus, in patients of the control group, when performing LFP because of the inability the precise orientation of the working tool and while not taking due the thickness of the soft tissues of the anterior abdominal wall arise technical difficulty during the surgery, and may develop intraoperative complications which lead elongate the duration operation.

To improve the technical aspects of implementation LFP we developed a computer program that allows us to determine the optimal combination of trocar insertion and working tools depending on the body type of patients.

In the main group, before LFP, the optimal parameters for introducing trocars and working tools were determined according to the program developed by us.

Based on the determination of optimal trocar insertion points in the main group with normasthenic and asthenic physiques duration LFP was on average,  $110 \pm 10$  minutes, with hypersthenic – on average  $140 \pm 14$  minutes (on average,  $125 \pm 12$  minutes in the main group). In this case, the patients with BMI greater than  $30 \text{ kg/cm}^2$  the operation duration was reduced by 45 minutes. There were no intraoperative complications. The operations were performed without any special technical difficulties, with adequate access to organs and good visualization. In the postoperative period, only one patient had dysphagia, which was solved conservatively.

Thus, the effectiveness of the software developed by us in LFP is determined by the fact

that the frequency of intra- and postoperative complications decreases – thereby shortening the duration of surgery and postoperative hospital stay, especially in patients with morbid obesity.

### **Conclusions**

1. Preformation of Nissen LFP using standard instrument insertion points, especially in patients with hypersthenic physique, presents certain difficulties and frequently causes intraoperative complications, prolongation of the duration of the intervention.

2. The proposed software allows professionals to determine the most optimal trocar insertion points when performing LFP by Nissen depends on the patient's body type, which helps to reduce the number of intraoperative complications and reduce the duration of surgery.

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