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The Method Of Optimal Installation Of Manipulation Trocars During Laparoscopic Appendectomy Based On Stereometry.

M. Sh. Khakimov
Head of Faculty and Hospital Surgery Department No. 1, Doctor of Medical Sciences, Professor. Tashkent Medical Academy. Tashkent. Uzbekistan.
Kh. I. Ernazarov
PhD, assistant of the department of general surgery. Tashkent Medical Academy. Tashkent. Uzbekistan.
ernazarovxojimurod9@gmail.com
S.I. Ernazarova
Doctoral student of the Department of Obstetrics and Gynecology Tashkent Medical Academy, Tashkent, Uzbekistan, E-mail: ernazarovas@icloud.com
K. Kh. Sadullayeva
Professional Development Center qualifications of medical workers. Tashkent. Uzbekistan.

Abstract
The Emergency Surgery Department of TMA performed 206 laparoscopic operations for acute appendicitis. The duration of laparoscopic operations for acute appendicitisperformed with and without the napeto algorithm was compared. The method developed by us for calculating the optimal placement of trocars allows us to model possible variants of intraoperative geometry individually for each patient before surgery and choose the most optimal arrangement of manipulative trocars. МетодThe calculation method is simple and нerequires no additionaloequipment.
Key words: stereometry, trocar, laparoscopic instruments.

Introduction.
The goal of any laparoscopic intervention is to reduce surgical trauma by avoiding laparotomy or lumbotomy. The laparoscopic technique allows combining the advantages of minimally invasive surgery with well-known long-term results of traditional open surgeries. According to many authors, the accuracy of port placement is one of the factors determining the success of endoscopic surgery [1, 2, 3]. An insufficiently developed technique for providing endoscopic access is considered as the reason for its conversion to open access, as well as the cause of intraoperative complications [2]. Trocar insertion points for performing laparoscopic operations are usually determined empirically, as experience is accumulated and the "learning curve" is overcome at the experimental and clinical stages.
Currently, there are a number of works devoted to the development of criteria for evaluating surgical approaches in video endosurgery and creating optimal endoscopic access. Thus, A. A. Bondarev etal. proposed objective criteria for evaluating surgical approaches in endosurgery on the example of laparoscopic cholecystectomy, upgrading the criteria used in open surgery by A. Yu. Sozon-Yaroshevich [1]. O. G. Ustinov etal. In their work, they evaluated various options for possible mutual positioning of manipulation instruments in an artificially created cavity, and proposed optimal geometric parameters for the mutual positioning of optics and instruments in the operation zone [3]. A. N. Tarasov developed a set of variables necessary for evaluating the operating space, clarified the criteria for evaluating endosurgical accesses, and proposed principles for forming optimal endosurgical access [2]. However, the choice of optimal endoscopic access and preoperative planning of trocar placement remains an open question.
Material and methods
The geometric parameters used for the study are not generally accepted, and we integrated them as a result of analyzing the literature devoted to the criteria for optimal laparoscopic access, so we describe them [1, 8, 9]. Operating action plane (SUB) - a plane perpendicular to the surgeon's position near the operating table and drawn through the operation object. Instrumental vector (IV) - the direction of the instrument and the distance between the points of its insertion into the cavity and its intersection with another instrumental vector or plane

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of surgical action. Instrument axis (OI) - an axis running along the center of the instrument [3], drawn from the point of its insertion on the body surface to the object of surgical intervention [1]. Wound depth (GR) - the distance from the cavity wall to the intersection with the surgical object, measured along the instrumental axis. The depth (wound) of the surgical action of the instrument (GDI) located in the trocar characterizes the point of maximum removal, which preserves the accessibility of the intervention object (the distance between the insertion site of the trocar sleeve and the operating field) [1]. Tool Plane Tilt angle (UNI) - the angle formed by the operational action plane and the tool plane. Operational action angle (UOD) - determine between the axes of the main and auxiliary tools directed to the operation object [1] (the angle between the tools). The lifting angle (UPOD) is determined by the slope of the OI relative to the intervention plane (between the tools and the horizontal plane) [1]. The viewing angle is formed by the angle of inclination of the eyepiece to the plane of the intervention or the operating table [8]. "Freedom of maneuver in the wound" - the ability to move tools in and out of the free cavity [1].

Monitor position from an ergonomic point of view, the best view for laparoscopy is when the image on the monitor is at the optimal 25 degrees below or within the horizontal plane of the eye [16, 24]. According to available research, this leads to the least tension in the neck. For best results, you can use standard LCD monitors placed on a low trolley separate from the operating room equipment. It is not recommended that the surgeon should be positioned "chin up" [16]. For operations where surgeons change ports and positions, a second monitor is necessary, such as total colectomy. A second monitor for assistants reduces the strain on their necks.

The location of trocars may differ from the "standard" schemes, but the necessary conditions must be observed. Do not install trocars in the immediate vicinity of the costal arch and xiphoid process of the sternum, pelvic bones - this limits their mobility. The proximity of trocars to each other interferes with the movement of tools. The angle between the two main manipulators when they approach each other in the operating area should be as small as possible. The introduction of trocars must be visually monitored from the abdominal cavity (the location of internal organs, the presence of splices of the parietal peritoneum, the course of the largest vessels determined by diaphanoscopy are taken into account). Strictly radial installation of trocars in relation to the operated organ greatly facilitates and accelerates the operation [2].

When arranging ports, you must also adhere to certain requirements. The distance between the insertion point of the sleeves and the operating field should be approximately half the length of the tool used (about 15 cm). This allows you to avoid a large range of movements with the handle (accidental violation of sterility) or the working end (danger of uncontrolled movements in the abdominal cavity), and also balances the tool. Tools should not be placed too close to each other (at least 5 cm) and parallel, as well as close to the back. There is a simple rule in endosurgery: the distance between two active trocars is equal to half the length of the instruments used. The video monitor should be positioned across the axis of the optical tube facing the operation area. Instruments should enter the operating field in the direction of the video monitor, not away from it [5].

The shortest time for forming an intracorporeal seam and the highest quality of execution is observed when the combination of the manipulation angle (the angle between tools) of 60 degrees with the lifting angle (between tools and the horizontal plane) of about 60 degrees. In this case, it is possible to fluctuate the value of the ascent angle with an equivalent azimuth angle in the range of 45-75 degrees. If the manipulation angle increases, then the lifting angle should also increase accordingly [16].

For practical implementation of the intracorporeal suture, an isosceles triangle between the instruments is recommended as the optimal geometry. At the same time, the angle between the tools should be 45 degrees, and the lifting angle 55 degrees [5, 15].

Point O – the point above the operating organ before insufflation.

Point H=OL – depth of organ location from point O

H_0 – height of the location of point O from the table to insufflation

H_{H1-the} height of the location of the point$_1$ O1 from the table after insufflation

H_A is the height of the tool insertion point A from the table

O_1A – distance of point A from$_{A1}$ (hypotenuse)

You need to define:

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AndL is the depth of insertion of the instrument to the organ at point A
λ is the angle of insertion of the instrument to the organ at point A
Definition:
$O_1L=H+H_1-H_0$ distance to the organ after insufflation
$AM= N_1-N_A$
$M\ O_1=\sqrt{(AO_1)^2+(AM)^2}$
$AT=M\ O_1$
$TL=O_1L-H_A$
$AL=\sqrt{(AT_1)^2+(TL)^2}$
$\lambda=\text{arctg}\ (\frac{TTLAT}{AT})$ (seeFigure 1).
Thisим путем is how they calculated points B, C, and D..

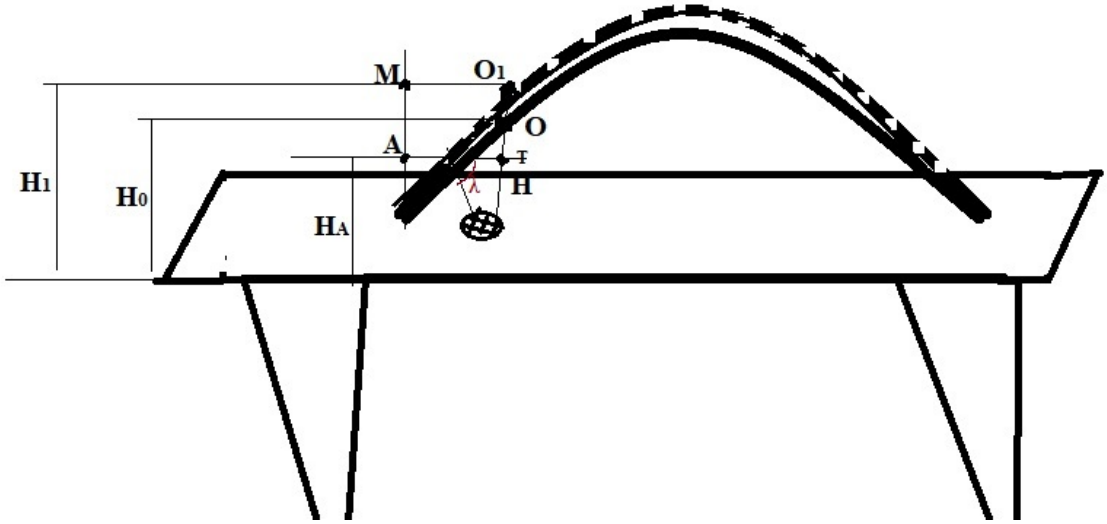

Fig. 1. Schematic representation of laparoscopic surgery.
anatomy of the abdominal cavity.

Results of the study.

A retrospective analysis of the results of surgical treatment of 250 patients with acute appendicitis complicated by widespread peritonitis, who were treated inpatient at the clinical bases of the Department of Faculty and Hospital Surgery No. 1 of the Medical Faculty of the Tashkent Medical Academy, Clinic No. 1, was conducted. The criteria for inclusion in this study werepatients with a clear clinical picture of acute appendicitis (OA), confirmed by clinical data (anamnesis, complaints, clinical examination). Laboratory data (general blood and urine analysis) were evaluated. A number of instrumental methods were used: ultrasound of the abdominal organs, which determined the presence of free and delimited fluid in the abdominal cavity, the location and size of the appendix, signs of its inflammation, and the presence or absence of appendicular infiltrate. ultrasound examination (ultrasound). These patients included patients with destructive forms of OA (phlegmonous, gangrenous, process empyema and the presenceof peritonitis in the patient) according to the classification of V. S. Savelyev [8], and laparoscopic intervention performed in this regardлапароскопическое. In the presence of inflammatory exudate in 3-5 areas, peritonitis was regarded as diffuse, in the presence of exudate in 6 areas or more-as diffuse. BStudyeincluded включено 56 patients who underwent laparoscopic access conversion and 4 patients out of 56operated from the median laparotomy access, due to the extreme severity of the condition at admission. To objectify the severity of peritonitis, specific point scales were used: the Mannheim Peritonitis Index, the WSES Sepsis Severity Score (WSES SSS) [9]. The operation was performed from an access point: the first trocar-a video port-was usually located in the paraumbilical region. In all cases, regardless of the patient's constitution, a pneumoperitoneum of up to 12 mm Hg was previously applied by puncturing the abdominal cavity with a Veresh needle.. The remaining

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trocars were introduced empirically at the discretion and experience of the surgeon "on the eye of the surgeon": inthe torus trocar-10 mm was introduced in the left iliac region. A third 5 mm trocar was inserted in the right iliac region and, if necessary, a fourthtrocar was inserted.

The therapeutic stage of laparoscopic intervention began with a thorough revision of the abdominal cavity and primary (preliminary) rehabilitation of the abdominal cavity if an effusion was detected in the abdominal cavity, which consisted in the evacuation of purulent peritoneal effusion and easily removable fibrin in all available areas, and rehabilitation of the abdominal cavity with an isotonic sodium chloride solution. In most patients, monopolar coagulation was used to treat the mesentery of the appendixмонополярную. The base of the appendix19 (87was treated using the ligature method in 2,19 (87.6%) patients. In 31 (12.44%) cases of gangrenous changes or perforation at the base перитонизациюof the appendix, the stump of the appendix was peritonized using an intracorporeal and open suturemethodoго шва. After appendectomy, the final sanitation of the abdominal cavity was performed using an isotonic sodium chloride solution. The volume of solution for sanitation was determined individually, at the discretion of the operating team. The presence of widespread appendicular peritonitis required mandatory drainage of the abdominal cavity, but the choice of the number of drains used (no more than 3) was left to the operating surgeon. Длительность The LAE duration ranged from 80 minutes to 120 minutes, including conversion. Antibiotic prophylaxis was performed by intravenous administration of third-generation cephalosporin (ceftriaxone) 30 minutes before surgery. Antibiotic therapy was continued in the postoperative period for at least 5 days.

In 147 (59%) of 250 patients, LAE was performed using 4 trocars, in 47 patients - with 3 trocars, andepexthe conversion ability was established in 56 (22.4%) of 250 patients. Based on the records of operating protocols, the reason for the transition to conversion was retrocecal or retroperitoneal location of the appendicular process, solderability with the dome of the cecum and surrounding tissues of the appendix, the appendix is intimately soldered to surrounding tissues, when the process is isolated, there is a violation of the integrity of surrounding tissues, a pronounced destructive process of the appendix that extends to the dome of the cecum, periappendicular abscess, abdominal abscesses, adhesive process (dense adhesions in the abdominal cavity, are separated with difficulty, when dissecting, damage to the structure of neighboring organs is noted), diffuse peritonitis, or a combination of them, as well as technical difficulties caused due to the obesity of patients, as a result of not being able to reach the organ with tools.

LAE performance based on the calculations of the program "Laparoscopic appendectomy exe". In the Department of Emergency Surgery for inpatient treatment at the clinical bases of the Department of Faculty and Hospital Surgery No. 1 of the Medical Faculty of the Tashkent Medical Academy, Clinic No. 1выполнено , 56 laparoscopic operations were performed for OA with preoperative calculation of the optimal placement of manipulative trocars.

The type of constitution, body mass index and type of adipose tissue distribution, the nature of the liver topography, and the topography of the hepatopancreatoduodenal zone were clinically evaluated according to radiation research methods (MRI, CT) and intraoperatively. The intercostal angle ranged from 70 ° to 120°. During the operation, the surgeon and videographer were positioned on the side opposite the intervention area (on the left), the assistant-opposite the surgeon. 30 ° optics with a diameter of 10 mm were used. All patients underwent LAE with preoperative calculation of the optimal placement of manipulation trocars and the insertion points were located in certain lines, but only depending on the type of constitution and BMI changed in cm.

1-point around the navel 10 mm trocar (for optics with 30°)

2-a point 4 cm in the mesogastrium on the right along the middle clavicular line 4 cm below the rib — a "classic" version of the port arrangement described in 1983 by K. Semm 5 mm trocar

3 - a 5 mm trocar is inserted into the abdominal cavity along the midline in the middle of the distance between the navel and the pubic bone (bikinihlevel**)** в брюшную полость вводится 5 мм троакар(seeFig.

If necessary, 4 - the distance from the middle along the midline of the abdomen and the navel.

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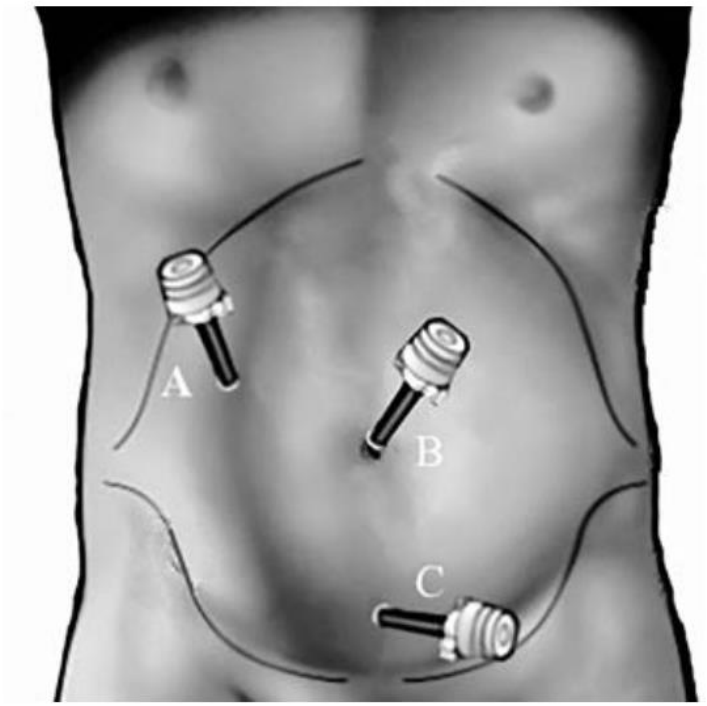

Fig. 2. Location of trocars with preoperative calculation of optimal placement of manipulative trocars.

Atotalof 5-6 laparoscopic procedures were performed for OA. We compared the duration of laparoscopic OA operations performedusing our algorithm, as well as preoperative calculations of the manipulation angle and elevation angle with the true intraoperative values (see Figure3)..

Расчет углов, место точек и глубину введения троакаров при Laparoscopic appendectomy

Ф.И.О.:	
Рост (см) =	
Вес (кг) =	
Высота стояния точки McBurney от операционного стола до инсуффляции (см) =	
Глубина расположения купола слепой кишки (по УЗИ) до инсуффляции (см) =	
Высота стояния точки McBurney от операционного стола после инсуффляции (см) =	

Точка	Высота стояния точки отоперационно- го стола после	Расстояние до точки McBurney
A (точка вокруг пупка)		
B (точка мезогастрии)		
C (уровня бикини)		
D (середина линии живот-пупок)		

СЧЕТ ВЫХОД

Fig. 3. The program "Laparoscopic appendectomy exe".

Based on the rules for introducing trocars: the location of trocars may differ from the "standard" schemes, but the necessary conditions must be met. Do not install trocars in the immediate vicinity of the costal arch and

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xiphoid process of the sternum, pelvic bones - this limits their mobility. The proximity of trocars to each other interferes with the movement of tools. The angle between the two main manipulators when they approach each other in the operating area should be as small as possible. The introduction of trocars must be visually monitored from the abdominal cavity (the location of internal organs, the presence of splices of the parietal peritoneum, the course of the largest vessels determined by diaphanoscopy are taken into account). The distance between the insertion point of the sleeves and the operating field should be approximately half the length of the tool used (about 15 cm). This allows you to avoid a large range of movements with the handle (accidental violation of sterility) or the working end (danger of uncontrolled movements in the abdominal cavity), and also balances the tool. Tools should not be placed too close to each other (at least 5 cm) and parallel, as well as close to the back. There is a simple rule in endosurgery: the distance between two active trocars is equal to half the length of the instruments used. In the program, the above-mentioned rules were taken into account and градацияа gradation of the tool insertion depth through the trocar was created.

Optimal or excellent 15-18
good ones 19-23
satisfactory 24-27
unsatisfactory 28-31
the bad ones are 32 and above.

"Laparoscopic appendectomy exe" the program helps to determine the optimal points of introduction of laparoscopic instruments along specified lines, at which there is no violation of the generally accepted rules for introducing laparoscopic instruments: thedistance between the insertion site of the sleeves and the operating field should be approximately half the length of the instrument used; The instruments should not be located too close to each other (at least 5 cm); avoid close proximity to the bones of the body-this limits their mobility.

Among 56 patients, there were cases of OA with the presence of retrocecal or retroperitoneal location of the appendicular process, fusion with the dome of the cecum and surrounding tissues of the vermiformprocess, the vermiform process is intimately soldered to surrounding tissues, when the process is isolated, there is a violation of the integrity of surrounding tissues, a pronounced destructive process of the vermiform process that extends to the dome of the cecum, periappendicular abscess, abscesses abdominal cavity, adhesive process (dense adhesions in the abdominal cavity, are separated with difficulty, when dissecting, damage to the structure of neighboring organs is noted), diffuse peritonitis, or a combination of them.

Out of 56, only 2 (3.5%) patients underwent the transition from LAE to the open method (conversion), which was causedилось by technical difficulties in performing LAE due to the patient's obesity, retroperitoneal location of the appendicular process, the vermiform process is intimately soldered to the surrounding tissues and there are dense adhesions in the abdominal cavity, which are separated from the rest of the body. with difficulty, when dissecting, damage to the structure of neighboring organs is noted), when the process was isolated, there was a violation of the integrity of the surrounding tissues, a pronounced destructive process of the vermiform process, which extends to the dome of the cecum, there is a periappendicular abscess, in addition, there is diffuse peritonitis. When calculating using the created program "Laparoscopic appendectomy exe" (seeFig. 3.), the optimal points for inserting laparoscopic instruments were determined.

However, this pattern was observed in 14 out of 56 patients, but the difference was the normosthenic or hyposthenic physique of the patient – the absence of excessive body fat. In which LAE was performed based on the program "Laparoscopic appendectomy exe" and the operations were performed successfully, without switching to conversion.

Рассуждая изBased on the results obtained, the reason for the conversion in 2 obese patients was, perhaps, the lackof experience of the surgeon or the fatigue of the surgeon's hands, as a result, the introduction of about 30 cm of the main instrument into the abdominal cavity (optimal 19-23 cm), which creates some inconveniences for the operating surgeon and leads to rapid hand fatigue a surgical operator.

It should also be noted that the angle created between the instrument and the organ on which the manipulation is performed is important.

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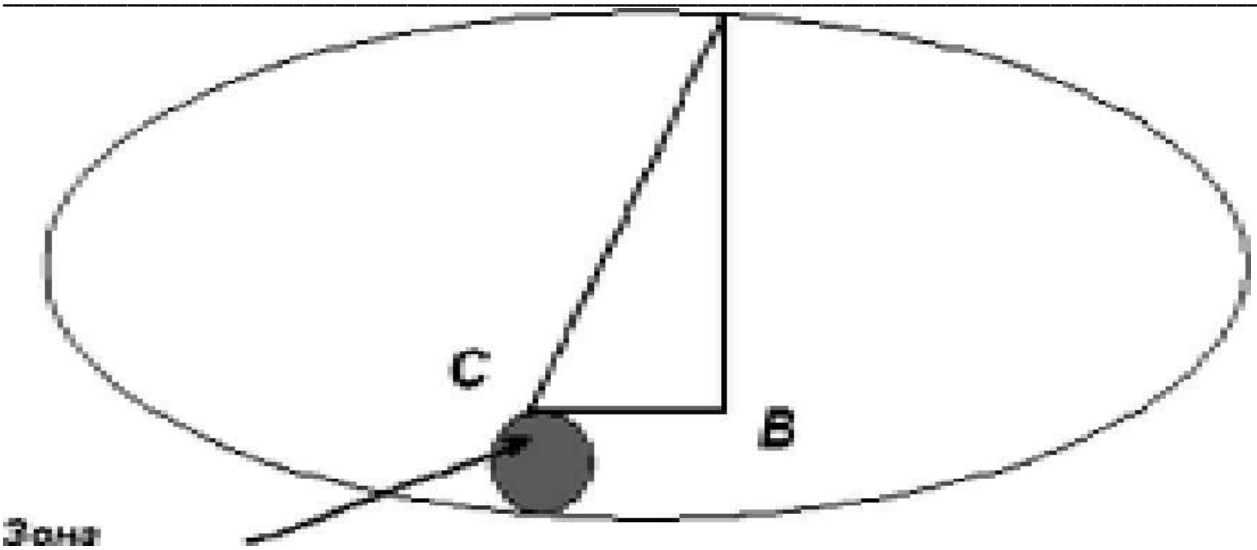

Operational area
Fig. 4. Schematic arrangement of the appendicular in the longitudinal section.

Consider in the sagittal plane (in the longitudinal section) the human body. Conventionally, we represent it as an ellipse (seeFigure4). We build a right triangle ABC inside the ellipse, in which:

- the hypotenuse of the AC (the depth of the operating action of the tool) is the distance between the insertion point of the trocar sleeve and the operating field (ideally half the length of the tool used);
- angle <C (elevation angle) - the value of which tends ideally to 60° and can fluctuate between 45°-75°; catheter AB - the depth of the wound, measured byомощи ultrasound.

According to the rule of relations between the sides and angles of a right triangle BC = AB/ tg<C, AC = AB/ Sin <C .

Data from a four-digit mathematical table by V. M. Bradtsa [1]. tg 45° = 1.0000; tg 60° = 1. 732; tg 75° = 3.732; sin 45° =0.7071; sin 60° = 0.8660; sin 75° = 0.9659.

We calculate the leg of the SUN and the hypotenuse of the AC at different values of the angle C-45,60,75°. Moreover, each value of the lifting angle will correspond to a certain depth of the operational action of the tool: the larger the lifting angle, the smaller the value of the depth of the operational action of the tool.

The therapeutic stage of laparoscopic intervention also began with a thorough revision of the abdominal cavity and primary (preliminary) rehabilitation of the abdominal cavity if an effusion was detected in the abdominal cavity, which consisted in the evacuation of purulent peritoneal effusion and easily removable fibrin in all available areas, and rehabilitation of the abdominal cavity with an isotonic sodium chloride solution. In most patients, monopolar coagulation was used to treat the mesentery of the appendixмонополярную. The base of the appendix 54 (96,4was treated using the ligature method in 54 (96.4%) patients. In 2 patients (3.6%) with gangrenous changes or perforation at the base перитонизациюof the appendix, the stump of the appendix was peritonized by an open method with наложениеthe application of a m pouch suture. After appendectomy, the final sanitation of the abdominal cavity was performed using an isotonic sodium chloride solution. The volume of solution for sanitation was determined individually, at the discretion of the surgeon. The presence of widespread appendicular peritonitis required mandatory drainage of the abdominal cavity, but the choice of the number of drains used (no more than 2) was left to the operating surgeon. The average duration of radical лапароскоlaparoscopic appendectomy with the use алгорилмаof algorilmaoptimal trocar installation ranged from 50 minutes to 100 minutes.

Conclusion.

1. Our proposed algorithm for optimal installation of manipulative data points.

the use of trocars in laparoscopic operations on retroperitoneal organs allows you to systematize the spatial orientation of the surgeon for the correct introduction of basic endosurgical materials and instruments, and reduces the duration of the operation.

2. Preoperative modeling of endoscopic access reduces the number of conversions and intraoperative complications.

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