

# On the Problem of Treatment and Diagnostic Algorithm for Acute Appendicitis

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**Abstract** **Relevance:** Dynamic progress in abdominal surgery, based on the development of non-invasive and minimally invasive diagnostic and treatment technologies, dictates the need to create an effective diagnostic and treatment algorithm that makes it possible to simultaneously solve the problem of diagnosis and treatment of acute appendicitis. **Aim-** To develop a diagnostic and treatment algorithm for acute appendicitis for a combined solution to the problems of diagnosis and surgical treatment of acute appendicitis based on the capabilities of non-invasive and minimally invasive technologies. **Materials and methods:** The study is based on an analysis of observations of 128 patients with acute appendicitis and its complications who underwent appendectomy using endovideolaparoscopic technique. The age of the patients ranged from 16 to 64 years. Men – 71 (55.5%), women – 57 (44.5%). Ultrasound examination (ultrasound) was performed using a SonoScape – P20 scanner, manufactured in Germany. According to indications, multislice computed tomography (MSCT) on a tomograph made in the USA, General Electric, model 2022. Surgical interventions were performed with an endovideolaparoscopic complex from COMEG, manufactured in Japan, and a set of instruments from Karl Storz, manufactured in Germany. **Results:** The sensitivity of ultrasound for acute appendicitis was 87.6%. In 123 patients, at the stage of diagnostic laparoscopy, the diagnosis was not in doubt, that is, the diagnostic accuracy of endovideolaparoscopy for acute appendicitis was 96%. Of the 128 patients, 22 (17.2%) were diagnosed with a catarrhal form, 89 (69.5%) patients with a phlegmonous form, and 17 (13.3%) with a gangrenous form. In the group with destructive forms -106 (82.8%) in 7 (6.6%) cases, appendectomy was performed extracorporeally with a minimal degree of traumatic open access, but sanitation and drainage were performed laparoscopically. In the early postoperative period, suppuration occurred at the point of insertion of the umbilical trocar in 6 (4.7%) patients. **Conclusions:** The use of a diagnostic and treatment algorithm optimizes the diagnosis of acute appendicitis and its complications, shortens the preoperative diagnostic period, specifies the indications for surgical treatment, expands the range of choice of an adequate surgical option, it is possible to simultaneously solve the problem as a diagnosis, and treatment, which generally improves the results of surgical treatment of acute appendicitis and its complications.

**Keywords** Acute appendicitis, Diagnostic videolaparoscopy, Laparoscopic appendectomy

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## 1. Relevance

The dynamic progress of modern abdominal surgery, based on the introduction of medical technology achievements and, accordingly, the development of non-invasive and minimally invasive diagnostic and treatment technologies, dictates the need to create an effective therapeutic and

diagnostic algorithm that combines the capabilities of all methods into one single whole and makes it possible to simultaneously solve the problem of diagnosis and treatment. This problem covers all urgent abdominal surgery in general and the problem of diagnosis and treatment of acute appendicitis and its complications in particular. This requirement is associated with the frequency of occurrence, which is 22.8 per 10,000 population [1,2], a high incidence of 4-6%, appendectomies account for about 40% of all operated urgent patients, in addition, the number of errors at stages diagnosis of acute appendicitis without use cases modern non-invasive and minimally invasive methods diagnostics services, it reaches up to 31% [3]. Diagnosis of acute appendicitis in atypical and rare forms is particularly difficult [4], and it should be taken into account that 4-42% of patients have complicated appendicitis [5], and every year in the world from 50 to 70 thousand people die from acute appendicitis and its complications. a person [6]. In addition,

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according to the data of the Chief Surgeon of the Ministry of Health of Russia A. Sh. According to Revishvili, 148,763 patients diagnosed with Acute appendicitis were treated in the Russian Federation in 2022, and surgical activity in 2020 was 98.1%, mortality-0.17% [7]. All these data together emphasize the urgency of the problem.

It is generally accepted that if there are differential diagnostic difficulties in acute appendicitis, diagnostic laparoscopy should be performed. As for surgical treatment, since 1983, laparoscopic appendectomy has gained wide popularity, and up to 75% of operations are performed laparoscopically in the world. Moreover, some authors advocate granting laparoscopic appendectomy the status of the "gold standard" for surgical treatment of acute appendicitis [8]. At the same time, although in Russia the role of laparoscopic technologies in the surgical treatment of acute appendicitis tends to increase, the frequency of their use remains low and amounts to 27% [9]. In addition, the use of laparoscopic access in the treatment of acute appendicitis, in particular complicated by advanced appendicular peritonitis, is still a controversial issue [10,11].

Problematic issues related to acute appendicitis are unified in the National Clinical Guidelines (NCR) and international recommendations of various surgical societies – the World Community for Emergency Surgery (WSES), European Association of Endoscopic Surgeons (EAES) [12]. Issues related to the definition of tactical approaches to complex clinical situations that arise in acute appendicitis were debatable during the NCR discussions [13]. Thus, the development and creation of an effective yet compact treatment and diagnostic algorithm for acute appendicitis, taking into account the capabilities of modern non-invasive and minimally invasive technologies, which makes it possible to simultaneously solve the problem of diagnosis and treatment, is relevant and timely. At the same time, it should be noted that acute appendicitis is primarily a clinical diagnosis [14], and the clinical manifestations of this pathology, together with the results of diagnostic methods, determine the vector of patient management and treatment.

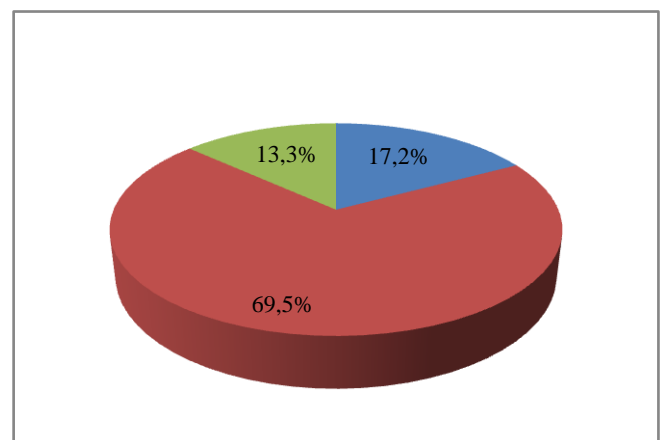
**Research objective:** To develop a therapeutic and diagnostic algorithm for acute appendicitis for the combined solution of problems of diagnosis and surgical treatment of acute appendicitis based on the capabilities of non-invasive and minimally invasive technologies.

**Tasks:** Based on our own clinical material to analyze the results of non-invasive and minimally invasive methods of diagnosis and treatment of acute appendicitis and its complications, to identify the effectiveness of these methods and determine the sequence of their application in order to develop a therapeutic and diagnostic algorithm.

## 2. Materials and Methods

Based on the Department of Surgery of a Medical hospital ALMOZSo, from 2019 to 2024, 182 patients underwent surgery for acute appendicitis using endovideolaparoscopic

techniques. This work is based on the analysis of observations of 128 patients with acute appendicitis and its complications who underwent appendectomy using endovideolaparoscopic techniques, 54 (29.7%) patients out of 182, the technique of performing operations had its own characteristics and they are the object of our further research. The age of the patients ranged from 16 to 64 years. Men – 71 (55.5%), women – 57 (44.5%). All patients underwent a comprehensive examination, while the basic ones were anamnesis collection, clinical and laboratory examination, ultrasound examination of the abdominal cavity, and diagnostic laparoscopy (DL). Ultrasound examination of the abdominal cavity was performed using a scanner SonoScape – P20, manufactured in Germany. Multispiral computed tomography (MSCT) is indicated. This study was performed on a CT scanner manufactured in the USA, General Electric, model 2022. Diagnostic laparoscopy and surgical interventions were performed using the company's endovideolaparoscopic complex COMEG, made in Japan, and a set of Ka toolsrl Storz manufactured in Germany. Histological studies were conducted at the Attasami Diagnostic Services Diagnostic Center, Tripoli, Libya. Statistical processing of the material included the calculation of extensive indicators.



**Figure 1.** Distribution of patients by pathomorphological diagnosis

According to Figure 1, out of 128 patients with acute appendicitis, 22 (17.2%) were diagnosed with catarrhal form, 89 patients (69.5%) were diagnosed with phlegmonous form, and 17 (13.3%) with gangrenous form. Patients were operated on within 3-4 hours of admission after a short-term intensive training, taking into account their general condition. Leukocytosis in the operated patients varied from 9.7 to 19.4 thousand /  $\mu$ l. A relatively high percentage of destructive forms of acute appendicitis, namely 106 or 82.8%, is associated with late hospitalization, remote residence of patients and local social conditions.

## 3. Results and Discussion

A thorough analysis of the available clinical material revealed a certain sequence of treatment from the moment of admission to discharge of patients. The first stage was a

general clinical examination, which was carried out in the classic version.

The next stage of the examination was the use of ultrasound examination of the abdominal cavity. Normally, the appendix is not visualized, so the very fact of visualization of the appendix indicates its inflammation. Direct ultrasound signs of acute appendicitis were an increase in the diameter of the appendix to 8-10 mm or more (normally 4-6 mm), thickening of the walls to 4-6 mm or more (normally 2 mm), which in cross-section gives a characteristic symptom of "target" ("cockades"). With gangrenous-perforated appendicitis, the contents of the process pour out into the abdominal cavity, dilatation disappears, and the process may not be located. It should be noted that the sensitivity of ultrasound examination in acute appendicitis was 87.6%. The results of this study show that accurate diagnosis of this method is directly proportional to the destructive changes in the appendix.

One of the methods of noninvasive diagnosis of acute appendicitis used by us was multislice computed tomography (MSCT) – 43 patients. In 28 cases, i.e. 65.1%, signs of acute appendicitis were diagnosed, in 15(34.9%) patients, acute appendicitis was excluded. These figures show the effectiveness of the method. Indications for this study were difficult-to-diagnose cases, to exclude somatic pathology simulating acute diseases of the abdominal cavity. On tomograms of acute appendicitis, signs of appendix inflammation were: Thickening of the wall (more than 3 mm), inflammation of the appendix membranes, peri-intestinal effusion around the cecum or adipose tissue infiltration, which were pathognomonic signs of acute appendicitis.

The initial stage of surgical intervention was diagnostic videolaparoscopy, which was performed through an 11-mm trocar installed at the top of the Tracing Paper. For a complete visual revision, a second 5 - mm trocar for the manipulator was installed along the midline 3-4 cm below the navel, depending on the situation, taking into account that if signs of appendicitis were detected, it was possible to perform a laparoscopic appendectomy. Direct signs were visible changes in the process, rigidity of the walls, hyperemia of the visceral peritoneum, small-point hemorrhages on the serous cover of the process, fibrin overlays, mesentery infiltration. Indirect signs: the presence of a cloudy effusion in the abdominal cavity (most often in the right iliac fossa and pelvis), hyperemia of the parietal peritoneum in the right iliac region, hyperemia and infiltration of the cecum wall.

Specific signs of catarrhal appendicitis, which allow us to distinguish it during laparoscopy from secondary changes in the process, were not detected against the background of another pathology. In each specific case, the issue of performing an appendectomy was decided individually, taking into account the clinic, the results of other research methods, and the operating situation.

With phlegmonous appendicitis, the process is thickened, tense, the serous membrane is hyperemic, has hemorrhages, fibrin deposits. The mesentery is infiltrated, hyperemic. There is a cloudy effusion in the right iliac region. In gangrenous

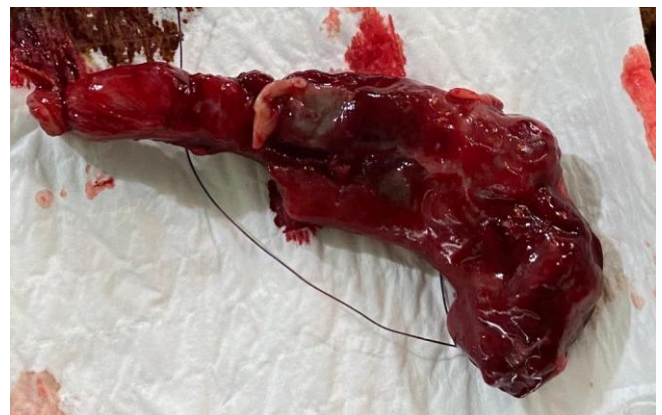
appendicitis, the process is sharply thickened, greenish-black in color, unevenly colored, fibrin overlaps on its serous membrane, and the mesentery is sharply infiltrated (Fig. In 123 patients at the stage of diagnostic laparoscopy, the diagnosis of acute appendicitis was not in doubt, that is, the diagnostic accuracy of endovideolaparoscopy in acute appendicitis was 96%.



A - simple acute appendicitis,



B-phlegmonous,



C-gangrenous form.

**Figure 2**

After verification of the diagnosis of acute appendicitis, a comprehensive assessment of the surgical situation, a separate 10 mm port was additionally installed in the right

iliac region. Thus, three trocar access was used. The location of trocars was not standard, each option - depending on the operational find.

Laparoscopic appendectomy was performed by antegrade and retrograde methods. Mobilization of the vermiform process from the adhesive process was performed with an endocuch under the cover of monopolar coagulation, and clipping or a knot was used for processing the mesentery of the process Roeder, depending on the condition of the mesentery. The process stump was doped twice.

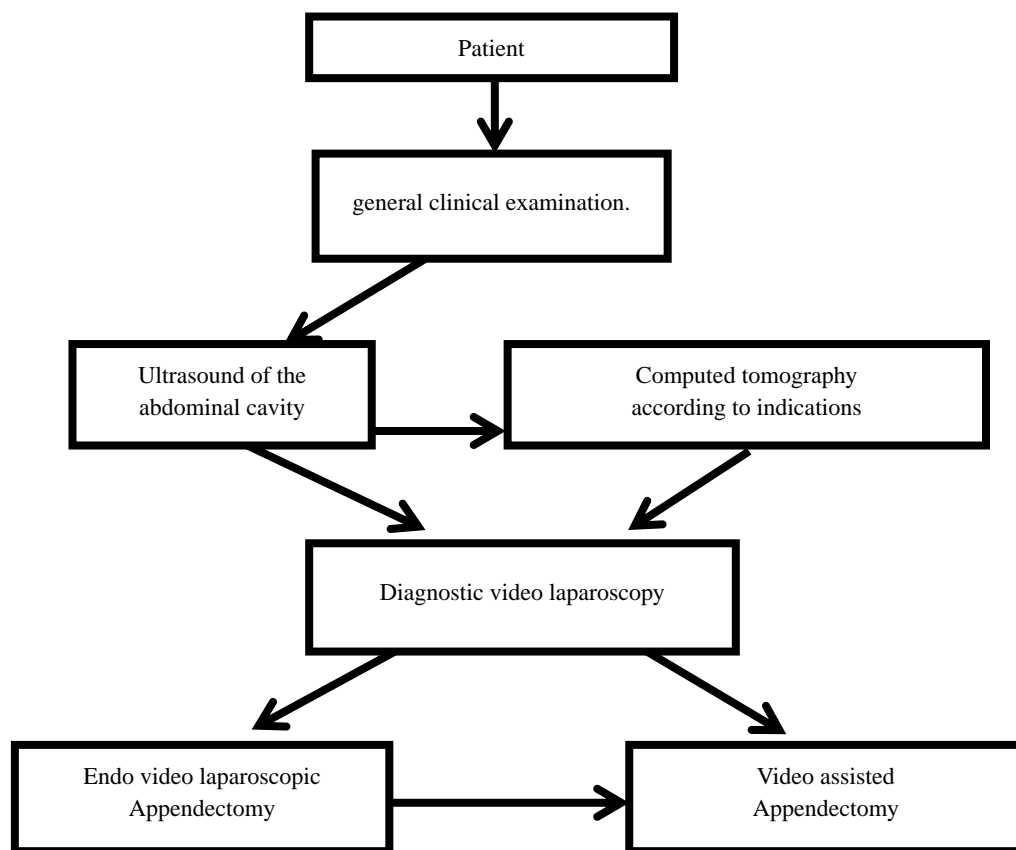
In some cases, if the condition of the base of the process allowed, clipping was also performed twice. The third clip is placed on the outgoing part of the appendix. In the treatment of the process stump, spot dosed monopolar coagulation was used. After ligation of the process stump and mesentery, the vermiform process was removed through a 10-mm trocar. In case of destructive forms of acute appendicitis, the operation was completed with sanitation and mandatory drainage of the abdominal cavity.

I would especially like to mention the group of patients with destructive forms of acute appendicitis-106 (82.8%). In 7 cases, morphological changes in the caecum dome and the base of the appendix-like process forced extracorporeal appendectomy with minimal open access trauma, which was

6.6%, but it should be noted that sanitation and drainage were performed by laparoscopic access. At this point, it should be noted that in 43 (40.6%) patients with widespread (within two anatomical zones of the abdominal cavity) and local peritonitis, sanitation and drainage of the abdominal cavity were performed by laparoscopic access. This circumstance required the installation of additional 5-mm trocars to perform high-quality and reliable sanitation of the area of interest and the installation of additional drains, which allowed avoiding a wide laparotomy. Thus, these cases are included in the category of video-assisted surgical interventions.

In the postoperative period, patients received non-narcotic analgesics, antibiotic therapy, early activation, and were discharged for 4-5-6 days, depending on their general condition. In the early postoperative period, suppuration occurred after the insertion of the umbilical trocar in 6 (4.7%) patients.

Thus, the analysis of existing clinical material, the sequence of stages of diagnosis and treatment using non-invasive and minimally invasive technologies, formed a therapeutic and diagnostic algorithm. (Certificate of official registration of the Ministry of Justice of the Republic of Uzbekistan No. DSU 40435 dated 20.06.2024), which is shown in Fig. 3.



**Figure 3.** Therapeutic and diagnostic algorithm for acute appendicitis

## 4. Conclusions

The results of non-invasive and minimally invasive diagnostic methods showed that the sensitivity of ultrasound examination in acute appendicitis was 87.6%, the exact diagnosis of this method is directly proportional to the destructive changes in the appendix. In 123 patients out of 128 at the stage of diagnostic laparoscopy, the diagnosis of acute appendicitis was not in doubt.

The surgical accuracy of endovideolaparoscopy in acute appendicitis was 96%.

These data prove the need to introduce non-invasive and minimally invasive diagnostic methods, namely ultrasound and diagnostic endovideolaparoscopy, into the program of the treatment and diagnostic algorithm for acute appendicitis. The use of videolaparoscopic techniques in the complex diagnosis of acute appendicitis will make it possible to transfer diagnostic endovideolaparoscopy to the therapeutic category when confirming the diagnosis.

The use of the therapeutic and diagnostic algorithm makes it possible to optimize the diagnosis of acute appendicitis and its complications, shorten the preoperative diagnostic period, specify indications for surgical treatment based on the results of non-invasive and minimally invasive diagnostic methods, and expand the possibility of choosing an adequate surgical intervention option. In addition, it is also possible to simultaneously solve the problem, both diagnosis and treatment. All this generally improves the results of surgical treatment of acute appendicitis and its complications.

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