MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
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«UZHHOROD NATIONAL UNIVERSITY»
FACULTY OF MEDICINE
DEPARTMENT OF SURGERY DISEASES

ACUTE APPENDICITIS

Methodological matherials for independent study for students

UZHHOROD

2024

UZHHOROD NATIONAL UNIVERSITY
FACULTY OF MEDICINE
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Methodical matherials are devoted to issues of etiopathogenesis, clinic, diagnosis and treatment methods of acute appendicitis. The authors also tried to highlight, aim questions that also concern various complications of acute appendicitis. The methodical matherials are intended for senior year students of higher medical educational institutions.

Uzhhorod

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Background

Appendicitis is defined as an inflammation of the inner lining of the vermiform appendix that spreads to its other parts. This condition is a common and urgent surgical illness with protean manifestations, generous overlap with other clinical syndromes, and significant morbidity, which increases with diagnostic delay. In fact, despite diagnostic and therapeutic advancement in medicine, appendicitis remains a clinical emergency and is one of the more common causes of acute abdominal pain.

No single sign, symptom, or diagnostic test accurately confirms the diagnosis of appendiceal inflammation in all cases, and the classic history of anorexia and periumbilical pain followed by nausea, right lower quadrant (RLQ) pain, and vomiting occurs in only 50% of cases.

Appendicitis may occur for several reasons, such as an infection of the appendix, but the most important factor is the obstruction of the appendiceal lumen. Left untreated, appendicitis has the potential for severe complications, including perforation or sepsis, and may even cause death. However, the differential diagnosis of appendicitis is often a clinical challenge because appendicitis can mimic several abdominal conditions.

Appendectomy remains the only curative treatment of appendicitis. The surgeon's goals are to evaluate a relatively small population of patients referred for suspected appendicitis and to minimize the negative appendectomy rate without increasing the incidence of perforation.

Epidemiology

Appendicitis is one of the more common surgical emergencies, and it is one of the most common causes of abdominal pain. In the United States, 250,000 cases of appendicitis are reported annually, representing 1 million patient-days of admission. The incidence of acute appendicitis has been declining steadily since the late 1940s, and the current annual incidence is 10 cases per 100,000 population. Appendicitis occurs in 7% of the US population, with an incidence of 1.1 cases per 1000 people per year. Some familial predisposition exists.

In Asian and African countries, the incidence of acute appendicitis is probably lower because of the dietary habits of the inhabitants of these geographic areas. The incidence of appendicitis is lower in cultures with a higher intake of dietary fiber. Dietary fiber is thought to decrease the viscosity of feces, decrease bowel transit time, and discourage formation of fecaliths, which predispose individuals to obstructions of the appendiceal lumen.

In the last few years, a decrease in frequency of appendicitis in Western countries has been reported, which may be related to changes in dietary fiber intake. In fact, the higher incidence of appendicitis is believed to be related to poor fiber intake in such countries.

There is a slight male preponderance of 3:2 in teenagers and young adults; in adults, the incidence of appendicitis is approximately 1.4 times greater in men than in women. The incidence of primary appendectomy is approximately equal in both sexes.

The incidence of appendicitis gradually rises from birth, peaks in the late teen years, and gradually declines in the geriatric years. The mean age when appendicitis occurs in the pediatric population is 6-10 years. Lymphoid hyperplasia is observed more often among infants and adults and is responsible for the increased incidence of appendicitis in these age groups. Younger children have a higher rate of perforation, with reported rates of 50-85%. The median age at appendectomy is 22 years. Although rare, neonatal and even prenatal appendicitis have been reported. Clinicians must maintain a high index of suspicion in all age groups.

Anatomy

The appendix is a wormlike extension of the cecum and, for this reason, has been called the vermiform appendix (fig. 1). The average length of the appendix is 8-10 cm (ranging from 2-20 cm). The appendix appears during the fifth month of gestation, and several lymphoid follicles are scattered in its mucosa. Such follicles increase in number when individuals are aged 8-20 years. A normal appendix is seen below.

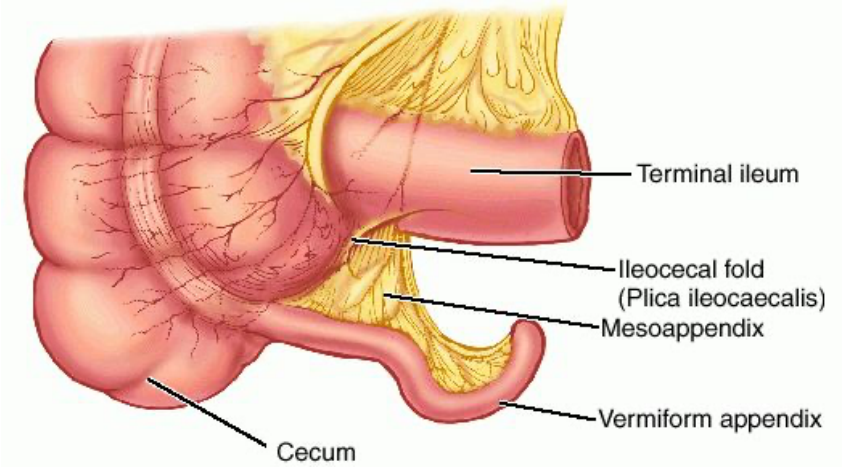


Fig. 1. Normal appendix; ileo-colic region.

The appendix is contained within the visceral peritoneum that forms the serosa, and its exterior layer is longitudinal and derived from the taenia coli; the deeper, interior muscle layer is circular. Beneath these layers lies the submucosal layer, which contains lymphoepithelial tissue. The mucosa consists of columnar epithelium with few glandular elements and neuroendocrine argentaffin cells.

Taenia coli converge on the posteromedial area of the cecum, which is the site of the appendiceal base. The appendix runs into a serosal sheet of the peritoneum called the mesoappendix, within which courses the appendicular artery, which is derived from the ileocolic artery. Sometimes, an accessory appendicular artery (deriving from the posterior cecal artery) may be found.

Blood supply and lymphatics. The vasculature of the appendix must be addressed to avoid intraoperative hemorrhages. The *appendicular artery* is contained within the mesenteric fold that arises from a peritoneal extension from the terminal ileum to the medial aspect of the cecum and appendix; it is a terminal branch of the *ileocolic artery* and runs adjacent to the appendicular wall. Venous drainage is via the *ileocolic veins* and the *right colic vein* into the *portal vein*; lymphatic drainage occurs via the *ileocolic nodes* along the course of the superior mesenteric artery to the celiac nodes and cisterna chyli.

Appendiceal location. The appendix has no fixed position (fig. 2). It originates 1.7-2.5 cm below the terminal ileum, either in a dorsomedial location (most common) from the cecal fundus, directly beside the ileal orifice, or as a funnel-shaped opening (2-3% of patients). The appendix has a retroperitoneal location in 65% of patients and may descend into the iliac fossa in 31%. In fact, many individuals may have an appendix located in the retroperitoneal space; in the pelvis; or behind the terminal ileum, cecum, ascending colon, or liver. Thus, the course of the appendix, the position of its tip, and the difference in appendiceal position considerably changes clinical findings, accounting for the nonspecific signs and symptoms of appendicitis.

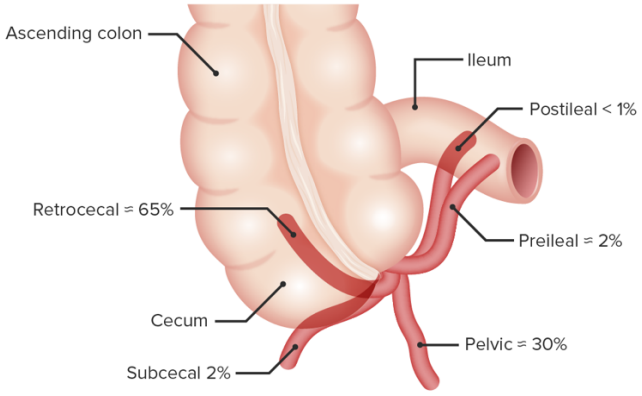


Fig. 2. Variability of appendix locations.

Positions of the vermiform appendix:

- Retrocaecal – approximately 65% of cases (12 o'clock).
- Pelvic – approximately 20% of cases (4 o'clock).
- Preileal and postileal – approximately 2-3% of cases (2 o'clock).
- Subcaecal – approximately 2% of cases (6 o'clock).
- Paracaecal.
- Subhepatic appendix is associated with subhepatic caecum. It occurs due to malrotation of the gut.

Congenital appendiceal disorders. Appendiceal congenital disorders are extremely rare but occasionally reported (eg, agenesis, duplication, triplication).

Etiology

Appendicitis is caused by obstruction of the appendiceal lumen. **The most common causes of luminal obstruction include:**

- lymphoid hyperplasia secondary to inflammatory bowel disease (IBD) or infections (more common during childhood and in young adults);
- fecal stasis and fecaliths (more common in elderly patients);

- parasites (especially in Eastern countries);
- more rarely – foreign bodies and neoplasms.

Fecaliths form when calcium salts and fecal debris become layered around a nidus of inspissated fecal material located within the appendix. Lymphoid hyperplasia is associated with various inflammatory and infectious disorders including Crohn disease, gastroenteritis, amebiasis, respiratory infections, measles, and mononucleosis.

Obstruction of the appendiceal lumen has less commonly been associated with bacteria (Yersinia species, adenovirus, cytomegalovirus, actinomycosis, Mycobacteria species, Histoplasma species), parasites (eg, Schistosomes species, pinworms, Strongyloides stercoralis), foreign material (eg, shotgun pellet, intrauterine device, tongue stud, activated charcoal), tuberculosis, and tumors.

Pathophysiology

Reportedly, appendicitis is caused by *obstruction of the appendiceal lumen* from a variety of causes. Independent of the etiology, obstruction is believed to cause an increase in pressure within the lumen. Such an increase is related to continuous secretion of fluids and mucus from the mucosa and the stagnation of this material. At the same time, intestinal bacteria within the appendix multiply, leading to the recruitment of white blood cells and the formation of pus and subsequent higher intraluminal pressure.

If appendiceal obstruction persists, intraluminal pressure rises ultimately above that of the appendiceal veins, leading to venous outflow obstruction. As a consequence, appendiceal wall ischemia begins, resulting in a loss of epithelial integrity and allowing bacterial invasion of the appendiceal wall.

Within a few hours, this localized condition may worsen because of thrombosis of the appendicular artery and veins, leading to perforation and gangrene of the appendix. As this process continues, a periappendicular abscess or peritonitis may occur.

Stages of Appendicitis. The stages of appendicitis can be divided into early, suppurative, gangrenous, perforated, phlegmonous, spontaneous resolving, recurrent, and chronic.

Early stage appendicitis. In the early stage of appendicitis, obstruction of the appendiceal lumen leads to mucosal edema, mucosal ulceration, bacterial translocation, appendiceal distention due to accumulated fluid, and increasing intraluminal pressure. The visceral afferent nerve fibers are irritated, and the patient feels mild visceral periumbilical or epigastric pain, which usually lasts 4-6 hours.

Suppurative appendicitis. Increasing intraluminal pressure eventually exceeds capillary perfusion pressure, which is associated with obstructed lymphatic and venous drainage and allows bacterial and inflammatory fluid invasion of the tense appendiceal wall. Transmural migration of bacteria causes acute suppurative appendicitis. When the inflamed serosa of the appendix comes in contact with the parietal peritoneum, patients typically feels the classic shift of pain from the periumbilicus to the right lower abdominal quadrant (RLQ), which is continuous and more severe than the early visceral pain.

Gangrenous appendicitis. Intramural venous and arterial thromboses occur, resulting in gangrenous appendicitis.

Perforated appendicitis. Persisting tissue ischemia results in appendiceal infarction and perforation. Perforation can cause localized or diffuse peritonitis.

Phlegmonous appendicitis or abscess. An inflamed or perforated appendix can be isolated by the adjacent greater omentum or small-bowel loops, resulting in phlegmonous appendicitis or focal abscess.

Spontaneously resolving appendicitis. If the obstruction of the appendiceal lumen is relieved, acute appendicitis may resolve spontaneously. This occurs if the cause of the symptoms is lymphoid hyperplasia or when a fecalith exits from the lumen.

Recurrent appendicitis. The incidence of recurrent appendicitis is 10%. The diagnosis is accepted as such if the patient underwent similar occurrences of RLQ pain at different times that, after appendectomy, were histopathologically proven to be the result of an inflamed appendix.

Chronic appendicitis. Chronic appendicitis occurs with an incidence of 1% and is defined by the following: (1) the patient has a history of RLQ pain of at least 3 weeks' duration without an alternative diagnosis; (2) after appendectomy, the patient experiences complete relief of symptoms; (3) histopathologically, the symptoms were proven to be the result of chronic active inflammation of the appendiceal wall or fibrosis of the appendix.

Classification

I. Acute appendicitis.

1. Acute simple (superficial) appendicitis.
2. Acute destructive appendicitis:
    a) phlegmonous;
    b) gangrenous;
    c) perforated;
    d) empyema of appendix.

3. Complicated acute appendicitis:
    a) appendicular infiltrate (mass);
    b) appendicular abscess;
    c) peritonitis of appendicular origin;
    d) other complications (pylephlebitis, sepsis, retropetironeal phlegmon).

II. Chronic appendicitis.
1. Primary-chronic appendicitis.
2. Residual chronic appendicitis.
3. Recurrent chronic appendicitis.

History

Variations in the position of the appendix, age of the patient, and degree of inflammation make the clinical presentation of appendicitis notoriously inconsistent. Statistics report that 1 of 5 cases of appendicitis is misdiagnosed; however, a normal appendix is found in 15-40% of patients who have an emergency appendectomy.

Symptoms

The classic history of **anorexia** and **periumbilical pain** followed by **nausea**, **right lower quadrant (RLQ) pain**, and **vomiting** occurs in only 50% of cases. **Nausea** is present in 61-92% of patients; **anorexia** is present in 74-78% of patients. Neither finding is statistically different from findings in patients who present to the emergency department with other etiologies of abdominal pain. In addition, when vomiting occurs, it nearly always follows the onset of pain. **One-time vomiting** is more frequent. Vomiting that precedes pain is suggestive of intestinal obstruction, and the diagnosis of appendicitis should be reconsidered. **Diarrhea or constipation** is noted in as many as 18% of patients and should not be used to discard the possibility of appendicitis. Diarrhea is more often may be present in case of retrocecal position of appendix.

The most common symptom of appendicitis is **abdominal pain**. Typically, symptoms begin as periumbilical or epigastric pain migrating to the right lower quadrant (RLQ) of the abdomen (***Kocher's sign***). This pain migration is the most discriminating feature of the patient's history, with a sensitivity and specificity of approximately 80%. Patients usually lie down, flex their hips, and draw their knees up to reduce movements and to avoid worsening their pain. Later, a worsening

progressive pain along with vomiting, nausea, and anorexia are described by the patient. Usually, a fever is not present at this stage.

The duration of symptoms is less than 48 hours in approximately 80% of adults but tends to be longer in elderly persons and in those with perforation. Approximately 2% of patients report duration of pain in excess of 2 weeks. A history of similar pain is reported in as many as 23% of cases, but this history of similar pain, in and of itself, should not be used to rule out the possibility of appendicitis.

In addition to recording the history of the abdominal pain, obtain a complete summary of the recent personal history surrounding gastroenterologic, genitourinary, and pneumologic conditions, as well as consider gynecologic history in female patients. An inflamed appendix near the urinary bladder or ureter can cause **irritative voiding symptoms** and **hematuria** or **pyuria**. Cystitis in male patients is rare in the absence of instrumentation. Consider the possibility of an inflamed pelvic appendix in male patients with apparent cystitis. Also consider the possibility of appendicitis in pediatric or adult patients who present with acute urinary retention.

Physical Examination

It is important to remember that the position of the appendix is variable. Of 100 patients undergoing 3-dimensional (3-D) multidetector computed tomography (MDCT) scanning, the base of the appendix was located at the McBurney point in only 4% of patients; in 36%, the base was within 3 cm of the point; in 28%, it was 3-5 cm from that point; and, in 36% of patients, the base of the appendix was more than 5 cm from the McBurney point (fig. 3).

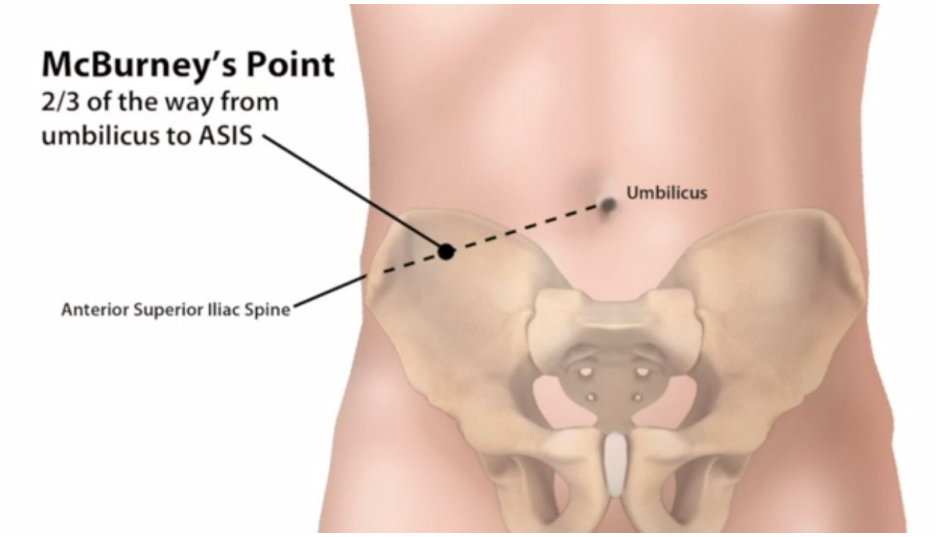


Fig. 3. McBurney's point.

The most specific physical findings in appendicitis are **rebound tenderness**, **pain on percussion, rigidity,** and **guarding**.

Rebound tenderness (also known as the Blumberg's sign), refers to tenderness that is worse on removal of the palpating hand than it is on pressing. This clinical sign suggests peritonism, or localised inflammation of the peritoneum.

Abdominal rigidity – firmness of the abdominal wall muscles may be due to guarding or rigidity. It is important to determine whether this is voluntary, due to the patient's apprehension, or involuntary - a sign of peritonism. *Guarding* – refers to a voluntary muscle contraction, to protect from pain. *Rigidity* – refers to an involuntary muscle spasm due to underlying inflammation

Although **RLQ tenderness** is present in 96% of patients, this is a nonspecific finding. Rarely, left lower quadrant (LLQ) tenderness has been the major manifestation in patients with situs inversus or in patients with a lengthy appendix that extends into the LLQ. Tenderness on palpation in the RLQ over the McBurney point is the most important sign in these patients.

A careful physical examination, not limited to the abdomen, must be performed in any patient with suspected appendicitis. Gastrointestinal (GI), genitourinary, and pulmonary systems must be studied. Male infants and children occasionally present with an inflamed hemiscrotum due to migration of an inflamed appendix or pus through a patent processus vaginalis. This is often initially misdiagnosed as acute testicular torsion. In addition, perform a rectal examination in any patient with an unclear clinical picture, and perform a pelvic examination in all women with abdominal pain.

Accessory signs. In a minority of patients with acute appendicitis, some other signs may be noted. However, their absence never should be used to rule out appendiceal inflammation.

D'elofoua's triad is a classic sign of acute appendicitis, which consists of: spontaneous pain in the RLQ; tension of muscles of RLQ during palpation of abdomen and skin hyperesthesia of RLQ of abdomen.

The Rovsing sign (RLQ pain with palpation of the LLQ) suggests peritoneal irritation in the RLQ precipitated by palpation at a remote location (descending colon, LLQ).

The obturator sign (RLQ pain with internal and external rotation of the flexed right hip) suggests that the inflamed appendix is located deep in the right hemipelvis.

The psoas sign (Coup's sign) (RLQ pain with extension of the right hip or with flexion of the right hip against resistance) suggests that an inflamed appendix is located along the course of the right psoas muscle.

The Dunphy sign (sharp pain in the RLQ occurs by a voluntary cough) may be helpful in making the clinical diagnosis of localized peritonitis. Similarly, RLQ pain in response to percussion of a remote quadrant of the abdomen, or to firm percussion of the patient's heel, suggests peritoneal inflammation.

Voscresenskiy's sign – worsening of pain in RLQ after sliding with hand through the strained shirt from the epigastrium to RLQ of the abdomen ("shirt symptom").

The Markle sign – pain appears in a certain area of the abdomen when the standing patient drops from standing on toes to the heels with a jarring landing, was studied in 190 patients undergoing appendectomy and found to have a sensitivity of 74%.

Aure-Rozanova's (Yaoure-Rozanov's) sign – a sign that is typically seen in retrocecal appendix. It is characterized by increased pain on palpation with finger in the right Petit triangle.

Bartom'e-Mihelson's sign – pain during palpation of right iliac fosse is more expressed, if patient lies on the left side than on the back (the sign is positive in cases of retrocecal location of appendix).

Rectal examination. There is no evidence in the medical literature that the digital rectal examination (DRE) provides useful information in the evaluation of patients with suspected appendicitis.

Three phases of acute appendicitis by Rusanov A.A.

1) appendicular colic – functional phase of AA, when ischemia of mucous membrane of appendix does not result in necrosis. In clinical picture there is only pain syndrome and there are no expressed signs of inflammatory process - increased body temperature, leukocytosis, local peritoneal symptoms are absent. This phase is called an epigastric phase by some authors, because the pains is often localized in the epigastrium.

2) phase of local inflammatory, or inflammatory-destructive changes. Pathomorphologicaly – superficial, phlegmonous, or even gangrenous appendicitis, but the inflammatory process is limited by the right iliac region, it does not spread into all parts of the peritoneum. Clinically both general and local symptoms are expressed in this phase of appendicitis, including the local symptoms of irritation of peritoneum, but they are determined only in the right iliac region.

3) phase of spreading inflammation to peritoneum. In this phase the main are the intoxication symptoms, peritoneal signs are expressed in other regions of abdomen.

Diagnosis

Complete Blood Cell Count (CBC). Studies consistently show that 80-85% of adults with appendicitis have a white blood cell (WBC) count greater than 10,500 cells/µL. **Neutrophilia** greater than 75% occurs in 78% of patients. Less than 4% of patients with appendicitis have a WBC count less than 10,500 cells/µL and neutrophilia less than 75%.

CBC tests are inexpensive, rapid, and widely available; however, the findings are nonspecific. In infants and elderly patients, a WBC count is especially unreliable because these patients may not mount a normal response to infection. In pregnant women, the **physiologic leukocytosis** renders the CBC count useless for the diagnosis of appendicitis.

Urinalysis. Urinalysis may be useful in differentiating appendicitis from urinary tract conditions. Mild pyuria may occur in patients with appendicitis because of the relationship of the appendix with the right ureter. Severe pyuria is a more common finding in urinary tract infections (UTIs). Proteinuria and hematuria suggest genitourinary diseases or hemocoagulative disorders.

One study of 500 patients with acute appendicitis revealed that approximately one third reported urinary symptoms, most commonly dysuria or right flank pain. One in 7 patients had pyuria greater than 10 WBCs per high power field (hpf), and 1 in 6 patients had greater than 3 red blood cells (RBCs) per hpf. Thus, the diagnosis of appendicitis should not be dismissed due to the presence of urologic symptoms or abnormal urinalysis.

Imaging studies.

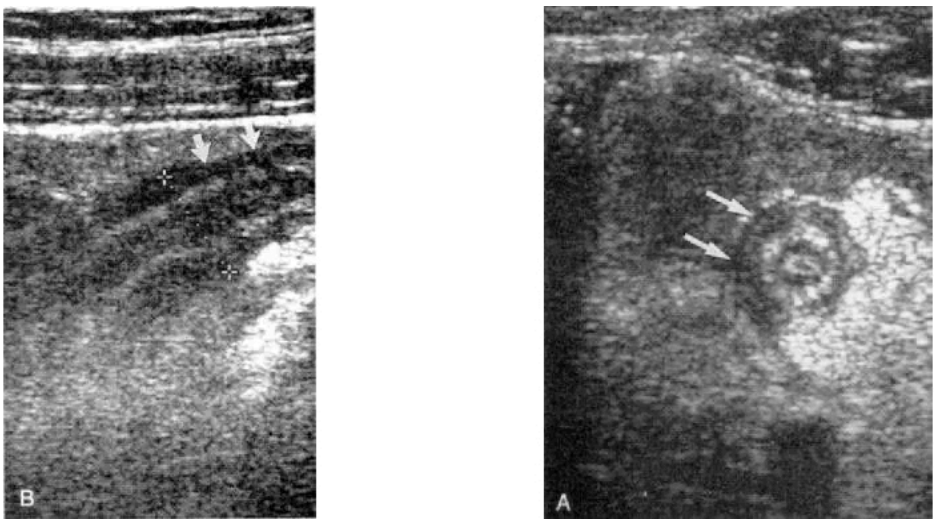
Ultrasonography (US). Because of concerns about patient exposure to radiation during computed tomography (CT) scans, ultrasonography has been suggested as a safer primary diagnostic modality for appendicitis, with CT scanning used secondarily when ultrasonograms are negative or inconclusive.

A healthy appendix usually cannot be viewed with ultrasonography. When appendicitis occurs, the ultrasonogram typically demonstrates a **noncompressible tubular structure of 7-9 mm in diameter** (fig. 4).

In pediatric patients, the American College of Emergency Physicians (ACEP) 2010 clinical policy update recommends using ultrasonography for confirmation, but not exclusion, of acute appendicitis. To definitively exclude acute appendicitis, CT is recommended.

Ultrasonography followed by magnetic resonance imaging (MRI) appears to be an effective combination for accurately diagnosing appendicitis in children.

Vaginal ultrasonography alone or in combination with transabdominal scan may be useful to determine the diagnosis in women of childbearing age.



A B

Fig. 4. Acute appendicitis (ultrasonography). *A – sagittal graded compression transabdominal sonogram shows an acutely inflamed appendix. The tubular structure is noncompressible, lacks peristalsis, and measures greater than 6 mm in diameter. A thin rim of periappendiceal fluid is present. B – transverse graded compression transabdominal sonogram of an acutely inflamed appendix. Note the targetlike appearance due to thickened wall and surrounding loculated fluid collection.*

US findings may also aid clinicians in differentiating complicated from uncomplicated appendicitis, which in turn guides the decision making regarding whether to administer antibiotic therapy first or initiate and perform appendectomy. In a retrospective, blinded study, the medical records of 119 patients with acute appendicitis were reviewed, of which 32 patients had complicated appendicitis (including gangrenous, with or without perforation). Investigators found that the only significant independent predictor of complicated appendicitis was loss of the normally echogenic submucosal layer, with 100% sensitivity and 92.0% specificity.

Computed tomography (CT) scanning. CT scanning with oral contrast medium or rectal Gastrografin enema has become the most important imaging study in the evaluation of patients with atypical presentations of appendicitis. Intravenous contrast is usually not necessary (fig. 5).

Studies have found a decrease in negative laparotomy rate and appendiceal perforation rate when pelvic CT imaging was used in selected patients with suspected appendicitis.

The use of CT has dramatically increased since the introduction of multidetector CT (MDCT) scanners. MDCT has a high rate of sensitivity and specificity (98.5% and 98%, respectively) for diagnosing acute appendicitis.

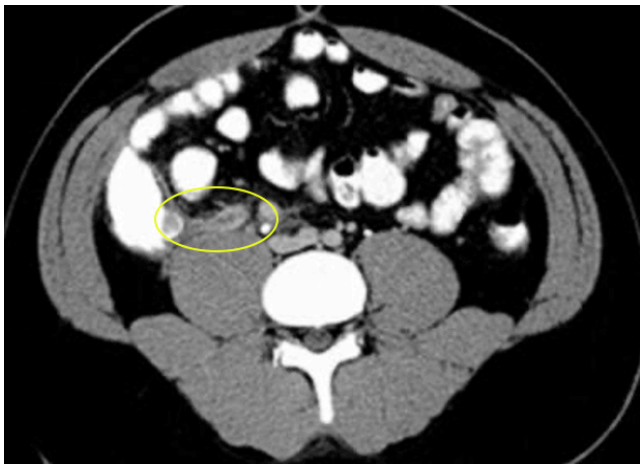


Fig. 5. Acute appendicitis (CT). *CT scan reveals an enlarged appendix with thickened walls, which do not fill with colonic contrast agent, lying adjacent to the right psoas muscle.*

In adults with appendicitis, the diagnostic performance of CT scans with intravenous contrast alone is comparable to that of scans with both intravenous and oral contrast, and patients who receive CT scans with intravenous contrast alone are discharged more quickly from the emergency department.

CT scanning may also be used to *detect atypically located acute appendicitis,* including inguinal or femoral canal, subhepatic, retrocecal, intraperitoneal abdominal midline as well as left side in situs inversus or intestinal malrotation patients. In this setting, patients may have an atypical presentation that causes a misleading or confusing diagnosis.

Concerns have grown over the possible adverse effects on patients from exposure to radiation from CT scanning. Low-dose abdominal CT allows for a 78% reduction in radiation exposure compared to traditional abdominopelvic CT and may be preferable for diagnosing children and young adults in whom exposure to CT radiation is of particular concern. Ultrasonography may offer a safer alternative as a primary diagnostic tool for appendicitis, with CT scanning used in those cases in which ultrasonograms are negative or inconclusive.

Radionuclide scanning. Whole blood is withdrawn for radionuclide scanning. Neutrophils and macrophages are labeled with technetium Tc 99m (^{99m}Tc) albumin and administered intravenously. Then, images of the abdomen and pelvis are obtained serially over 4 hours. Localized uptake of tracer in the RLQ suggests appendiceal inflammation.

Magnetic resonance imaging (MRI). Traditionally, MRI has played a relatively limited role in the evaluation of appendicitis because of its high cost, long scan times, and limited availability. However, the lack of ionizing radiation makes it an attractive modality in pregnant patients. The sensitivity and specificity

of MRI for appendicitis appears to be similar to those of computed tomography (CT) scanning.

Nonetheless, when evaluating pregnant patients with suspected appendicitis, graded compression ultrasonography should be the imaging test of choice. If ultrasonography demonstrates an inflamed appendix, the patient should undergo appendectomy. If graded compression ultrasonography is nondiagnostic, the patient should undergo MRI of the abdomen and pelvis. When used for evaluating pediatric patients, MRI has a higher sensitivity than ultrasound.

Differential diagnosis

The overall accuracy for diagnosing acute appendicitis is approximately 80%, which corresponds to a mean negative appendectomy rate of 20%. The classic history of anorexia and periumbilical pain followed by nausea, right lower quadrant (RLQ) pain, and vomiting occurs in only 50% of cases. The differential diagnosis of appendicitis is often a clinical challenge because appendicitis can mimic several abdominal conditions. Patients with many other disorders present with symptoms similar to those of appendicitis, such as the following:

- Pelvic inflammatory disease (PID) or tubo-ovarian abscess.
- Endometriosis.
- Ovarian cyst or torsion.
- Ureterolithiasis and renal colic.
- Diverticulitis.
- Crohn disease.
- Colonic carcinoma.
- Rectus sheath hematoma.
- Cholecystitis.
- Bacterial enteritis.
- Mesenteric adenitis and ischemia.
- Omental torsion.
- Biliary colic.
- Renal colic.
- Urinary tract infection (UTI).
- Gastroenteritis.
- Enterocolitis.
- Pancreatitis.
- Perforated duodenal ulcer.

Other problems that should be considered in a patient with suspected appendicitis include appendiceal stump appendicitis, typhlitis, epiploic appendagitis, psoas abscess, and yersiniosis.

Appendicitis is misdiagnosed in 33% of nonpregnant women of childbearing age. The most frequent misdiagnoses are PID, followed by gastroenteritis and urinary tract infection. In distinguishing appendiceal pain from that of PID, anorexia and onset of pain more than 14 days after menses suggests appendicitis. Previous PID, vaginal discharge, or urinary symptoms indicates PID. On physical examination, tenderness outside the RLQ, cervical motion tenderness, vaginal discharge, and positive urinalysis support the diagnosis of PID.

Treatment

Approach considerations. Appendectomy remains the only curative treatment of appendicitis, although nonoperative management is increasingly recognized as being safe and effective for uncomplicated cases of acute appendicitis.

Nonsurgical treatment may be useful when appendectomy is not accessible or when it is temporarily a high-risk procedure. Although many controversies exist over the nonoperative management of acute appendicitis, antibiotics have an important role in the treatment of patients with this condition. Antibiotics considered for patients with appendicitis must offer full aerobic and anaerobic coverage. The duration of the administration is closely related to the stage of appendicitis at the time of the diagnosis, considering either intraoperative findings or postoperative evolution. According to several studies, antibiotic prophylaxis should be administered before every appendectomy. When the patient becomes afebrile and the white blood cell (WBC) count normalizes, antibiotic treatment may be stopped. Cefotetan and cefoxitin seem to be the best choices of antibiotics.

Medication summary. The goals of therapy are to eradicate the infection and to prevent complications. Thus, antibiotics have an important role in the treatment of appendicitis, and all such. Agents under consideration must offer full aerobic and anaerobic coverage. The duration of the administration is closely related to the stage of appendicitis at the time of the diagnosis.

Antibiotic agents are effective in decreasing the rate of postoperative wound infection and in improving outcome in patients with appendiceal abscess or septicemia. The Surgical Infection Society recommends starting prophylactic antibiotics before surgery, using appropriate spectrum agents for less than 24 hours for nonperforated appendicitis and for less than 5 days for perforated appendicitis.

Contraindications. There are no known contraindications for appendectomy in patients with suspected appendicitis, except appendicular infiltrate (mass), in the case of a patient with a long history of symptoms and signs of a large phlegmon. If a periappendiceal abscess or phlegmon exists secondary to appendiceal perforation or rupture, some clinicians may choose a conservative approach with broad-spectrum antibiotics and percutaneous drainage followed by appendectomy later (interval appendectomy).

Certain contraindications exist for laparoscopic appendectomy, including extensive adhesions, radiation or immunosuppressive therapy, severe portal hypertension, and coagulopathies. Laparoscopic appendectomy is contraindicated in the first trimester of pregnancy.

Rarely, an appendiceal mucocele (ie, a collection of mucus within the appendiceal lumen) may occur. Occasionally, patients may present with a low-grade carcinoma of the appendix or the cecum. In such cases, the surgeon must avoid perforation during dissection, because it may cause seeding of the peritoneum with viable cells, leading to pseudomyxoma peritonei.

Management of complications:

- Appendicular infiltrate (mass) – conservative treatment + interval appendectomy.
- Abscess – drainage + appendectomy/interval appendectomy.
- Perforation – midline laparotomy, appendcectomy, abdominal cavity lavage and drainage.

Patient preparation. Appendectomy requires general anesthesia. Before the start of the surgical procedure, the anesthesiologist performs endotracheal intubation to administer volatile anesthetics and to assist respiration.

There are different surgical accesses for appendectomy (fig. 6):

1. McBurney's access (Volkovich-Dyakonov) – incision is made in the right iliac fossa (McBurney's point), it is parallel to the inguinal ligament.

2. Lekser's access – through the McBurney's point, as well as the previous, but avoiding traumas of muscles, - through the spigelian line.

3. Lenander's access – right-sided pararectal cut, it is carried out in case of doubt in the diagnosis (AA or cholecystitis, AA or urgent gynecological diseases).

4. Lower midline laparotomy – it is carried out in case of diffuse peritonitis of appendicular origin (perforated appendicitis).

5. Laparoscopic Appendectomy – minimally invasive surgical access carried out with the help of video laparoscope and creating carboxyperitoneum (CO_2 in the abdominal cavity).

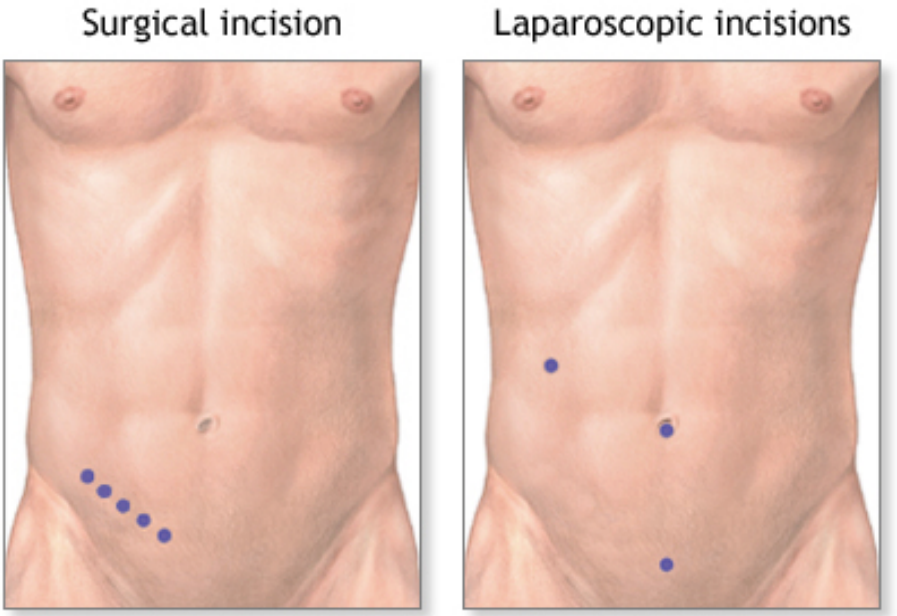


Fig. 6. Surgical accesses for appendectomy (open and laparoscopic).

Appendectomy techniques (open and laparoscopic).

1. Open technique (fig. 8).

Before incision, the surgeon should carefully perform a physical examination of the abdomen to detect any mass and to determine the site of the incision.

Open appendectomy requires a transverse incision in the right lower quadrant over the McBurney's point (ie, two thirds of the way between the umbilicus and the anterior superior iliac spine). Vertical incisions (eg, the Battle pararectal) are rarely performed because of the tendency for dehiscence and herniation.

The abdominal wall fascia (ie, Scarpa fascia) and the underlying muscular layers are sharply dissected or split in the direction of their fibers to gain access to the peritoneum. If necessary (eg, because of concomitant pelvic pathologies), the incision may be extended medially, with dissecting some fibers of the oblique muscle and retracting the lateral part of the rectus abdominis. The peritoneum is opened transversely and entered. The layers dissected during access in McBurney's point (fig. 7):

- skin and subcutaneous fat;
- external oblique muscles aponeurosis;
- internal oblique muscles and transversal muscles;
- peritoneum.

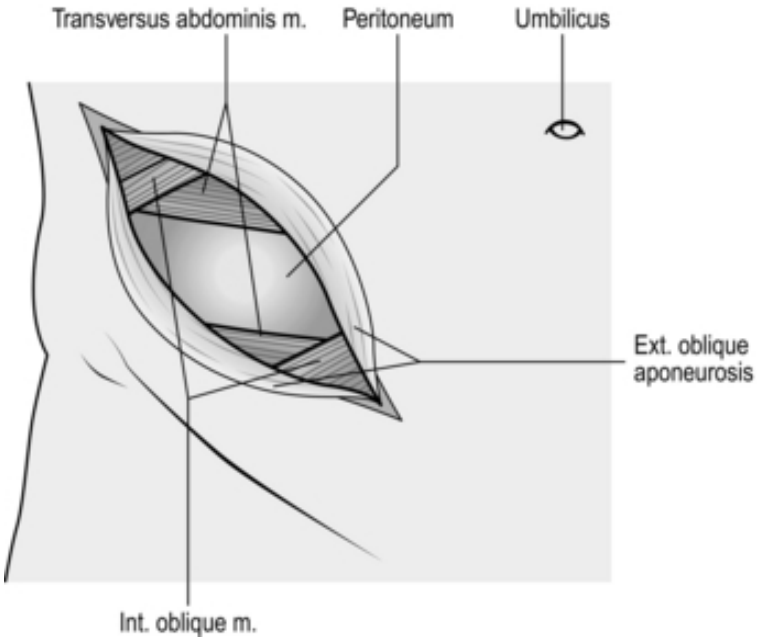


Fig. 7. Layers of abdominal wall in McBurney's point.

The character of any peritoneal fluid should be noted to help confirm the diagnosis, and the fluid should then be suctioned from the field. If the fluid is purulent, it should be collected and cultured.

Retractors are gently placed into the peritoneum. The cecum is identified and medially retracted. It is then exteriorized by using a moist gauze sponge or Babcock clamp, and the taeniae coli are followed to their convergence. The convergence of the taeniae coli is detected at the base of the appendix, beneath the Bauhin valve (ie, the ileocecal valve), and the appendix is then viewed. If the appendix is hidden, it can be detected medially by retracting the cecum and laterally by extending the peritoneal incision.

If the appendix appears normal, other causes of the patient's condition should be sought, such as ovarian pathology, Meckel diverticulum, and sigmoid disease.

After exteriorization of the appendix, the mesoappendix is held between clamps, divided, and ligated (fig. 8-1,2). The appendix is clamped proximally about 5 mm above the cecum (fig. 8-3) to avoid contamination of the peritoneal cavity, and the cut is made above the clamp by a scalpel (fig. 8-4). Fecaliths within the lumen of the appendix may be detected. The appendix must be ligated to prevent bleeding and leakage from the lumen.

The residual mucosa of the appendix is gently cauterized to avoid a future mucocele. The appendix may be inverted into the cecum (fig. 8-6) with the use of a purse-string suture (fig. 8-5) or Z-stitch. Appendiceal stump inversion is not mandatory, however.

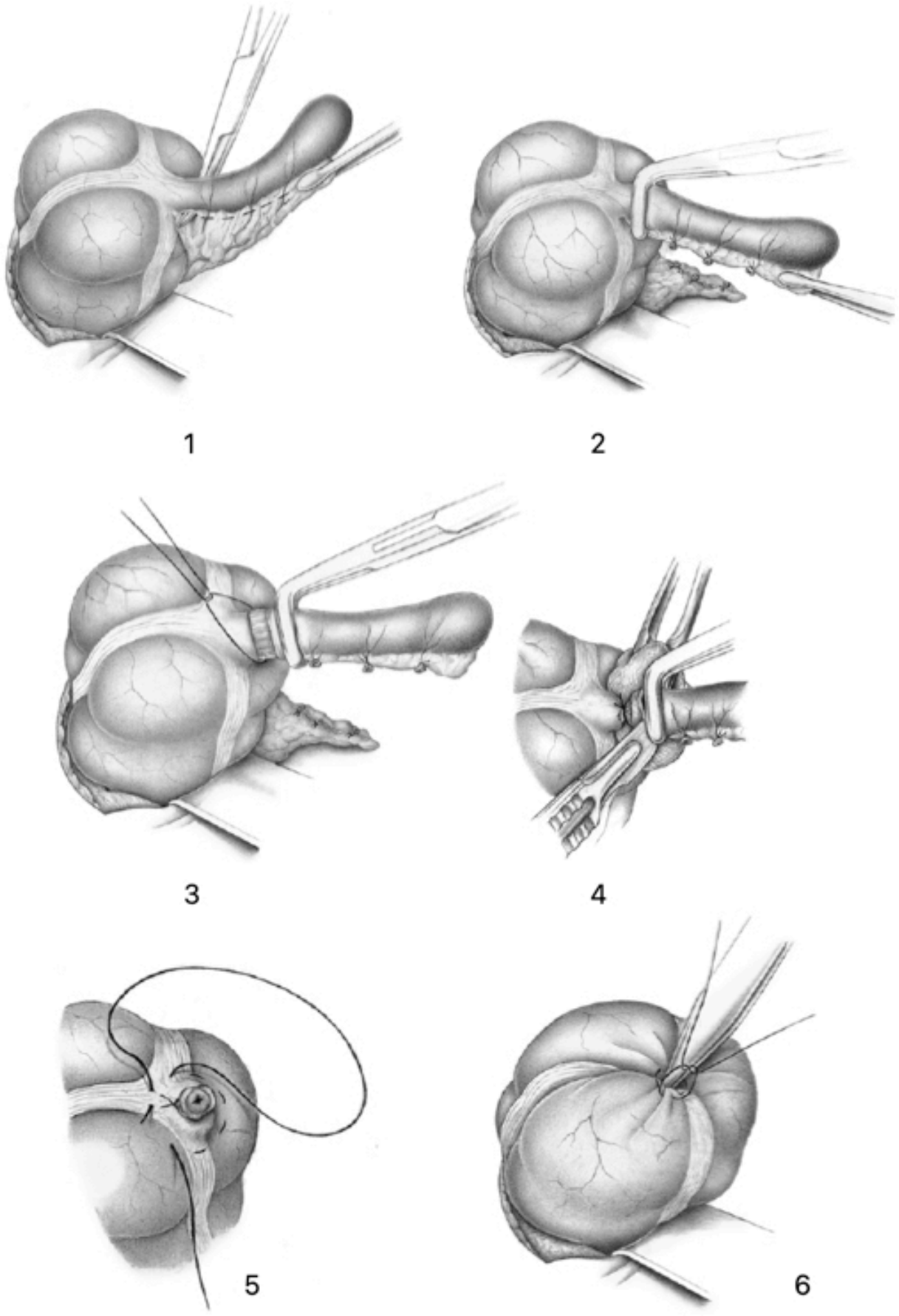


Fig. 8. Open appendectomy technique.

The cecum is placed back into the abdomen, and the abdomen is irrigated. When evidence of free perforation exists, peritoneal lavage with several liters of warm saline is recommended. After the lavage, the irrigation fluid must be completely aspirated to minimize the possibility of spreading infection to other areas of the peritoneal cavity. The use of a drain is not commonly required in patients with acute appendicitis, but obvious abscess with gross contamination calls for drainage.

Wound closure begins with closing of the peritoneum with a continuous suture. Then, the fibers of the muscular and fascial layers are reapproximated and closed with a continuous or interrupted absorbable suture. Finally, the skin is closed with subcutaneous sutures or staples.

In cases of perforated appendicitis, some surgeons leave the wound open, allowing for secondary closure or a delayed primary closure until postoperative day 4 or 5. Other surgeons prefer immediate closure in these cases.

2. Laparoscopic technique (fig. 9).

The surgeon typically stands on the left of the patient, and the assistant stands on the right. The anesthesiologist and the anesthesia equipment are placed at the patient's head, and the video monitor and the instrument table are placed at the feet.

Although some variations are possible, one standard approach is to place three cannulae during the procedure. Two of these have a fixed position (ie, umbilical, suprapubic); the position of the third, which is placed in the right periumbilical region, may vary greatly, depending on the patient's anatomy. It should be noted that these are suggested port sites and that it is acceptable to adjust port placement according to the characteristics of the patient, the type of ports used, and the experience of the surgeon.

According to the preferences of the surgeon, a short umbilical incision is made to allow placement of a Hasson cannula or Veress needle that is secured with two absorbable sutures. Pneumoperitoneum (10-14 mm Hg) is established and maintained by insufflating carbon dioxide. Through the access, a laparoscope is inserted to view the entire abdomen cavity.

A 12-mm trocar is inserted above the pubic symphysis to allow the introduction of instruments (eg, incisors, forceps, or stapler). Another 5-mm trocar is placed in the right periumbilical region, usually between the right costal margin and the umbilicus, to allow insertion of an atraumatic grasper to expose the appendix.

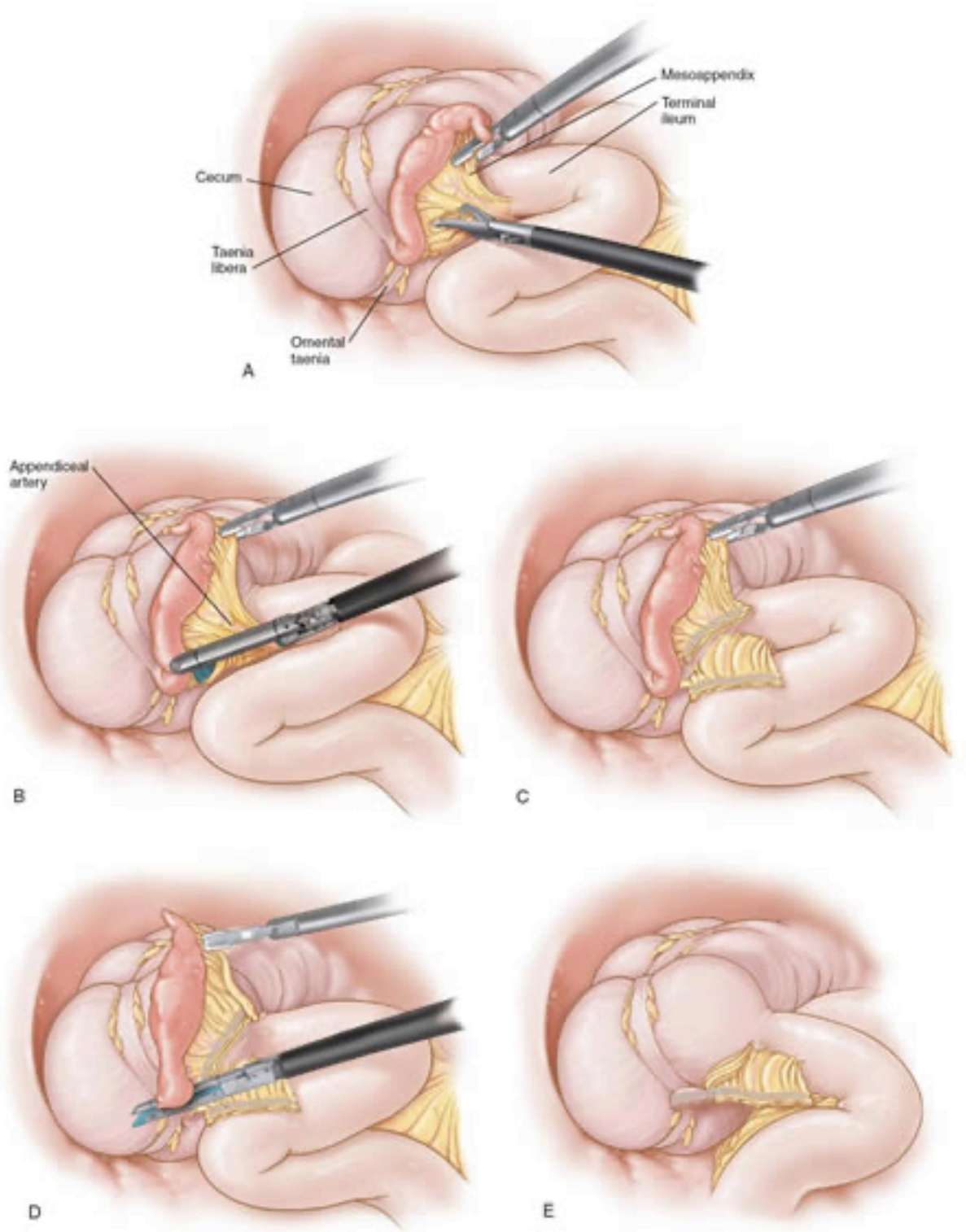


Fig. 9. Laparoscopic appendectomy technique.

The appendix is grasped and retracted upward to expose the mesoappendix. The mesoappendix is divided with a dissector (A, fig. 9) inserted through the suprapubic trocar. Then, a linear endostapler, endoclip, or suture ligature is passed through the suprapubic cannula to ligate the mesoappendix (B, fig. 9). The mesoappendix is transected with scissors or electrocautery (C, fig. 9); to avoid

perforation of the appendix and iatrogenic peritonitis, the tip of the appendix should not be grasped.

The appendix may now be transected with a linear endostapler (D, fig. 9), or, alternately, the base of the appendix may be suture-ligated in a similar manner to that in an open procedure. The appendix is now free (E, fig. 9) and may be removed through the umbilical or the suprapubic cannula in a laparoscopic pouch to prevent wound contamination. Peritoneal irrigation is performed with antibiotic or saline solution. The irrigant must be completely aspirated. Peritoneal irrigation appears to be a risk factor for intra-abdominal abscess after laparoscopic appendectomy.

The cannulae are then removed, and the pneumoperitoneum is reduced. The fascial layers at the cannula sites are closed with absorbable suture. The cutaneous incisions are closed with interrupted subcuticular sutures or sterile adhesive strips.

Single-port appendectomy. Single-port appendectomy has been investigated as an alternative to conventional laparoscopic appendectomy. In comparing results from 35 patients who underwent the procedure with those from 37 patients who were treated with the three-port laparoscopic method, Lee et al found no statistically significant differences between the two groups with regard to surgery time, length of hospital stay, or number of times the patients received analgesic injection.

In this study, the complication rate was 8.6% for the single-port patients vs 2.7% for those who underwent three-port surgery; complications included two cases of wound infection in the single-port group and one case in the three-port group, as well as one case of intra-abdominal fluid accumulation in a single-port patient with perforated appendicitis. The investigators concluded that the single-port procedure is a feasible technique that, in addition to leaving a nearly inconspicuous scar, has outcomes comparable with those of three-port appendectomy.

Postoperative care. Administer intravenous antibiotics postoperatively. The length of administration is based on the operative findings and the recovery of the patient; in complicated appendicitis, antibiotics may be required for many days or weeks. Antiemetics and analgesics are administered to patients experiencing nausea and wound pain.

When appendicitis is not complicated, the diet may be advanced quickly postoperatively and the patient is discharged from the hospital once a diet is tolerated. In patients with complicated appendicitis, a clear liquid diet may be started when bowel function returns. These patients may be discharged after complete restitution of infection.

Postoperative complications. Complications may occur in patents with appendicitis, accounting for an average morbidity near 10%. Death is rare but can occur in patients who have profound peritonitis and sepsis.

Severe infection may result in adynamic ileus. Postoperatively, wound infection or dehiscence may occur, especially in patients with gangrenous or perforated appendicitis, persistent ileus, cecal fistulas, and pelvic or abdominal abscess. Patients with these conditions present with wound tenderness or soreness, drainage of fluid from the incision, or swelling and redness at the incision site. Patients with postoperative infections usually present with a mild fever, abdominal pain, and disorders of bowel transit (ie, diarrhea, constipation). Persistent nausea, vomiting, difficulty with micturition, and persistent pain in the lower limbs may also occur.

Treatment of chronic appendicitis usually doesn't involve surgical removal of the appendix, despite such measures being common for the acute form of the disease.

Instead – prescribe antibiotics to fight the infection. Sufferers of chronic appendicitis may have to take the drugs over time to help beat the disease. The option in case of uneffective conservative methods – appendectomy.

Acute appendicitis in children

Acute appendicitis in children of the first year of life occurs very rarely. The diagnostics of appendicitis at the children of early age is very difficult because it is impossible to take the history and to define pain symptoms which are assessed in adults.

The onset of the disease is characterized with the high body temperature (39-40 °C), with multiple vomitings, quite often with diarrhea. The examination of child is difficult because the palpation of abdomen results in crying and in active strain of abdominal muscles. Quite often in cases of acute appendicitis in children of the first year of life pain and muscle rigidity in the RLQ of abdomen are the only symptoms. Painful feelings at the palpation of the RLQ are detected, when the baby pushes away the surgeon’s hand during palpation of the RLQ. High leucocytosis (up to 18-20 cells/μL) is an often finding.

Treatment – appendectomy under general anaesthesia. Appendix is ligated without purse-string suture due to thin walls of the ceacum.

Acute appendicitis and pregnancy

The incidence of appendicitis is unchanged in pregnancy relative to the general population, but the clinical presentation is more variable than at other times.

During pregnancy, the appendix migrates in a counterclockwise direction toward the right kidney, rising above the iliac crest at about 4.5 months' gestation (fig. 10). RLQ pain and tenderness dominate in the first trimester, but in the latter half of pregnancy, right upper quadrant (RUQ) or right flank pain must be considered a possible sign of appendiceal inflammation.

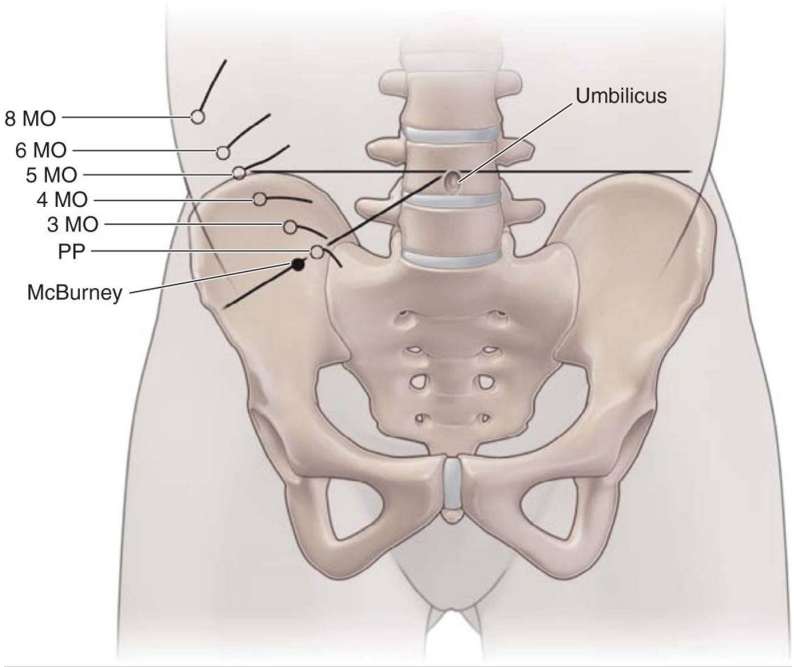


Fig. 10. Location of appendix during pregnancy.

Abdominal rigidity is rarely presented at physical examination.

Nausea, vomiting, and anorexia are common in uncomplicated first trimester pregnancies, but their reappearance later in gestation should be viewed with suspicion.

In pregnant women, the physiologic leukocytosis renders the CBC count useless for the diagnosis of appendicitis.

Surgery is the only method of treatment. In the second half of pregnancy McBurney's operational access is used, but it is displaced upwards the more, than the term of pregnancy is greater. Carefulness of manipulations in the area of uterus, prescribing of sufficient anaesthetic and spasmolitic therapy in postoperative period are necessary for saving the pregnancy.

At acute peritonitis of appendicular origin (perforated appendix) tactics do not differ from tactics in other cases. Artificial termination of pregnancy in such cases is the rough tactical error.

Acute appendicitis in elderly persons

The body temperature raises insignificantly, or it is normal, the specific symptoms are poorly presented, abdominal rigidity is absent in half of cases, rebound tenderness is poorly presented. Intestinal paresis is a common finding.

Leukocytosis is not always seen in the CBC because of the reduction of reactivity of organism.

Appendectomy is the only one method of treatment of acute appendicitis.

Complications of acute appendicitis

1. Appendicular (peri-appendicular) mass/infiltrate – a mass, which is composed mainly of greater omentum, edematous cecal wall, edematous parts of small intestine, and in the middle a perforated or otherwise inflamed vermiform appendix is located. It is the conglomerate of organs and tissues around the inflamed vermiform appendix. It develops, certainly, on 3–5th day from the onset of the disease (fig. 11).

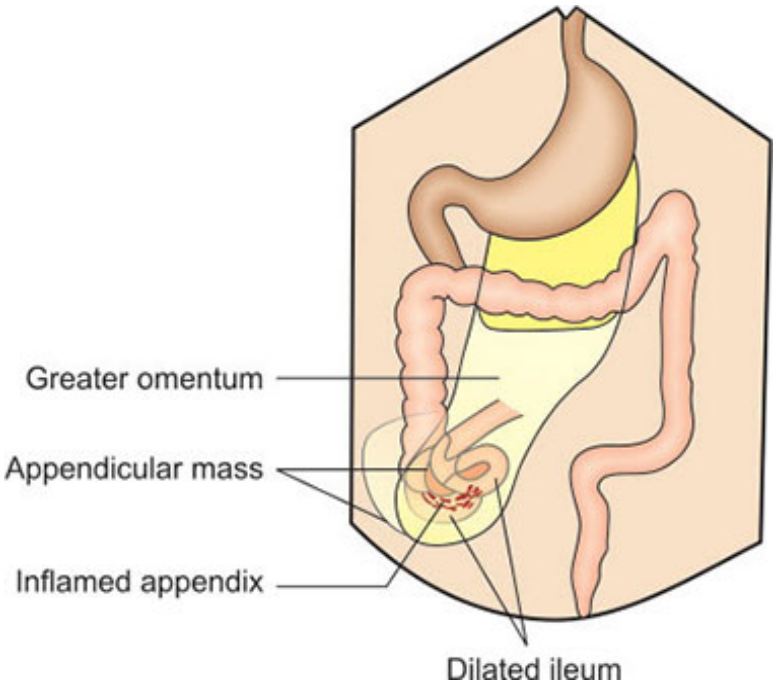


Fig. 11. Appendicular mass.

In patients with a delayed presentation, a tender mass with overlying muscle rigidity may be felt in the right iliac fossa. The presence of a mass may be

confirmed on ultrasonography or computed tomography scan; underlying neoplasia must be excluded, especially in elderly people.

Clinical features and symptoms. History of acute appendicitis, 2-3 days back. On *3rd day* after the onset of acute appendicitis – a tender mass is felt in right iliac fossa (or in pelvis), some rigidity of overlying musculature. On *4th or 5th day* mass becomes more circumscribed, and as the rigidity passes off its periphery can be defined clearly. During *5th - 10th days* – swelling becomes larger, and it results in appendicular abscess or it becomes smaller, and subsides slowly as inflammation resolves.

Diagnosis. During ultrasound examination, the appendicular infiltrate has the appearance of a homogeneous focus in the right iliac or mesogastric area of varying density without clear contours. Abscessing of the infiltrate reveals an echo-negative cavity fluid formation with clear contours of various shapes, the absence of intestinal peristalsis with the presence of a dense perifocal infiltrate around the abscess. The echo structure of a purulent focus depends on the degree of tissue destruction.

Treatment consideration. The recommended management algorithm for appendiceal mass is described on figure 12.

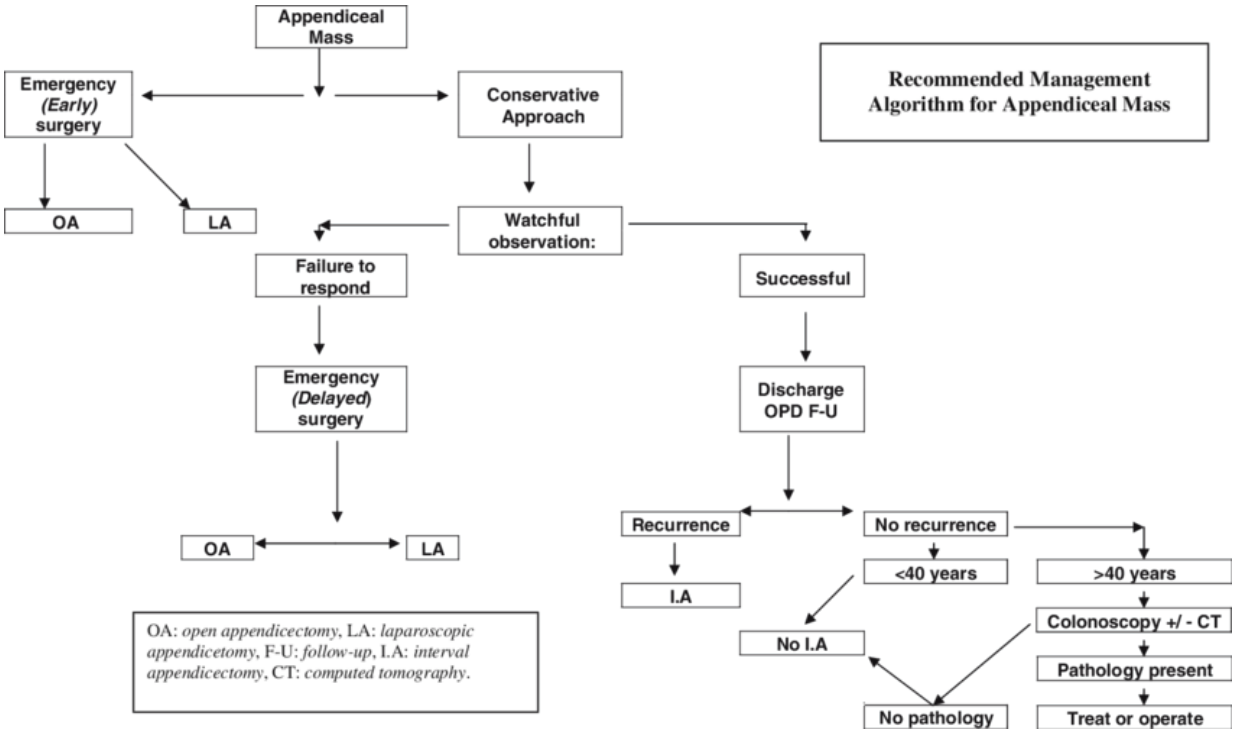


Fig. 12. Recommended management algorithm for appendiceal mass.

The initial treatment in a patient who is otherwise well is conservative, with initiation of appropriate resuscitation and intravenous broad-spectrum antibiotics. In most cases the mass will decrease in size over the subsequent days as the

inflammation resolves, although patients need careful observation to detect early signs of progress of the inflammatory process. As appendicitis can recur, management after resolution of the mass is usually an interval appendicectomy; a conservative approach with outpatient follow-up has been suggested, but no definitive evidence exists to support this

Conservative treatment. Ochsner - Sherren regimen – if the condition of patient is satisfactory, then conservative treatment is performed as follows:

1) Monitoring: Pulse, every four hours; temperature, every four hours; watch for vomiting; if excessive or recurrent, transnasal gastric aspiration is performed.

2) Diet: water, 30 ml hourly, given by mouth; desire for food, usually about 4th-5th day, is an indication that satisfactory progress is being made, and that oral feeding may be started.

3) Intravenous fluids: given according to fluid balance chart and daily assay of electrolytes.

4) Drugs: non-steroid anti-imflammatory drugs (NSAIDs); morphine is given only, when it is decided definitely to treat the patient by conservative measures.

5) Antibiotic therapy: parenteral ampicillin, gentamicin, and metronidazole; oral antibiotics when oral feeding is resumed.

6) Bowels: if bowels movements are abscent by 4th or 5th day, a glycerine suppository is given.

7) Antithromboembolic therapy: prophylaxis against thrombosis of pelvic lower limb veins should be given with compression stockings and subcutaneous low-dose heparin.

Conservative therapy is given up to complete resorption, elective appendectomy is carried out after 3 months (**interval appendectomy**).

Surgical treatment is indicated if appendicular mass becomes an abscess. Appendectomy is indicated if in spite of conservative treatment there is:

- Significantly rising pulse rate.
- Severe vomiting.
- Increasing or spreading abdominal pain.
- Increasing size of an abscess.

2. Appendicular abscess – is a condition in which an abscess is formed around the appendix as a result of appendiceal perforation or extension of inflammation to the adjacent tissues due to aggravation of appendicitis. It is unusual and rare entity; appendicular abscess is a life-threatening complication of acute appendicitis (preoperatively) or appendectomy (postoperatively). It is observed in 2-7% of population presenting with appendicitis (fig. 13).

Symptoms. Symptoms of an appendicular abscess include that of appendicitis with late presentation and can overlap. Typical symptoms of appendicitis may or may not be present but patient presents with:

- Fever > 38.5 °C.
- Generalized abdominal pain.
- Vomiting.
- Diarrhea.
- Tenesmus.

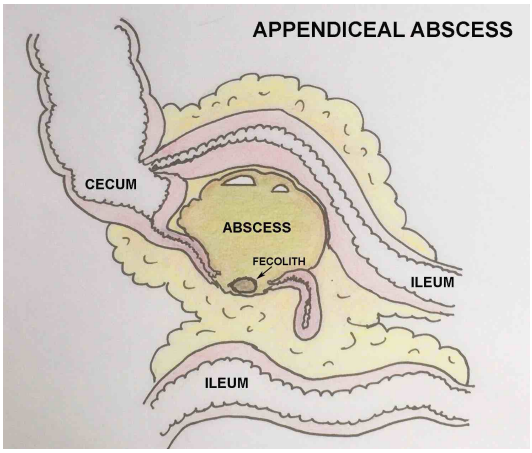


Fig. 13. Appendicular abscess.

Diagnosis. Physical examination: the patient may appear toxic with diffuse abdominal pain and high-grade fever and tachycardia. Even minimal pressure on the abdomen can elicit a marked response from the patient due to pain. Typical signs of appendicitis may not be elicited.

CBC count: infection-like leukocytosis, anemia, abnormal platelet counts, and abnormal liver function tests (due to intoxication) frequently are present in patients with appendicular abscess.

Ultrasound: fluid collection in the appendicular region.

CT: Fluid collection is seen in the appendicular region sometimes mixed with air; appendiceal wall thickening (wall ≥ 3mm) with hyperenhancement and mural stratification can be seen.

Treatment. Percutaneous drainage under ultrasound control + antibiotics. Emergency appendectomy with drainage is performed in cases with peritonitis or large appendiceal abscess.

Management of patients with an appendiceal abscess can usually be divided into the following 3 treatment categories:

- *Patients with a phlegmon or a small abscess:* after intravenous (IV) antibiotic therapy, an interval appendectomy can be performed 4-6 weeks later.

- *Patients with a larger well-defined abscess:* after percutaneous drainage with IV antibiotics is performed, the patient can be discharged with the catheter in place. Interval appendectomy can be performed after the fistula is closed.
- *Patients with a multicompartmental abscess:* these patients require early surgical drainage.

3. Perforated appendicitis. Acute perforation of the appendix is one of the complications of appendicitis that is associated with increased morbidity and mortality and hence regarded as a surgical emergency. Risk factors for perforated appencidicits include extremes of age, male sex, pregnancy, immunosuppression, comorbid medical conditions and previous abdominal surgery.

In addition to the history and symptoms of acute appendicitis we see the **symptoms of peritonitis**: abdominal pain in all parts of abdomen, it may be exacerbated by any movement (eg, coughing, flexing the hips) and local pressure, the pain becomes diffuse. Anorexia and nausea are frequently present. On physical examination, patients with peritonitis most often appear unwell and in acute distress. Fever with temperatures that can exceed 38 C is usually present, tachycardia. Intravascular hypovolemia caused by anorexia and vomiting, fever, and third-space losses into the peritoneal cavity and bowels. With progressive dehydration, patients may become hypotensive, they may demonstrate decreased urine output, and, with severe peritonitis, they may present septic shock.

On abdominal **examination**, essentially all patients demonstrate tenderness to palpation. In most patients with generalized peritonitis and severe diffuse abdominal pain, the point of maximal tenderness is in the RLQ of abdomen. Patients with severe peritonitis often avoid all motion and keep their hips flexed to relieve the abdominal wall tension. The abdomen is often distended, with hypoactive-to-absent bowel sounds.

Treatment. Emergent surgical treatment is the only one method – midline laparotomy, appendectomy, lavage and drainage of abdominal cavity.

4. Pylephlebitis (portal pyemia). Pylephlebitis is defined as an inflamed thrombosis of the portal vein. It is a rare complication of an intra-abdominal infection (as from appendicitis) and the diagnosis is often missed due to its nonspecific clinical presentation. It usually occurs as a complication of abdominal or pelvic infections such as diverticulitis and appendicitis.

Etiology. Nearly any intra-abdominal or pelvic infection involving viscera with drainage via the portal venous system can be complicated by pylephlebitis. In the early 20th century, appendicitis was a common inciting infection, but owing to antibiotics, this is rarely the case today. Currently, diverticulitis is one of the most common sources, though cases have been associated with other inflammatory and

infectious conditions including inflammatory bowel disease, pancreatitis, gastroenteritis, cholangitis, peptic ulcer disease, liver abscess, amoebiasis, and even cases associated with umbilical vein catheters, and migration of an adjustable gastric band. 88% of cases are associated with bacteremia, frequently polymicrobial.

Pathophysiology. Pylephlebitis begins with thrombophlebitis of small veins draining an area of infection → spreading of the thrombophlebitis into larger veins leads to septic thrombophlebitis of the portal vein, which can extend further to involve the mesenteric veins. The superior mesenteric vein is involved in 34% of cases. Mesenteric vein involvement can lead to bowel ischemia, infarction and death.

Clinical features. Although rather nonspecific, common presenting symptoms of patients with pylephlebitis include fatigue, fever (> 38.0 °C), chills, abdominal pain, nausea, vomiting, diarrhea, and weight loss.

Important physical examination findings though not always present, include abdominal tenderness, epigastric pain, splenomegaly, hepatomegaly (tenderness in the right hypochondrium, ascites, and jaundice, usually seen with disseminated hepatic involvement.

Diagnosis. Medical history can be used as a basis for diagnosis.

Blood: early leukocytosis, but both leukopenia and a normal white blood cell count have been reported. Abnormal liver chemistries, including elevation in alkaline phosphatase, AST, ALT, and gamma-glutamyl transferase, are seen in most patients, usually without a concurrent increase in bilirubin unless widespread hepatic involvement is present.

Ultrasound and **CT scan** show increased size of liver and changes in portal vein (the presence of blood clot). Both computed tomography and color flow Doppler ultrasonography have the ability to demonstrate a portal vein thrombus. Still, CT may prove more useful given the ability to detect complications, including hepatic abscesses and intestinal ischemia

Blood cultures help to determine the causative microorganism and their sensitivity to antibiotics.

Treatment. The cornerstone of treatment involves an appropriate *antibiotic regimen*, remembering that the infection is often polymicrobial and frequently caused by gram-negative aerobes, anaerobes, and streptococcus species.

Once culture results and susceptibility data become available, antibiotics should be narrowed accordingly. Initially, antibiotics should be administered via a parenteral route, but ultimately, consideration may be given to transitioning to an oral route pending antimicrobial susceptibility data and clinical complications. The

typical duration of antibiotics is approximately four to six weeks, but consultation with an infectious disease specialist is advised.

Due to the lack of high-quality evidence, it is reasonable to consider *anticoagulation* (heparin or low-molecular-weight heparin) in a patient with an underlying neoplasm, inherited thrombophilia, or extension of the thrombus into the mesenteric veins. It should also be considered when bacteremia is due to a *Bacteroide* species as it possesses surface components that enhance fibrin clotting in addition to the ability to elaborate enzymes that degrade heparin. As the clot burden increases, thrombolytic therapy can be considered, but there is no definite evidence of efficacy.

Surgical treatment. Surgical drainage of abscess and dead tissue removal; ligation of inflamed vein; removal of thrombosis; treatment of underlying cause such as appendicitis, cholecystitis and diverticulitis.

Complications. Pylephlebitis itself is considered a complication of an inciting infectious or inflammatory process, but subsequent complications include chronic thrombosis, an extension of the clot into a mesenteric vein, bowel ischemia, hepatic abscess, hepatic infarction, portal hypertension, splenic infarction, fetal death in pregnant women and death.

Multiple choice questions

1. Differential diagnosis of acute appendicitis should be performed with:
   A. Right-sided renal colic.
   B. Acute cholecystitis.
   C. Ovarian apoplexy.
   D. Acute pancreatitis.
   E. All answers are correct.

2. Choose the contraindication for appendectomy:
   A. Appendicular mass (infiltrate).
   B. Hemorrhagic stroke in history.
   C. 20-24 weeks of pregnancy.
   D. Lidocaine intolerance.
   E. Acute peritonitis.

3. Etiological factors of acute appendicitis include:
   A. Inflammatory bowel diseases.
   B. Fecaliths.
   C. Parasites.
   D. Bacteria.
   E. All answers are correct.

4. Appendicular artery, which supplies blood to the appendix and is located in the mesoappendix (mesentery of appendix), is the branch of which artery?
   A. Common hepatic artery.
   B. Ileocolic artery.
   C. Left colic artery.
   D. Superior rectal artery.
   E. Right femoral artery.

5. The sign, when the pain starts as periumbilical or epigastric pain and then migrates to the right lower quadrant of the abdomen, is called:
   A. Mayo-Robson's sign
   B. Ortner’s sign
   C. Kocher’s sign
   D. Murphy's sign
   E. Rovsing’s sign

Clinical cases

1. You examine a male patient, 46 y.o., in surgical department. Complaints of high fever up to 39.6 °C, weakness, acute pain in right lower quadrant of abdomen which started 2 days ago. Ultrasound: fluid collection in the appendicular region 4.0 x 5.0 cm. CBC: leukocytosis. Which complication of acute appendicitis occurred?

A. Appendicular abscess
B. Appendicular mass/infiltrate
C. Pylephebitis
D. Peritonitis
E. Not-complicated appendicitis

2. Patient C., 28 years, is presented with complaints of moderate pain in the right lower quadrant of abdomen, which started 2 days ago; body temperature up to 37.4 °C. During examination a tender mass was palpated in the RLQ of abdomen, rigidity of muscles. Which complications of acute appendicitis occurred?

A. Sepsis
B. Appendicular abscess
C. Pylephlebitis
D. Appendicular mass/infiltrate
E. Peritonitis

3. A young patient complains of pain in the right lower quadrant of the abdomen that started 2 hours ago in the epigastrium. There was a one-time vomiting. Body temperature is 37.4 °C. On palpation, there is pain and guarding in the right lower quadrant of the abdomen, Rovzing's sign and Blumberg's sign are positive. What is the primary diagnosis?

A. Acute cholecystitis.
B. Acute appendicitis.
C. Acute pancreatitis.
D. Perforated peptic ulcer.
E. Dysentery.

MCQ answers						**Clinical cases answers**			
Question	1	2	3	4	5	Case	1	2	3
Answer	E	A	E	B	C	Answer	A	D	B

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