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Acute appendicitis

Textbook for students of the 4th year of the Faculty of Dentistry in the discipline
"Surgical Diseases"

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The authors presented modern methods for the research and treatment of acute appendicitis. The textbook " Acute appendicitis" is developed on the discipline "Surgical Diseases" in accordance with the requirements of the FSEI HPE, is intended for students of medical Universities and faculties, trained in the specialty 31.05.03 Dentistry.

The manual is developed in accordance with the requirements of the Federal state educational institution, is intended for senior students of medical Universities and faculties enrolled in the specialty 31.05.03 Dentistry.

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Vermiform appendix***Anatomy***

The appendix appears during the fifth month of gestation. Initially several lymphoid follicles are scattered throughout the developing organ. These follicles increase with growth up to 8–20 years of age. The vermiform appendix is a narrow (around 5mm) diverticulum of highly variable length (5–15cm). The base of the appendix is attached to the posteromedial surface of the caecum approximately 3cm inferolateral to the junction of the ileum and caecum. Its blood supply, which originates from the ileocolic artery, reaches it via a small extension of the mesentery of the small bowel, which passes posterior to the terminal ileum. The appendix is highly variable in position. Often (65%) it lies posterior to the caecum (retrocaecal) but it may also extend into the iliac fossa and lesser pelvis (30%) and lie close to the ovary, fallopian tube and ureter. As with the small bowel, the appendix is covered with peritoneum and has an external layer of longitudinal muscle and an internal layer of circular muscle. At the base of the appendix the longitudinal muscle is continuous with the three taeniae of the caecum and the colon. In the submucosal layer there are lymph follicles which are separated by crypts of the columnar epithelial lining that contains many goblet cells. When the submucosal layer becomes swollen it can readily block the lumen of the appendix.

Aetiology and epidemiology of appendicitis

Appendicitis is caused by obstruction of its lumen, most commonly by lymphoid hyperplasia (more common during childhood and in young adults) secondary to various inflammatory and infectious conditions, e.g. gastroenteritis, respiratory infections, measles, infectious mononucleosis and inflammatory bowel disease. The other common cause of appendiceal obstruction leading to appendicitis is faecalith impaction (more common in elderly patients). Rare causes include parasites, foreign bodies and neoplasms. Obstruction is less commonly due to bacterial infections.

The high incidence of acute appendicitis in the West and its relative rarity in Africa suggest a protective effect of a highfibre diet. The high-fibre diet decreases bowel transit time and is thought to minimize the formation of faecaliths. There is also evidence that appendicitis is commoner in urban society than in rural districts, and this may be attributed to a high incidence of enteric infections related to crowded living conditions. Domestic and food hygiene have improved dramatically over the past 40 years and this has coincided with a significant fall in the incidence of appendicitis. There is also epidemiological evidence indicating that the consumption of green vegetables and tomatoes may be protective against appendicitis, whereas potato consumption appears to be related to the disease. In elderly patients there is some evidence that chronic intake of non-steroidal anti-inflammatory drugs may increase the risk.

Acute appendicitis

Pathology

The obstruction causes an elevated intraluminal pressure from increased secretion of fluids and mucus by the mucosa with stasis of the contents and proliferation of intestinal bacteria which recruit polymorphonuclear leucocytes forming pus, thereby inducing a further rise in the intraluminal pressure. This ultimately leads to venous outflow obstruction, ischaemia, loss of epithelial integrity and bacterial invasion of the appendiceal wall. As the pathology progresses thrombosis of the appendicular artery and veins occurs with gangrene and perforation of the appendix forming a periappendicular abscess or local/generalized peritonitis. The presence of gangrene or perforation seems to be associated with the presence of faecaliths, which are radio-opaque intraluminal laminated appendiceal calculi. Approximately 50% of cases of gangrenous or

perforated appendicitis are associated with a faecalith in contrast with uncomplicated appendicitis in which a faecalith is rarely present. The rate of perforation varies from 16% to 40%, with a higher frequency occurring in younger age groups (40–57%) and in patients older than 50 years (55– 70%), in whom misdiagnosis and delayed diagnosis are common.

Clinical features

Appendicitis is one of the more common surgical emergencies and is the commonest cause of abdominal pain requiring hospital admission. The current annual incidence of acute appendicitis is one in 1000 individuals. There is a slight male preponderance (3:2) in teenagers and young adults. In adults, the incidence of appendicitis is approximately 1.4 times higher in males. The incidence of appendicitis peaks in the late teen years, and gradually declines thereafter. In the paediatric age group the mean age at presentation is 6–10 years. This is thought to result from the higher prevalence of lymphoid hyperplasia.

Examination

The first part of the examination should consist of general inspection of the patient's wellbeing with measurement of their pulse and temperature. Patients with appendicitis may well have a normal pulse rate and temperature, but a sustained tachycardia is highly significant in the presence of abdominal pain and tenderness and should always be taken seriously. Although the temperature may be normal, most patients with appendicitis have low-grade pyrexia. A very high temperature (above 39°C) indicates probable abscess formation or some other diagnosis such as a viral illness.

The next stage is to observe the patient's abdomen and to look for movement with respiration. It is then useful to ask the patient to cough while watching their facial expression. If coughing produces obvious pain the patient should be asked to indicate the site of maximum pain. If this lies in the right iliac fossa this will indicate localized peritonitis in this area and is highly suggestive of appendicitis. The tongue, mouth and throat should be examined as a furred tongue and fetor oris will be present in about 50% of patients, particularly those with a delayed diagnosis. The tonsils should also be inspected particularly in children, as tonsillitis may be associated with mesenteric adenitis. Attention should then be turned to

palpation of the abdomen. The first point to establish is the site of maximal tenderness. In the majority of patients this is at or close to 'McBurney's point' which is situated at the junction between the upper two-thirds and lower one-third of a straight line joining the umbilicus and the anterior superior iliac spine. It must be stressed, however, that in patients with inflammation in a retrocaecal appendix the pain may be considerably higher and more lateral than this, and in pelvic appendicitis the pain may be lower and almost midline. Indeed, with a low pelvic appendix tenderness may be only detectable by rectal examination. The abdomen should then be assessed for guarding or the involuntary contraction of the abdominal wall muscles over the area of inflamed peritoneum. Right lower quadrant guarding is found in about 90% of patients with acute appendicitis and if the appendix has perforated leading to generalized peritonitis the area of guarding may extend beyond the right lower quadrant. Rebound tenderness is another useful sign. This may be elicited by pressing gently on the right lower quadrant of the abdomen and then suddenly releasing the hand and watching the patient's face for signs of discomfort. Another approach is to use percussion which, in the presence of peritoneal irritation, will elicit the same response and is kinder.

When the amount of tenderness permits, careful palpation of the right iliac fossa for a mass should be carried out. This may indicate the presence of an appendiceal abscess or an appendix mass (phlegmon) created by omentum wrapped around the inflamed appendix. Of course, it may also indicate some other pathology such as a caecal carcinoma which is mimicking appendicitis in its presentation. After careful examination of the abdomen, attention should be turned in the male to the testes as both acute torsion and orchitis may present initially with right lower quadrant pain. The hernial orifices should also be carefully examined for strangulated inguinal or femoral hernias and it should never be forgotten that acute appendicitis can occasionally occur in an appendix lying within a hernial sac. Rectal examination can be extremely helpful in the clinical assessment of suspected appendicitis but in a patient with clearcut symptoms and signs it is unnecessary. However, particularly in a patient with diarrhoea and abdominal pain who does not have convincing abdominal signs, a rectal examination should always be carried out. The examining finger should be pressed on to the pelvic peritoneum first to the left and then to the right. When there is a pelvic appendicitis there will be more discomfort felt on the right. In female patients, the surgeon should then take opportunity of moving the cervix

through the rectal wall as pain associated with this manoeuvre is highly indicative of pelvic inflammatory disease.

Diagnosis

The diagnosis of acute appendicitis is made largely on clinical grounds. The problem is that the diagnosis is correct in only 50% and up to 20% of appendicectomy specimens are normal especially in females. A systemic review of published series identified the following useful predictors of appendicitis in patients with abdominal pain: raised inflammatory markers, clinical signs of peritoneal irritation, migration of abdominal pain.

However, certain investigations which may be of value in problematic cases include:

- elevated white cell count and C-reactive protein
- a plain abdominal radiograph
- ultrasound and CT scanning
- pregnancy test in adult females
- laparoscopy
- urinalysis.

The majority of patients with acute appendicitis will have a polymorphonuclear leucocytosis and a white cell count of more than $14 \times 10^9 /L$ is suggestive of appendicitis. However, it must be remembered that various other causes of abdominal pain result in an increased white cell count and around 25% of patients with appendicitis have a normal preoperative white cell count. In patients in whom the diagnosis of acute appendicitis is doubtful and in whom a period of observation is felt to be appropriate, it is worthwhile repeating the white cell count. A falling white cell count will strongly support the diagnosis of non-specific abdominal pain. In a patient with clear-cut symptoms and signs of acute appendicitis a plain abdominal radiograph is of little or no diagnostic value. However, it is clearly indicated if there is some clinical suspicion of intestinal obstruction or ureteric colic. An erect chest radiograph should always be requested when there is a suspicion of a perforated viscus. A urinalysis should always be carried out to exclude the possibility of urinary tract infection, bearing

in mind that about 20% of patients with appendicitis will have sterile proteinuria and pyuria.

Ultrasound and CT scanning

Ultrasound examination of the pelvis is particularly useful in female patients when a differential diagnosis of gynaecological pathology such as a twisted ovarian cyst is being entertained. It may also be useful in distinguishing between an appendix mass and an abscess. In addition to this there have been some reports indicating that ultrasound can be used to make the diagnosis of appendicitis with a high level of sensitivity and specificity. This has not become routine however owing to the fact that a high level of expertise is required. Such expertise is not routinely available for emergency situations in most institutions. CT scanning may occasionally be useful in establishing the diagnosis where a right lower quadrant mass is present. However, it does not have a place in the routine diagnosis of acute appendicitis.

Laparoscopy

Laparoscopy has an established role in the diagnosis of acute appendicitis when the clinical diagnosis is uncertain. It is particularly of value in women of child-bearing age where there are a number of different causes of right lower quadrant pain and tenderness. Several studies now testify to the reduction in the negative appendicectomy rate in such patients. Use of laparoscopy in males and in children is less well established, but whenever there is a diagnostic problem and the surgeon is unhappy about prolonged observation then laparoscopy is appropriate in any patient who has not had previous extensive abdominal surgery. During the procedure a probe should always be used in order to manipulate the caecum so that the appendix can be fully visualized.

Laparoscopy is greatly superior to a right lower quadrant gridiron incision for visualizing the abdominal and pelvic organ. For this reason it is particularly useful in planning incisions both for acute appendicitis and for other unsuspected intra-abdominal pathology. Laparoscopy can also be used to carry out appendicectomy (see section on treatment).

Complications

Complications of acute appendicitis are secondary to gangrenous or perforated appendicitis and can therefore be avoided by prompt recognition of the condition and appropriate treatment. These are:

- appendix abscess
- appendix mass
- wound infection
- generalized peritonitis, particularly in the very young or elderly
- intraperitoneal abscess formation, either subphrenic or multiple small intraloop abscesses
- faecal fistula usually following draining of an abscess
- recurrent intestinal obstruction due to the formation of adhesions
- portal pyaemia
- sterility in women of child-bearing age; there is some debate as to whether perforation of the appendix increases the rate of infertility but recent studies indicated that it is probably not a major except for patients with perforation and peritonitis leading to obstruction of fallopian tubes from adhesions
- overwhelming sepsis and death.

Treatment

In cases of doubt regarding the diagnosis, a period of 'active observation' is advisable. Reports suggest that this approach reduces the negative appendicectomy rate without increasing the risk of perforation. Intravenous fluids and analgesia should be given. Opiate analgesia should be administered as it does not mask the signs of peritonism. Antibiotics should be withheld until the decision to operate has been made. The mainstay of treatment in acute appendicitis is early appendicectomy. This is normally done through a small skin crease incision in the right iliac fossa, which involves splitting the underlying abdominal muscles rather than cutting them. After removal of the appendix, the appendiceal stump is traditionally buried into the caecum but there have been trials to show that this manoeuvre is unnecessary. If the appendicitis is diagnosed at the time of a

laparoscopy it is possible to carry out a laparoscopic appendicectomy if the surgeon has the necessary expertise. There have now been a number of randomized trials comparing conventional appendicectomy with laparoscopic appendicectomy. These have shown similar outcome except for reduced postoperative pain and a lower postoperative wound infection rate with the laparoscopic approach. In all patients undergoing appendicectomy, prophylactic antibiotics should be used and a combination of metronidazole and cefuroxime is widely favoured. However there is evidence that metronidazole alone, administered as a suppository, is appropriate. In the patient who has a perforated appendix, appendicectomy should be followed by peritoneal lavage with saline containing an antibiotic (cefuroxime or tetracycline). When perforation has occurred it is common practice to continue intravenous antibiotics for 3–5 days postoperatively. Clinical trials have shown that drains do not confer any benefit and may indeed increase the incidence of wound infection. Appendicitis can be treated conservatively by means of bed rest and intravenous antibiotics (cefuroxime and metronidazole) but the risk of perforation and widespread peritonitis on this regime is such that it cannot be recommended for routine use. However, in certain circumstances where surgery is impractical (e.g. on a ship without a surgeon on board), this may be the only feasible approach. The treatment of patients presenting with an appendiceal mass is rather different. Although some surgeons favour an operative approach the majority will treat an appendix mass conservatively. If the patient has a fever and a high white count and the mass is tender these are indications that an abscess has formed. This can be confirmed by ultrasound or CT scanning and insertion of a percutaneous drain is the current treatment of choice. Occasionally this can be followed by the development of a faecal fistula but this is usually a low-output fistula which normally heals spontaneously. If percutaneous drainage is inadequate, it may be necessary to carry out operative drainage through an incision placed lateral to the mass. If, on the other hand, a mass develops without the signs and symptoms of an abscess the best approach is conservative. However, it is important that the patient should be investigated and a barium enema about 2 months after the development of the mass is necessary to exclude other pathology, such as a caecal carcinoma. In patients who have had an appendix mass treated conservatively, about 15% will develop recurrent appendicitis. This should be explained to the patient and an interval appendicectomy can be carried out according to a decision made jointly by the patient and the surgeon. When a

patient has a laparoscopy or laparotomy which reveals an apparently normal appendix and no other pathology, there is some debate as to whether or not to carry out an appendicectomy. Given that the risk of developing appendicitis in adults is in the region of 0.04 and the risk from death from acute appendicitis is about one in 800, it seems reasonable to leave the appendix in situ. The reality is that when a normal appendix is seen at laparoscopy most surgeons skilled in laparoscopic appendicectomy tend to remove the appendix. Especially with the open approach most surgeons perform appendicectomy for the following reasons.

- If a scar is present in the right iliac fossa, a future assumption that appendicectomy has been carried out may be made.
- If the patient has recurring right iliac fossa pain, appendicectomy will rule out an important cause of the symptom.
- About 20% of normal-appearing appendices show microscopic evidence of mucosal ulceration and pus in the lumen.
- The majority of cases of carcinoid of the appendix occur in organs which look macroscopically normal.

Prognosis

The overall mortality rate of 0.2–0.8% from appendicitis is attributable to complications of the disease rather than to the surgical treatment. In children, the mortality rate ranges from 0.1% to 1%; in patients older than 70 years, the rate rises above 20%, primarily because of diagnostic and therapeutic delay. Appendiceal perforation is associated with increased morbidity and mortality. Complications occur in 1–5% of patients with appendicitis, and postoperative wound infections account for almost one-third.

Tests

1. In what case of acute appendicitis general anesthesia is indicated?

1. A patient with early term of pregnancy
2. Acute appendicitis complicated with diffuse peritonitis

3. Patients from 14 to 16 years old

4. In suspected retrocecal location of the vermiform appendix

5. An elderly patient with typical picture of noncomplicated acute appendicitis

2. In a patient operated on acute phlegmonous appendicitis and diffuse peritonitis through an approach in the right iliac area right-sided subdiaphragmatic abscess was diagnosed. What was the possible reason of its formation?

1. A patient didn't take Trendelenburg's position after the surgery

2. A patient didn't take Fowler's position after the surgery

3. The wrong approach had been chosen, inferomedian laparotomy had to be performed

4. Exudate in the abdominal cavity hadn't been drained

5. Tamponade of the abdominal cavity hadn't been performed

Choose the right answer combination:

a) 1, 3, 5

b) 1 and 4

c) 1 and 5

d) 2, 3, 4

e) 2, 3, 5

3. In 76-year-old patient with transmural myocardial infarction phlegmonous appendicitis was detected. What are your actions?

1. Emergency surgery

2. Observation and surgery in case of peritonitis symptoms

3. Indication of massive doses of antibiotics and surgery in case of ineffective antibioticotherapy

4. Laparoscopy, in case of diagnosis confirmation - surgery

5. All variants are wrong

4. Appendicular infiltrate usually develops:

1. First 2 days from the onset
2. 3-4 days from the onset
3. 7 - 9 days from the onset
4. Early period after appendectomy
5. Late period after appendectomy

5. Tamponade of the right iliac fossa after appendectomy is indicated after:

1. Periappendiceal abscess
2. Vermiform appendix gangrene
3. Retrocecal position of the vermiform appendix
4. Capillary bleeding from the tissues in the area of the vermiform appendix location
5. Peritonitis Choose the right answer combination:

- a) 1, 4
- b) 3, 5
- c) 4, 5
- d) 1, 2, 3
- e) 2, 3, 4

6. In complication of acute appendicitis with appendicular infiltrate conservative therapy is indicated because:

1. Self-recovery is possible
2. Infiltrate resorption is possible
3. In attempt to carry out appendectomy small bowel perforation is possible

4. After infiltrate resorption the mild case of the disease is chronic appendicitis
5. In attempt to expose the vermiform appendix from the infiltrate peritonitis can develop

Choose the right answer combination:

- a) 1, 3
- b) 2, 4
- c) 1, 2, 3
- d) 3 and 5
- e) All variants are correct

7. Douglas abscess after appendectomy is characterized by following signs:

1. Hectic temperature
2. Pains deep in the pelvis and tenesmus
3. Limited diaphragm mobility
4. Overhanging vaginal walls or anterior walls of the rectum
5. Muscles tension of the anterior abdominal wall

Choose the right answer combination:

- a) 1, 3, 5
- b) 1, 2, 4
- c) 1, 3, 4
- d) 2, 3, 4
- e) 2, 3, 5

8. Emergency appendectomy is not indicated in:

1. Acute catarrhal appendicitis
2. Acute appendicitis in late pregnancy
3. The first attack of acute appendicitis

4. Obscure diagnosis of acute appendicitis in elderly patients
5. Acute appendicitis in children

9. Symptoms of appendicular infiltrate are following except:

1. Low grade fever
2. Disease duration of 4-5 days
3. Intractable diarrhea
4. Increased level of blood leukocytes
5. Palpable tumor-like mass in the right iliac area

10. The reason of wound abscess after appendectomy is:

1. Fecal fistula
2. Wound infection during a surgery
3. Actinomycosis
4. Blind gut cancer
5. Foreign body (tissue)

Situational task 1

Patient K., 40 years old, complains of pain in the right iliac region. He became ill about 8 hours ago when there were pains in the epigastrium, and then they shifted to the right iliac region. The chair was, feces of ordinary color, decorated. Urination is not impaired. Body temperature 37.2 ° C.

1. Make a preliminary diagnosis.
2. What is the treatment tactic?

Situational task 2

Patient M., 62 years old, was admitted to the surgical department 4 days after the onset of the disease with complaints of moderate pain in the right iliac region, fever up to 37.6 °C. From the anamnesis: 4 days ago there was an attack of pain in

the right iliac region. Objectively: the tongue is moist, the stomach is involved in the act of breathing, soft. On palpation in the right iliac region, a rounded formation is determined.

1. Make a preliminary diagnosis.
2. What diseases should be used for differential diagnosis?

Situational task 3

A 32-year-old patient was admitted on the 4th day of illness. There were pains in the right iliac region, nausea. I did not go to the doctor, took analgesics, the pain subsided. In the right iliac region, a dense fixed formation of 18x12 cm in size, adjacent to the iliac crest, is painful on palpation. The abdomen is soft, the symptoms of peritoneal irritation are negative; body temperature 37.8 ° C.

1. Make a preliminary diagnosis.
2. Prescribe treatment to the patient.

Answers to Tests and Tasks

1. 2
2. d
3. 1
4. 2
5. a
6. e
7. b
8. 4
9. 3
10. 2

Situational task 1

1. Acute appendicitis.

2. Appendectomy

Situational task 2

1. Acute appendicitis complicated by appendicular infiltrate.
2. Appendicular infiltrate should be differentiated from a cecum tumor.

Situational task 3

1. Appendicular infiltrate.
2. Half bed mode. Table No. 4. Cold on the area of infiltrate. Antibiotics, a wide spectrum of action.

Literature:

1. Yano T, Yamamoto H, Sunada K, et al. Endoscopic classification of vascular lesions of the small intestine (with videos). *Gastrointest Endosc* 2008;67:169.
2. Rha SE, Byun JB, Jung SE, et al. Neurogenic tumors in the abdomen: tumour types and imaging characteristics. *Radio graphics* 2003;23:29–43.
3. Noomen, CG, Hommes DW, Fidder HH. Update on genetics in inflammatory disease. *Best Pract Res Clin Gastroenterol* 2009;23:233–243.
4. Monkemuller K, Neumann H, Evert M. Cronkhite-Canada syndrome. Panendoscopic characterization with esophagogastroduodenoscopy, endoscopic ultrasound, colonoscopy, and double balloon enteroscopy. *Clin Gastroenterol Hepatol* 2008;6:A26.
5. Levy AD, Abbott RM, Rohrmann CA Jr, et al. Gastrointestinal hemangiomas: imaging findings with pathologic correlation in pediatric and adult patients. *AJR Am J Roentgenol* 2001;177:1073–1081.
6. Hyperlink-Fletcher C, Berman J, Corless C, et al. Diagnosis of gastrointestinal stromal tumors: a consensus approach. *Hum Pathol* 2002;33:478–483.
7. d'Amore F, Brincker H, Grønbaek K, et al. Non-Hodgkin's lymphoma of the gastrointestinal tract: a population-based analysis of incidence, geographic distribution, clinicopathologic presentation features, and prognosis. Danish Lymphoma Study Group. *J Am Soc Clin Oncol* 1994;12:1673–1684.