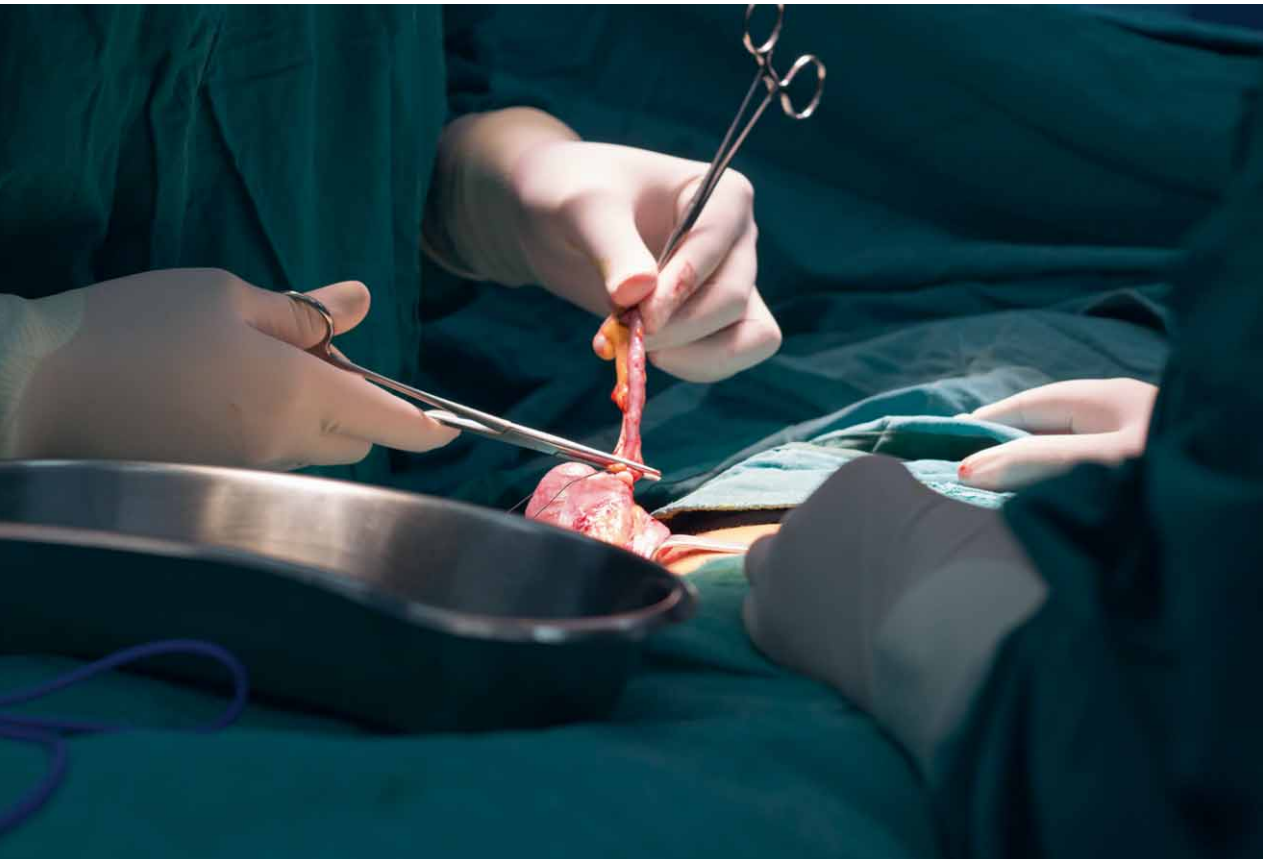


Vitezslav Marek, et al.

Acute appendicitis

early diagnosis and
preoperative consideration



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ACUTE APPENDICITIS

early diagnosis and preoperative consideration

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Motto:

“I know the day will come when one suffering from an unknown disease will entrust himself into the hands of physicists. They will not ask them anything; they will take the patient’s blood, determine certain constants, multiply them by each other, check all the data according to a logarithmic table and cure the patient with a single pill. However, when I get sick, I prefer to see an old doctor. He will look at me, feel my heartbeat, palpate the abdomen, listen to my chest. He will then light his pipe, cough, rub his chin and smile at me, to ease my pain. Of course, I admire science, but I also admire wisdom.”

Antoine de Saint-Exupéry

This publication is dedicated, with love, to my parents. They were always there,

by Vitezslav Marek

Preface

Dear readers,

We would like to present to you a new publication offering the latest knowledge in the field of early diagnostics and preoperative considerations related to acute appendicitis (AA). The initial examination of a patient with acute abdominal pain at the surgical outpatient clinic is essential, as it decides the patient's future. Acute appendicitis ranks among the most common Acute Abdominal Emergency (AAE) cases. Its course is uncertain, misleading, highly variable and despite many scientific advances in elucidating its pathophysiology and diagnostics, it can still surprise and catch even an experienced diagnostician off guard. The reason for writing this publication was the fact that several young women who had overcome a complicated, perforating appendicitis recently came to the surgical outpatient clinic and currently are having trouble becoming pregnant. Their sadness and sense of helplessness inspired us to emphasize the importance of early diagnosis and preoperative considerations in acute appendicitis. In the individual chapters of this publication, we analyse diagnostic examination methods. We emphasize the anamnesis and physical examination of the abdomen of a patient suspected of having AA, which currently is and in the near future will remain the cornerstone of the diagnostics of this insidious disease. We are trying to learn to understand the nature of individual clinical symptoms and thus comprehend the logic of diagnostics in clinical examination. The diagnosis of AA itself belongs to the surgeon; it is inadmissible to give up this task up and place it on the shoulders of a radiologist. A thorough physical examination of the abdomen not only leads to diagnosis of the disease but also teaches the surgeon about the accuracy, thoroughness and thinking over of each diagnostic-therapeutic step, which can then be used in surgery. In most cases, a thorough diagnostician is also a thorough surgeon. Preoperative considerations require, in addition to knowledge, a certain amount of experience. We have tried to design an algorithm for preoperative reasoning and considerations in a therapeutic indication. We are aware that it is advantageous for a young novice in surgery to meet a senior, experienced colleague at the department, who will introduce him/her to this issue. We dedicate the publication to medical students, general practitioners, paediatricians, surgeons and other colleagues for whom AA diagnostics are a common daily bread. It will be our great pleasure, if it is useful to them and helps them improve their diagnostics of this disease. Finally, we would like to thank Ing. Pavol Marek and Ing. Jana Kucerova for their help with the image and text documentation and prof. Rudolf Hyrdel, MD, CSc. (Comenius University) and prof. Marian Vidiscak, MD, Mgr., PhD., FEBPS (University of Cambridge) for their review of the work.

Bratislava 31. may 2021

Vitezslav Marek, Stefan Durdik

1 Case studies

Vitezslav Marek

Case Report No. 1

male, 22 years old, married, 1 child, employed as a turner

The patient complains of abdominal pain, anorexia and nausea. He is subfebrile. Abdominal pain started 6 hours ago in the epigastrium; later it moved to the right hypogastrium, and it becomes more intense with coughing.

Clinical examination

The patient arrives cautiously to the surgical outpatient clinic, holding the right hypogastrium with his right hand, climbing onto the diagnostic table is difficult for him due to intense abdominal pain. Upon palpation examination we identify palpable painfulness in the right hypogastrium in the area of McBurney's point, with peritoneal irritation (défense musculaire) indicated. Percussion in the area of the right hypogastrium is significantly painful, tympanic in the rest of the abdomen; peristalsis is weakened, almost disappeared. Examination per rectum: ampoule, Douglas space painless.

Patient's weight: 80 kg, Height: 180 cm

Axillary body temperature: 37.2 °C, Heart rate: 110/min, Blood pressure: 110/80 mmHg

Laboratory results

Haemoglobin: 140 g/l, Leukocytes: 13.8 g/l, CRP 50 mg/l, NLR 4.2, Procalcitonin 8 ng/ml, IL-6 14 ng/l

Biochemical examination of urine: negative

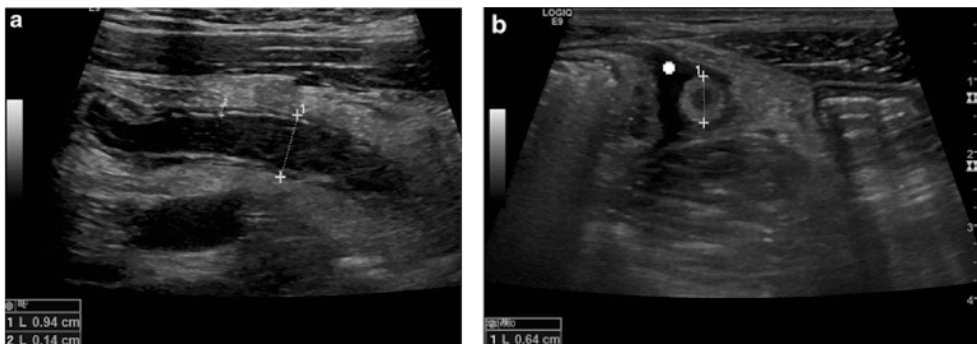


Fig. 1.1 Longitudinal (a) and transverse (b) US scan of acute appendicitis. Thickening of the wall (crosses 2), diameter > 6 mm (crosses 1) and free fluid surrounding the appendix (Assoc. Prof. Viera Lehotska, MD, PhD., Department of Radiology, St. Elizabeth Hospital, Medical School of Comenius University, Bratislava)

Transabdominal sonographic examination

Describes the diameter of the appendix – more than 6 mm, and free of fluid around the appendix.

Diagnosis

Acute appendicitis – surgical revision of the abdominal cavity indicated.

Management

Patient urgently admitted to the surgical department, peripheral vein found, hydration of the patient with crystalloid infusion solutions, oral food intake excluded. The patient underwent urgent surgery – laparoscopic appendectomy. Post-surgery course without complications, ATB not administered.

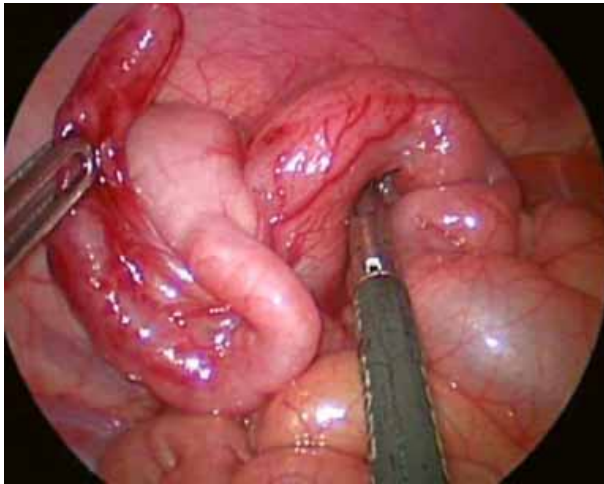


Fig. 1.2 *Acute phlegmonous appendicitis (Vitezslav Marek, MD, PhD., Department of Surgical Oncology, St. Elizabeth Hospital, Medical School of Comenius University, Bratislava)*

Histological examination

Phlegmonous appendicitis

Case Report No. 2

female, 30 years old, married, 2 children, employed as a primary school teacher

The patient complains of abdominal pain, vomiting and a febrile condition. Abdominal pain started 3 days ago in the right hypochondria; it is intensified by coughing.

Clinical examination

The patient enters the surgical clinic exhausted, vomiting repeatedly; she is dehydrated. On palpation, we identify a palpation pain in the right hypochondrium, Murphy's sign is negative. Tapotement of the right lumbar region is positive.

Abdominal percussion examination negative, peristalsis weakened, almost disappearing.

Examination per rectum: ampoule, Douglas space painless.

Clinical examination suspected hepatobiliary sepsis or pyelonephritis.

Patient's weight: 78 kg, Height: 173 cm

Axillary body temperature: 39.2 °C, Heart rate: 105/min, Blood pressure: 130/80 mmHg

Laboratory results

Haemoglobin: 125 g/l, Leukocytes: 14.5 g/l, CRP 115 mg/l, NLR 4.8, Procalcitonin 15 ng/ml, IL-6 21 ng/l

Biochemical examination of urine: blood +

Transabdominal sonographic examination of the abdomen

No pathological findings in the area of Morrison's pouch and signs of pelvic inflammation.

CT examination of the abdomen and pelvis

It described the collection of fluid in the subhepatic space and a long, retrocaecal appendix extending to the anterior right pararenal space.

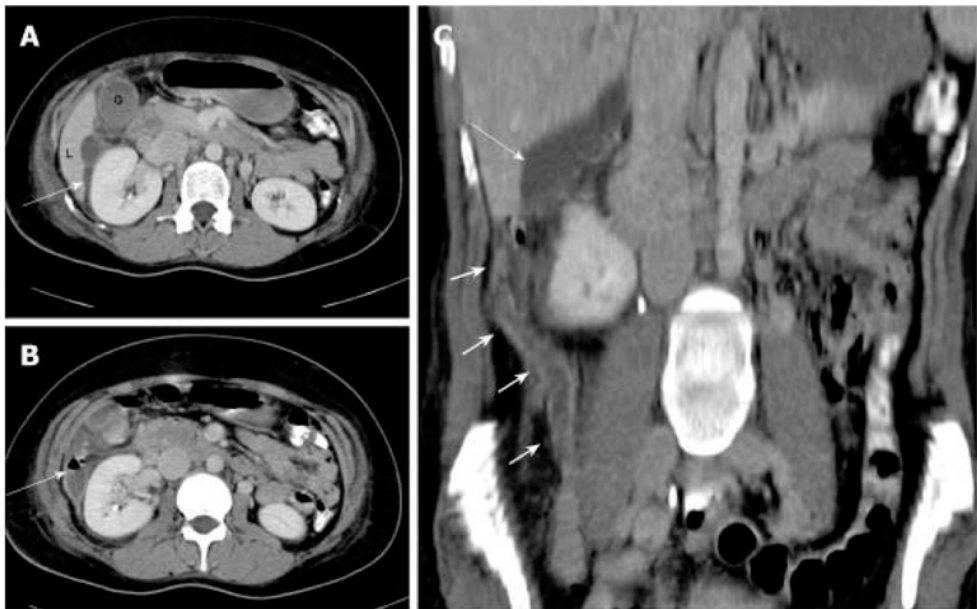


Fig. 1.3 *A – contrast-enhanced CT scan showing fluid collection (arrow) in the subhepatic region, extending anteriorly to the gallbladder fossa, B – the air fluid level in the collection adjacent to the right kidney, C – coronal reconstruction showing the long thickened and inflamed appendix (short arrows) reaching the subhepatic region, and the subhepatic collection (arrow) (Assoc. Prof. Viera Lehotska, MD, PhD.)*

Diagnosis

Retrocaecal, subhepatic appendicitis – surgical revision of the abdominal cavity indicated

Management

Patient urgently admitted to the ICU of the surgical department, central venous catheter (CVC) applied, hydration of the patient with crystalloid infusion solutions, oral food intake excluded, ATB treatment (amoxiclav + efloran i.v.) Urgent patient's surgery – open appendectomy, lavage and drainage of the abdominal cavity. Postoperative course without complications, ATB administered postoperatively for 7 days.

Histological examination

Gangrenous, retrocaecal, perforated appendicitis

Case Report No. 3*girl, 4 months old*

The patient, brought to the paediatric outpatient clinic with a muffled voice, crying; she is restless. Repeated vomiting and she has diarrhoea.

Clinical examination

The abdomen is in the niveau of the chest, palpably without abdominal pain and a protective spasm of the abdominal muscles, peristalsis is present, non-forced.

Patient's weight: 6.0 kg, Height: 61 cm

Axillary body temperature: 39.3 °C, Heart rate: 145/min, Blood pressure: 105/80 mmHg

Laboratory results

Haemoglobin: 135 g/l, Leukocytes: 12.0 g/l, CRP 76 mg/l, NLR 4.5, Procalcitonin 20 ng/ml, IL-6 43 ng/l

Biochemical examination of urine: negative

Chest X-ray examination

No pathological changes in the organs of the thoracic cavity

Transabdominal sonographic examination of the abdomen

No clear pathology in the abdominal cavity.

Diagnosis

Pyelonephritis susp.

Management

Patient urgently admitted to the paediatric ward, peripheral vein found in the frontal area of the head, hydration of the patient with crystalloid infusion solutions, antipyretics. Orally administered fluids, ATB: 3rd generation of Cephalosporin.

24 hours after admission, the clinical findings worsen. The child vomits repeatedly, the abdomen is distended. On palpation, we have found signs of peritoneal irritation.

X-ray native abdomen

Distended curves of the small intestine, without layers

Follow-up transabdominal sonographic examination of the abdomen

An incompressible 8 mm structure is present in the right hypogastrium, without fluid collection in its vicinity.

Surgical intervention: laparoscopic appendectomy.

Post-surgical course uncomplicated, ATB not administered post-surgically.

Histological examination

Phlegmonous appendicitis

Case Report No. 4

boy, 5 years old

Patient brought to a paediatric outpatient clinic with convulsive abdominal pain, repeated vomiting of stomach contents. Stool is regular, of firm consistency, diarrhoea is not present.

Clinical examination

The abdomen is slightly above the chest level, palpable pain is localized periumbilically, with no signs of peritoneal irritation, peristalsis is weakened, audible.

Patient's weight: 23 kg, Height: 110 cm

Axillary body temperature: 38.3 °C, Heart rate: 142/min, Blood pressure: 85/50 mmHg

Laboratory results

Haemoglobin: 125 g/l, Leukocytes: 17.3 g/l, CRP 71.6 mg/l, NLR 4.2, Procalcitonin 22 ng/ml, IL-6 35 ng/l

Biochemical examination of urine: negative

Transabdominal sonographic examination of the abdomen

No clear pathology in the abdominal cavity.

Diagnosis

Acute gastroenteritis susp.

Management

Patient urgently admitted to the paediatric ward. Peripheral vein found, hydration of the patient with crystalloid infusion solutions, antipyretics. Orally administered fluids, ATB: 3rd generation of Cephalosporin.

12 hours after admission, abdominal pain persists. Abdominal distension and constipation occur. There are no signs of peritoneal irritation on palpation.

Follow-up transabdominal sonographic examination of the abdomen

A striped formation 25.6 mm long, 9.4 mm wide, is present in the right hypogastrium.

X-ray native abdomen standing

Hydroaeric formations in the right hypogastrium.



Fig. 1.4 Abdominal X-ray showing air-fluid level or gas deposition on the right lower quadrant abdomen (Prof. Stefan Durdik, MD, PhD., Department of Surgical Oncology, St. Elizabeth Hospital, Medical School of Comenius University, Bratislava)

Based on imaging examination, acute appendicitis is suspected. Immediate surgery indicated – laparoscopic appendectomy.

Postoperative course uncomplicated, ATB not administered postoperatively.

Histological examination

Phlegmonous appendicitis

Case Report No. 5

female, 64 years old, married, 2 children, pensioner

The patient comes to the surgical outpatient clinic with palpable tumorous resistance in the right hypogastrium, formed 2 months ago when lifting a mattress. Over the last 2 weeks, the resistance has increased and become sensitive to touch and coughing. She did not vomit, without signs of nausea. The stool is regular. She gave birth 43 years ago via gasterhysterotomy.

Clinical examination

The patient arrives to the surgical clinic calmly, she does not complain of abdominal pain when moving. Redness and a warming of the skin is visible in the area of the right hypogastrium. On palpation of the abdomen we found a tumorous resistance with mild pain in the right hypogastrium, without signs of peritoneal irritation. The percussion is painful in the right hypogastrium and tympanic in the rest of the abdomen. During auscultation, we found weakened, almost disappeared, peristalsis. Examination per rectum: ampoule, Douglas space painless.

Patient's weight: 98 kg, Height: 172 cm

Axillary body temperature: 37.4 °C, Heart rate: 111/min, Blood pressure: 105/80 mmHg

Laboratory results

Haemoglobin: 138 g/l, Leukocytes: 13.0 g/l, CRP 167.3 mg/l, NLR 4.8, Procalcitonin 35 ng/ml, IL-6 87 ng/l

Biochemical examination of urine: negative



Fig. 1.5 *The patient's abdomen (1)*

CT examination of the abdomen and pelvis

In the right hypogastrium, there is an abscess measuring 140 × 70 mm located in the subcutaneous tissue. Inflammatory changes present in the locality of the appendix communicating with the abscess by an enterofascial fistula.

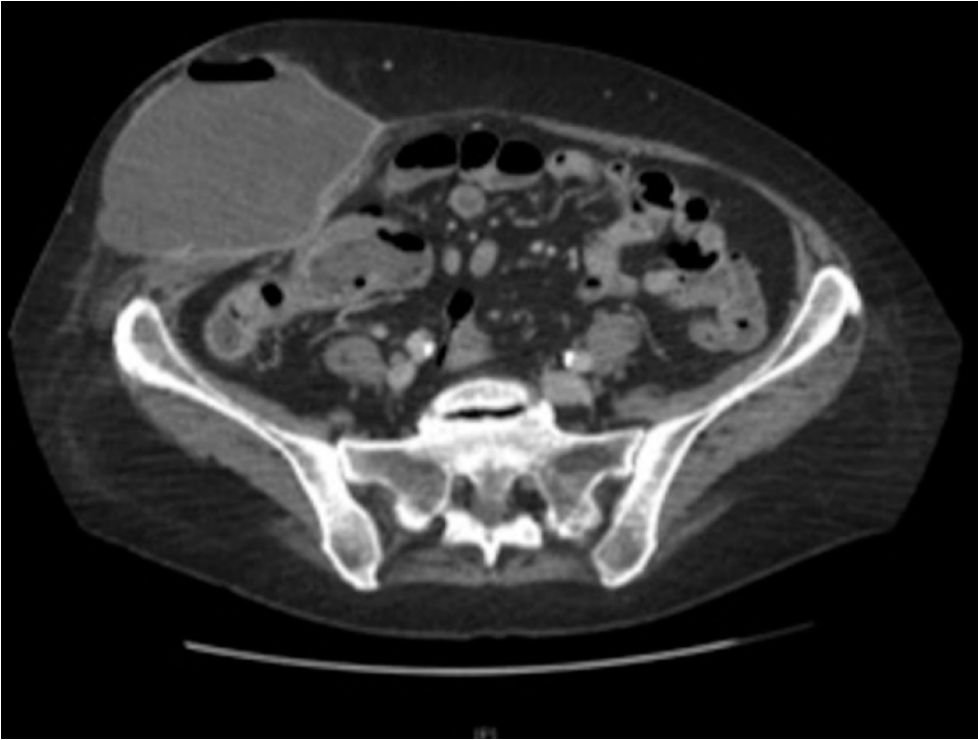


Fig. 1.6 Axial CT of the abdomen showing fistulation and subcutaneous abscess (1)

Diagnosis

Subcutaneous abdominal abscess
Perforated acute appendicitis
Enterofascial fistula

Management

Patient urgently admitted to the ICU of the surgical department, CVC applied, hydration of the patient with crystalloid infusion solutions, oral intake excluded. Preoperative ATB treatment (amoxiclav + efloran i.v.)

The patient underwent surgery immediately – evacuation of the abscess nidus, vacuum sealing applied. Postoperative course without complications, ATB administered postoperatively for 7 days.

On day 10, a small intestinal body appeared in the wound – a suspected enterocutaneous fistula.

Follow-up CT examination of the abdomen and pelvis

Verifies a large volume enterocutaneous fistula.

Patient again underwent a surgical procedure – revision of the abdominal cavity, abdominal lavage, hemicolecotomy l.dx. Postsurgical course uncomplicated, ATB administered postsurgically for 7 days.

Histological examination

Perforated gangrenous appendicitis, enterocutaneous fistula

Case Report No. 6

female, 27 years old, married, 2 children, landscape architect

Patient examined at a gynaecological outpatient clinic with 8 weeks of gestation. She complains of diffuse abdominal pain and diarrhoea lasting for 4 days (more than 15 times a day). Repeatedly vomits her stomach contents.

Clinical examination

The patient is suffering from severe dehydration.

On palpation, we found diffuse abdominal pain with indicated peritoneal irritation. In the right hypogastrium a localized tumorous resistance is present. The percussion is diffusely painful, peristalsis present, non-forced. Examination per rectum: ampoule, Douglas space painless.

Patient's weight: 75 kg, Height: 163 cm

Axillary body temperature: 38.4 °C, Heart rate: 123/min, Blood pressure: 100/80 mmHg

Laboratory results

Haemoglobin: 125 g/l, Leukocytes: 14.5 g/l, CRP 120.3 mg/l, NLR 4.0, Procalcitonin 30 ng/ml, IL-6 50 ng/l

Biochemical examination of urine: negative

Diagnosis

Gastroenteritis susp.

Management

Patient acutely admitted to the ICU of the gynaecological department. CVC applied, hydration of the patient with crystalloid infusion solutions, oral intake excluded. Parenteral ATB treatment(amoxiclav i.v.), antipyretics.

On day 4 after admission, the clinical and laboratory findings worsened. A saw-tooth pattern fever up to 38.5 °C started.

Transabdominal sonographic examination of the abdomen

Cystic formation present in the right hypogastrium with inflammatory plastron and free fluid in the Douglas space.

Despite ATB treatment, the patient's health did not improve. The consulted surgeon originally recommended a laparoscopic revision of the abdominal cavity. Due to serious deterioration of the patient's health and the presence of a large plastron in the abdominal cavity, the surgical intervention was rejected. The patient was administered more effective, teratogenic ATBs. After consultation with the patient, reflecting the high risk of foetal harm with ATB treatment, abortion was indicated.

The subsequent course of treatment was without complications. There was a gradual remediation of the inflammatory nidus in the abdominal cavity and the elimination of sepsis.

After 6 weeks, the patient underwent an open interval appendectomy.

Histological examination

Gangrenous appendicitis with fibrous transformation

Case Report No. 7

male, 83 years old, widower, 2 children, pensioner

Patient hospitalized for 20 days at the internal medicine department due to nausea, tympanites, abdominal pain, ischemic heart disease with chronic atrial fibrillation. Colonoscopy and irigography examination were not performed due to technical reasons. Transabdominal sonographic examination of the abdomen depicted a tumour lesion in the pelvis minor. Due to the sudden deterioration of his health condition under the image of diffuse peritonitis, the patient was transferred to the ICU of the surgical department.

Clinical examination

The patient lies in an antalgic position (saves his abdomen), walking is not possible. The abdomen is above the niveau, costal breathing dominates. Upon palpation, we found diffuse abdominal pain with signs of peritoneal irritation. Peristalsis is not audible, the percussion is tympanic, painful. Per rectum: ampoule, Douglas space is painful.

Patient's weight: 81 kg, Height: 172 cm

Axillary body temperature: 38.0 °C, Heart rate: 140 min irregular, Blood pressure: 90/80 mmHg

Laboratory results

Haemoglobin: 115 g/l, Leukocytes: 21.2 g/l, CRP 130.4 mg/l, NLR 5.3, Procalcitonin 78 ng/ml, IL-6 89 ng/l

Biochemical examination of urine: negative

X-ray native abdomen lying down

Tympanites of the small and large intestine

Follow-up transabdominal sonographic examination of the abdomen

Inflammatory tumour lesion (plastron) present in the small pelvis.

Diagnosis

Diffuse peritonitis

Suspected perforated appendicitis

Pelvic plastron



Fig. 1.7 Abdominal X-ray: appendicolith (arrow) in right lower quadrant with bowel dilatation (Vitezslav Marek, MD, PhD.)

Management

Patient acutely admitted to the ICU of the surgical department, CVC applied, hydration of the patient with crystalloid infusion solutions, oral intake excluded. Preoperative ATB treatment (amoxiclav + efloran i.v.) After prompt preparation, the patient underwent surgery. During the surgery we have found diffuse purulent peritonitis, plastron present in the right hypogastrium. Appendix unidentifiable. Thorough toilette executed and drainage of the abdominal cavity. Intensive care and treatment continues postoperatively: ATB (cefoperazone + ornidazole), support of diuresis, support of blood circulation by infusions, nootropics and cardiotonics. Despite full intensive care, the patient died on the 2nd post-surgical day.

Autopsy finding

Subacute perforated, gangrenous appendicitis, diffuse purulent peritonitis

References

1. Beaumont A, Miller R, Guy R. Atypical presentation of appendicitis. *BMJ Case Rep* 2016; doi: 10.1136/bcr-2016-217293

2 Definition and history

Vitezslav Marek

Acute appendicitis is defined as non-specific bacterial inflammation of the appendix. The clinical symptomatology is dominated by migrating abdominal pain from the epigastrium to the right hypogastrium, varying degrees of loss of appetite, even vomiting. The disease tends to progress and cause perforation of the appendix.

The doyen of Czechoslovak surgery, academician Arnold Jirásek, defines acute appendicitis as “an insidious, unpredictable and dangerous disease, which causes diagnostic difficulties with its unpredictable onset and course” (1).

The first historical mention of the anatomical unit – the appendix vermiformis – comes from the beginning of the 16th century, from the sketches of Leonardo of Vinci, who named it the “orecchio” (ear). A detailed anatomical description of the appendix was made by Da Capri in 1524 and by Vesalius in 1543.

The first reports describing the clinical course of acute appendicitis date back to the Middle Ages. The English surgeon John of Arderne (1307–1390) described a disease called “passio iliaca”, which is strikingly reminiscent of the clinical course of the acute appendicitis. The description of the disease made by John of Arderne persisted in the medical terminology for almost two centuries. The original term “passio iliaca” was later replaced by the term typhlitis (gr. typhlon, lat. caecum). The reason was the differentiation between acute appendicitis and the obstructive ileus. The term “passio iliaca” henceforth defined the obstructive ileus (2).

In 1554, Fernel was the first to describe the course of a complicated form of AA in a 7 year old girl with diarrhoea treated with quince (*Cydonia oblonga*). The diarrhoea progressed, with onset of severe abdominal pain, and the girl died. Upon necropsy, they identified obstruction of the appendix orifice with quince, necrotizing and perforating appendicitis.

In the 18th century, appendicitis was described only during autopsy.

Despite accurate descriptions of the clinical course of AA and pathological-anatomical findings obtained at autopsy, the role of the appendix in acute inflammatory disease of the right lower abdomen was not recognized. Typhlitis (inflammation of the caecum) was incorrectly considered as the cause. An example of a different views on the cause of the right abdomen acute inflammatory disease was the public dispute between French physician François Mélier and surgeon Guillaume Dupuytren in the early 19th century. Mélier saw the cause in the appendix; Dupuytren sharply criticized him and considered the cause of pain to be inflammation of the caecum (*typhlitis*) (2).

In the 19th century, appendicitis was treated conservatively (laxatives, cold compresses and opiates), and mortality reached more than 50%.

The term “appendicitis” was introduced into clinical practice in 1886 by Reginald Heber Fitz, a professor of medicine at Harvard University, at a medical congress in Boston. In the lecture *Perforating Inflammation of the Vermiform Appendix: With Special Reference to Its Early Diagnosis and Treatment*. He described 466 autopsy patients treated for abdominal pain of indeterminate diagnosis. In all cases, he identified perforating AA. He changed the originally used generic name *typhlitis* to *appendicitis*.