

MINI-REVIEW

Acute abdomen in the emergency department: the emergency surgeon contribute "old is the new approach"

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Abstract

Acute abdominal pain is the most frequent complaint evaluated by the emergency surgeon. The frequency of this presentation and the multitude of diagnoses and severity of cases reinforce the importance of a methodic clinical approach and knowledge of the causes of acute abdomen. In this article, we intend to review the process of diagnosing an acute abdomen and remind the medical community the importance of an accurate history and physical examination in this process.

Keywords

Acute abdomen; Anamnesis; Physical examination; Emergency surgery

1. Introduction

Acute abdominal pain is one of the most common reasons for visits to the emergency department and accounts for 5.76% of total emergency department visits in 1 year [1]. Underlying causes are vast, ranging from simple harmless diseases to life-threatening surgical emergencies.

In an era of easily accessible laboratory testing, ultrasound and CT (computed tomography), the once quintessential clinical history and physical examination are today relinquished to a secondary role. Indeed, nowadays physicians tend to trust more on complementary diagnostic exams than in the classic clinical findings. As a result, numerous unnecessary exams are requested every day, sometimes with deleterious consequences to our patients and increases in costs to health systems.

On the other hand, an experienced emergency surgeon can rapidly identify a patient who needs immediate care or surgical intervention.

In this paper, we aim to bring back the emphasis on the traditional, but sharp and detailed, clinical history and physical examination in order to allow surgeons to make accurate diagnoses in the emergency department and to be judicial when requesting complementary exams.

2. Pathophysiology

There is no universal definition for acute abdomen as it refers to multiple diagnosis presentations. Mayumi *et al.* [2] describe it as an intra-abdominal disease, with less than one week of evolution that may require urgent treatment, such as surgery. In fact, this entity is associated with symptoms and signs such as abdominal pain and tenderness requiring proper management, as it is often a surgical problem.

It is important to mention that some extra-abdominal dis-

eases may mimic an acute abdomen and they must be investigated and discarded. Besides, there are also some non-surgical pathologies that mimic the acute abdomen presentation and need urgent treatment. These causes, such as diabetic ketoacidosis and vaso-occlusive pain crises due to sickle cell anemia, must be listed in the differential diagnosis.

Embryological development is a cornerstone science to be able to understand and correlate the patient's symptoms with the affected anatomy (Table 1) [3, 4]. Neurological pathways define three types of abdominal pain: visceral, parietal and referred.

—Visceral: vague and its localization is related to the embryologic development of the digestive tract.

—Parietal (somatic): occurs due to irritation of the parietal peritoneum, giving an accurately localized sharp pain.

—Referred: is a pain perceived in a different location from the affected organ as the sensitive innervation of both sites are connected.

3. History

Clinical history is the basis of medical practice and the beginning of the doctor-patient relationship [5].

A good clinical history should be meticulous and the information collected must include details about the acute symptoms, as well as past family and personal history and medication. Medical practice is an art and the artistic process is to extract information from the patient without the rigidity of a flowchart or an algorithm in a formulary.

Abdominal pain is the chief complaint of the patient with an acute abdomen. Therefore, it is of utmost importance to describe it as incisively as possible.

TABLE 1. Development of the digestive system.

Divisions	Organs and structures	Pain location
Foregut	Esophagus, stomach, liver, gallbladder, bile ducts, pancreas and proximal duodenum	Epigastric
Midgut	Distal duodenum, jejunum, ileum, cecum, appendix, ascending colon, and proximal 2/3 of transverse colon	Periumbilical
Hindgut	Distal 1/3 of the transverse colon, descending colon, sigmoid colon and the upper anal canal	Hypogastric

3.1 Pain characteristics

A classic mnemonic can be used to systematically describe the patient's pain—PQRST [3].

—P3: Positional, palliating, and provoking factors—worsening complaints with walking or coughing suggest peritoneal irritation. Conversely, pain variation with eating and fasting can differentiate between peptic ulcer disease or intestinal obstruction.

—Q: Quality—vague pain suggests visceral pain, with the position in the abdomen correlating to the embryologic origin of the affected structure. Therefore, pain in the epigastrium, periumbilical or lower abdomen represents an affected organ originated from the foregut, midgut or hindgut, respectively. Sharp pain that can be pointed with one finger suggests parietal pain, correlating with a precise anatomic location. It is important to remember that intra-abdominal diseases can have referred pain to extra-abdominal regions and vice-versa.

—R3: Region, radiation, referral—location of pain is dependent on the type of pain the patient has, as previously stated. Radiation of pain is also a valuable characteristic, as the knowledge of neurological pathways help clinicians predicting the most probable diagnosis. Kehr's sign is a classic example as the irritation of the diaphragm results in pain radiating to the shoulders.

—S: Severity—pain intensity is a highly subjective characteristic to assess. Although severe pain may point to a more severe underlying cause, the clinician should not exclude serious illness in specific population groups that can under-report the symptoms, as the elderly and diabetics [6].

—T3: Temporal factors—(time and mode of onset, progression, previous episodes)—The onset of symptoms is also an important element: the acute onset may prompt immediate attention. However, as stated before, there are groups of patients who have atypical presentations of the same disease. The duration and progression of pain can help a lot in the diagnostic process. As traditionally described in acute appendicitis, pain progression starts as a vague periumbilical pain and progresses to a parietal right iliac fossa pain and sometimes the sharp characterization of this progression can be enough to establish the diagnosis.

Abdominal pain is the main symptom in the acute abdomen and the surgeon must not forget to start pain therapy as it can lead to serious discomfort and negative consequences to the patient. Although in the past there was some controversy on abdominal pain therapy before reaching a diagnosis, the literature supports its safeness, as it does not increase the risk of diagnosis error [7, 8].

3.2 Associated symptoms

Although gastrointestinal and urinary symptoms are the main focus when evaluating an acute abdomen, surgeons must not forget to look for symptoms from other systems such as the cardiopulmonary and reproductive systems. All the associated symptoms must be integrated with the patient current status and previous medical history. The sequence in which these symptoms start and relate to the main symptoms helps in guiding the diagnostic workup.

Vomiting is a symptom frequently present in acute abdominal pain. The characteristics of onset may help in identifying the cause as well as the association with feeding, its content or the evolution it has, for example from a biliary to enteric content [2, 3].

Changes in the bowel movements, such as constipation or the absence of flatus must be integrated with the whole clinical history, and physical examination, as it can potentially be a disease needing surgical intervention or just in need of medical support and optimization of previous medical diseases.

Associated gynecological symptoms such as metrorrhagia and menorrhagia must also be valued as there are some gynecological causes of acute abdomen.

3.3 Past medical history, current medication and social history

A systematic approach when questioning patients about their previous medical and surgical conditions may help identifying some diagnoses and exclude others. A good example of such importance can be seen in cases of diabetic ketoacidosis which can present as a non-surgical cause of acute abdominal pain in diabetic patients, on the other hand, in a previously cholecystectomized patient acute cholecystitis can be excluded. As far as what previous surgeries are concerned, the massification of laparoscopic surgeries relying only on scars is not as accurate as in laparotomy procedures and, sometimes, scars might not be visible at all or be misleading, therefore it is always important to confirm the previous surgical history with the patient and, whenever possible, access clinical records.

In female patients it is also important to ask for menstrual history and last menstrual period as it may be helpful in the diagnosis of emergent pathologies such as ectopic pregnancy or, on the other hand, suggest physiological conditions, namely Mittelschmerz. Sexual history may also be of value in both men and women as sexually transmitted infections may originate acute abdomen-like complaints. Pelvic inflammatory disease is an important differential diagnosis for acute abdomen in the female.

Current medications should be explored to exclude possible

iatrogenic effects, such as gastric ulcer perforation due to NSAIDs (non-steroidal anti-inflammatory drugs) abuse, or to explain possible symptoms such as constipation or altered mental status. A history of drugs or alcohol consumption can point to a specific diagnosis, for example, alcohol abuse is a frequent cause of acute pancreatitis. Less commonly, cocaine and methamphetamine use can be responsible for intense vasospasm causing life-threatening cardiac or intestinal ischemia.

4. Physical examination

Physical examination remains the cornerstone in diagnosing acute abdominal conditions. It starts with the assessment of the overall condition the patient presents with. Attention to detail is of the utmost importance, p. ex., changes in walking, the position assumed, or even facial expressions can provide important information to a prompt diagnosis. Although we know that some of these details can be assessed on the go, or even evaluated in a disguised and subtle way, vital signs are a critical step at this stage as they can reveal patients who need emergent action even when at first sight it may not look so. Following, the abdominal examination should traditionally include: inspection, auscultation, percussion and palpation. Other regions such as the chest, lower back, perineum and urogenital apparatus should not be forgotten, but intentionally will not be addressed in this paper [2, 3, 9–12].

4.1 Inspection

Inspection should be made with the patient fully exposed from the processus xiphoideus to the groin area. The physician must look for an abdominal wall that moves with the respiratory movements, surgical scars, herpes zoster infection, stigmata of cirrhosis, hernia, distension, masses, pulsatile movements of the abdominal wall and the traditional signs of hemorrhage, such as Grey Turner's sign (flank ecchymoses with a retroperitoneal origin) or Cullen's sign (bluish umbilicus with intraperitoneal bleeding) [2].

4.2 Auscultation

Abdominal auscultation is part of the classic abdominal examination but its findings are difficult to interpret. As a result, the latest guidelines state that auscultation is of very limited diagnostic utility [2, 13]. However, as clinicians, we must not bypass this step as the routine auscultation may help differentiate a normal condition from an altered status. We should evaluate the frequency, timbre and location of sounds in order to correlate them with the additional findings. For example, the presence of high-pitched tinkling sounds may suggest an intestinal obstruction, while a late presentation of this pathology may be the absence of bowel sounds. The presence of unexpected bruits and friction rubs may sometimes unveil the diagnoses and lead the rest of the pathway.

4.3 Percussion

Percussion gives important information through two main findings: dullness and tympany (or hyperresonance). Dullness

comes from the transmission of sound waves through a dense structure or rich in fluids. So, dullness can be said to be useful in estimating liver size or determining the presence of fluid in patients with suspicion of having ascites. Differentiation between ascites and a dull mass can be done by asking the patient to change to a lateral decubitus position followed by evaluating the corresponding change in the dullness. A change in dullness position suggests ascites, which should be confirmed with the wave-test sign—one side of the abdomen is compressed while the ascitic wave is felt on the contralateral side. Hyperresonance is the clinical representation of the presence of air, either in viscera or free intraperitoneal air. The best place to identify a possible pneumoperitoneum is in the right upper quadrant—the presence of tympany at this site is called Jobert's sign. Percussion may also help to identify peritonitis, either generalized or localized, as the patient will have exquisite tenderness and cannot tolerate the maneuver.

4.4 Palpation

Being the most informative phase of the abdominal physical examination, palpation should start superficially and away from the site where the pain is intense, in order to identify changes in the abdominal wall that can explain the complaints. The examiner must specifically identify the quadrant of maximum pain to identify the most probable structures affected. Following the superficial palpation, and using the same methodology, deep palpation is used to assess the presence of masses, organomegalies or tenderness. When present, guarding refers to the contraction of the abdominal wall muscles to protect the inflamed organs from the pain triggered by the pressure done during palpation. It is important to differentiate voluntary from involuntary guarding. A voluntary guarding occurs when the patient contracts the abdominal wall in anticipation of the painful stimulus. A useful technique to prevent this voluntary reflex is to ask the patient to lie supine and flex his legs with the soles of its feet flat on the bed. Other useful tricks include asking the patient to breathe deep, which relaxes the abdominal muscles or to find a way to distract its attention. With these methods, the physician ceases the voluntary guarding process and can then evaluate the presence of involuntary guarding.

There are also particular cases in which the pain arises from the abdominal wall and in these cases, the physician may perform the abdominal wall tenderness test (Carnett's sign). This sign is positive when the pain remains unchanged, or increases, when the patient is voluntarily guarding. It is useful in diagnosing abdominal wall ache or psychogenic stomachache and excluding intra-abdominal lesions. Obesity poses important challenges in having a conclusive physical examination, and it is well accepted lower the threshold to proceed to imaging exams in this group of patients.

Although not routinely performed by the clinicians, the rectal examination is of paramount importance in the evaluation of a possible acute abdomen. The information given by such a simple act may change dramatically the diagnostic workup and is usually underestimated in the context of the emergency department. As an example, in the presence of a palpable, and adherent, mass in the rectum in a patient

with acute digestive hemorrhage and anemia our diagnostic resources must be directed toward a better characterization of such finding.

5. Diagnostic studies

In this topic, there will not be an exhaustive exposure of all diagnostic studies that can be performed in the emergency setting when studying a patient with an acute abdomen. Only well-accepted diagnostic studies, to be done in the emergency context, will be approached by highlighting the main advantages or weaknesses of their use. The aim of this paper remains in emphasizing the importance of the clinical assessment before the use of complementary diagnosis workup.

5.1 Laboratory studies

Blood samples are helpful to narrow the differential diagnosis and stratify the patients who need emergent care [14]. The standard evaluation includes a complete blood count, electrolytes, liver and kidney function, and inflammatory markers. Other parameters, such as C-reactive protein and procalcitonin are recommended to be routinely assessed as a severity indicator in patients with acute abdomen conditions [15]. Lactate blood levels are an important indicator of anaerobic metabolism, which increases in situations where tissue perfusion is compromised. Situations such as hypothermia, shock or ischemic events, p. ex. acute arterial occlusion in a lower limb, can result in an increase in the level of lactate indicating a severe condition is emerging which needs immediate care. In this setting, a blood gas analysis should also be performed in order to evaluate base excess (BE), pH and the levels of pO_2 and pCO_2 , as a deeper understanding of the acid-base balance is important in determining the etiology of the acute condition.

Additional analysis should be tailored to the clinical suspicion, p. ex. in cases of suspected acute pancreatitis, the lipase and amylase levels should be requested.

Urinalysis is usually performed in patients with abdominal pain to exclude lower urinary tract infection or pyelonephritis. Also, in cases of suspected nephrolithiasis, the presence of erythrocytes in the urine supports the diagnosis. Women at fertile age should have urinary human chorionic gonadotropin levels assessed to rule out pregnancy.

5.2 Imaging

Diagnostic imaging exams are a non-invasive step when studying a patient with an acute abdomen and, when requesting them, it should be taken into account the level of suspicion of specific diagnosis and available resources. Physicians should have a hierarchization of the exams they have access to at the places they work at. Different countries, and even different regions inside the same country, can have severe limitations in the accessibility to some of the exams guidelines recommend as being the best practices when studying patients with specific conditions.

Although for some already outdated, plain radiography is cheap, easily accessible and provides important information with a low radiation dose. While supine abdominal radiography is the most frequently used incidence, specially due

to overcrowded emergency departments, in the emergency setting a standing abdominal, and posterior-anterior chest radiographs, are more suitable in providing relevant information. A standing abdominal radiograph can reveal dilated bowel loops with air-liquid levels in cases of bowel obstruction or show the sentinel loop sign in cases of acute appendicitis. Conversely, chest radiographs are more sensitive to detect pneumoperitoneum or to exclude acute pulmonary disease, which can cause referred abdominal pain. Therefore, and despite a global low accuracy, plain radiographs should be considered as useful and be a first line exam when starting to study a patient with an acute abdomen. Being the most accessible exam it can confirm bowel obstruction, pneumoperitoneum and, less commonly, radiographs can be used to detect the presence of intra-abdominal foreign body [14, 16–20].

Ultrasonography (US) is a cheap, innocuous and accessible exam with a growing number of indications and popularity, some already call it the stethoscope of the XXI century surgeons. Point-of-Care Ultrasound (POCUS) is described in the literature as a diagnostic modality in emergency medicine. A group of authors developed the ACUTE ABDOMEN protocol to help in the systematic sonographic evaluation of the acute abdominal pain. ACUTE is the first part of the mnemonic and includes the evaluation of five critical causes: A: abdominal aortic aneurysm, C: collapsed inferior vena cava, U: ulcer (perforated viscus), T: trauma (free fluid), E: ectopic pregnancy. The second part looks for other surgical causes and stands for: A: appendicitis, B: biliary tract, D: distended bowel loop, O: obstructive uropathy, Men: testicular torsion, Women: ovarian torsion. Being a dynamic and readily accessible exam, ultrasonography allows surgeons to evaluate their patients more than once and even to perform percutaneous guided procedures, p. ex. placement of a percutaneous drain in life-saving situations. Regardless of its immense potential, and increasing popularity, ultrasonography must only be performed by physicians who are certified, trained and perform it regularly as it is recognized as being a highly operator-dependent exam and there cannot be worse than not diagnosing an abnormal finding than considering such finding as normal when indeed it can be a life-threatening condition. Literature shows that currently, ultrasonography is the first-line exam in patients with suspected biliary tract or urogenital disease. In addition, it is particularly useful when assessing young or pregnant patients due to the lack of ionizing radiation [21–25].

Computerized Tomography (CT) is the most accurate exam to evaluate acute abdominal conditions. In the past, its higher costs, the use of ionizing radiation and the need for nephrotoxic intravenous contrast have delayed the widespread use of this technology. However, current developments in CT technology have allowed radiation doses to be similar to those in plain radiography with the same accuracy, as well as significantly reduced the need for high volumes of intravenous contrast, mitigating the disadvantages. Still, CT should be requested whenever the previous exams have been inconclusive or to clarify previous findings. It gives detailed information about the entire abdomen and pelvis, p. ex. it can accurately identify causes of bowel obstruction, visceral perforation or acute bleeding [26–28].

A reasonable approach in clinical practice is to start the

assessment with plain radiographs or ultrasound, proceeding to CT when the results are inconclusive or negative but clinical suspicion is high [17].

5.3 Diagnostic laparoscopy

Diagnostic laparoscopy is used as the last diagnostic resource in patients with acute abdominal conditions of unclear etiology. In patients with high suspicion of an acute abdomen without a cause identified after extensive diagnostic workup, diagnostic laparoscopy may be an option and should be performed by a team with a high level of expertise in laparoscopy and emergency surgery [14, 29, 30]. Especially in the emergency setting, where patients might be critically ill, having certified and trained surgeons who perform laparoscopy regularly is of paramount importance as the delicacy in handling structures and the time spent in performing the diagnostic procedure can drastically change the outcome of the patient. Iatrogenic injuries and excessive exposure to pneumoperitoneum with little progress, or no assertive answer about the etiology of the acute abdomen, should lead the surgeon to change the minimally invasive approach to a classic laparotomy. Being a highly operator-dependent procedure there cannot be worse than not diagnosing an abnormal finding than considering such finding as normal when indeed it can be a life-threatening condition. When conversion to laparotomy happens it should not be interpreted as a sign of weakness from the surgeon as the technical approach should never prevail over the need to solve the patient's case.

6. Conclusion

Recent decades have been of great innovation in the medical area, particularly in the diagnostic field. The art of diagnosing must rely mainly on the clinical history and physical examination followed by the confirmation of our best hypothesis using the technology available. Surgeons must not bypass the fundamentals of medicine and wait for technology to give the answers they are looking for.

AVAILABILITY OF DATA AND MATERIALS

Not applicable.

AUTHOR CONTRIBUTIONS

CMO, MC, LM, NM—performed the research, analyzed the data and wrote the manuscript. All authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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