Appendicitis: a case study

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Abstract
The presentation of patients with abdominal pain is a common occurrence in emergency departments. Since there are many potential causes of abdominal pain, diagnosis may be challenging. Accurate history taking and appropriate physical examination are essential to identify potentially life-threatening conditions, such as appendicitis, and ensure prompt treatment. This article presents a case study of a patient presenting with right lower quadrant abdominal pain. Assessment, differential diagnosis and management of the patient are discussed.

Case study
Timothy, a male aged 21 years with abdominal pain, was admitted to the surgical unit from the emergency department in one hospital. He was living in student accommodation and had been revising for his university examinations, which were due to take place in two months’ time. He had experienced several episodes of nausea and vomiting, and had pain in his right iliac fossa radiating to the umbilical area. Timothy had not eaten for 48 hours. His skin was dry, he was dehydrated and had low-grade pyrexia. The patient’s clinical history and a physical examination were undertaken.

History taking
It is essential that healthcare professionals ascertain the patient’s medical history to aid accurate diagnosis and prompt treatment. Griffith et al (2003) stated the patients should be encouraged to explain their symptoms and express their emotions. Timothy’s medical history was taken to provide information about his abdominal pain. Initial information gathered was demographic in nature, for example that he was a 21-year-old male student residing in university accommodation.

ABDOMINAL PAIN IS one of the most common presentations in patients attending emergency departments (Bates and Plevris 2013). There may be many causes of such pain and clinicians need to be able to distinguish between functional disorders, such as irritable bowel syndrome, and medical emergencies, such as appendicitis. Knowledge of the gastrointestinal system and disorders is essential to aid accurate assessment and diagnosis to guide appropriate treatment decisions.
the patient felt the pain first and if it extended to other areas. Abdominal pain spreading from the right iliac fossa to the umbilical area might indicate appendicitis (Keshav 2004). Pain radiating to the back might be related to pancreatic disease, a peptic ulcer or abdominal aortic aneurysm (Talley and O’Connor 2010).

It is vital to recognise the different types and characteristics of abdominal pain, such as dull, sharp, burning, colicky or stabbing sensations. Sensation of burning might be associated with a peptic ulcer. Often, pain that is colicky in nature is related to an obstruction of the bowel, bile duct or ureters (Talley and O’Connor 2010). Pain that involves sharp or tearing sensations may be linked to appendicitis, ruptured ectopic pregnancy or dissecting aneurysm (Cole et al 2006).

The clinician should document whether the pain became worse since onset or is relieved at times. Pain may be relieved if the patient changes position, for example, and vomiting and passing wind or stool should be noted (Miller and Alpert 2006). Pain that worsens during eating or vomiting may indicate the presence of a peptic ulcer (Apau 2010). It is important to record severity of pain and its duration, from onset to presentation. This could help to identify whether the pain was or is acute or chronic. Useful information that could aid diagnosis may include associated symptoms such as weight change, bowel habit, and nausea and vomiting. To establish an accurate diagnosis, the time, content and amount of vomit should be noted. Burkhitt and Quick (2002) suggested that weight loss and anorexia are often related to malignant abdominal conditions such as gastric cancer, liver cancer and colorectal cancer. An overview of the different diagnoses of abdominal pain is outlined in Table 1.

The clinician should report any change in bowel habit, in terms of consistency of stool and frequency of bowel movement. The presence of diarrhoea with abdominal pain may indicate infection or inflammatory bowel disease (Epstein 2009). It is also important to note the presence of either fresh (bright red) or altered (dark brown or black) blood in the stool. Fresh blood in stool may be caused by inflammation of the lower intestine or haemorrhoids. Similarly, altered blood might indicate higher intestinal bleeding (Cole et al 2006). Constipation of recent onset, associated with colic, could be indicative of bowel obstruction (Bickley and Szilaygi 2010).

### TABLE 1

<table>
<thead>
<tr>
<th>Differential diagnosis for abdominal pain</th>
<th>Common symptoms</th>
<th>Common signs</th>
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<tbody>
<tr>
<td>Infective gastroenteritis</td>
<td>Vomiting, diarrhoea and diffuse abdominal pain</td>
<td>Dehydration and abdominal tenderness.</td>
</tr>
<tr>
<td>Peptic ulcer</td>
<td>Epigastric pain can radiate to the back. Pain may be alleviated by antacids.</td>
<td>Epigastric tenderness, acute abdominal perforation.</td>
</tr>
<tr>
<td>Oesophageal reflux</td>
<td>Burning retrosternal, epigastric pain. Pain may be alleviated by antacids. Pain may be worse at night when lying flat.</td>
<td>None.</td>
</tr>
<tr>
<td>Biliary colic</td>
<td>Sudden onset, severe right upper quadrant abdominal pain and possible vomiting.</td>
<td>Right upper quadrant tenderness.</td>
</tr>
<tr>
<td>Cholecystitis/cholangitis</td>
<td>Right upper quadrant abdominal pain, exacerbated by consuming fatty foods.</td>
<td>Right upper quadrant tenderness and fever.</td>
</tr>
<tr>
<td>Pancreatitis</td>
<td>Severe epigastric pain that may radiate to the back, and vomiting.</td>
<td>Epigastric tenderness and breathlessness.</td>
</tr>
<tr>
<td>Bowel obstruction</td>
<td>Vomiting, absolute constipation and abdominal pain.</td>
<td>Abdominal distension, generalised tenderness and tinkling bowel sounds.</td>
</tr>
<tr>
<td>Diverticulitis</td>
<td>Pain, especially involving the left lower quadrant, fever and change in bowel habit.</td>
<td>Fever, tenderness and clinical features of acute abdomen if perforated.</td>
</tr>
<tr>
<td>Aortic aneurysm</td>
<td>Central abdominal pain. Back pain may be sudden and severe with ruptured aneurysm.</td>
<td>Expansible pulsatile mass and shock with ruptured aneurysm.</td>
</tr>
<tr>
<td>Renal colic</td>
<td>Intermittent, severe pain of acute onset in the loin radiating to the groin or testes. Intensity of pain may wax and wane. Haematuria may be present.</td>
<td>Loin tenderness, and reagent strip urinalysis positive for blood.</td>
</tr>
</tbody>
</table>

(Adapted from Gleadle 2012)
Harmston (2011) stated that the appendix could cause irritation of the rectum, which might lead to alteration of bowel habit, usually diarrhoea.

Timothy had not eaten for 48 hours. He did not have any medical history, had not taken medication at the time pain commenced and stated that he was not allergic, as far as he was aware, to any drugs or foods. Medical history should establish the presence or absence of cardiac illness, diabetes, Crohn’s disease, peptic ulceration and any past surgery. In addition, alcohol consumption and smoking status should be recorded because these factors may contribute to abdominal disorders such as pancreatitis, splenomegaly, hepatitis and gastroduodenal ulcers (Stewart and Ackroyd 2011). The patient’s travel history should be explored because particular diseases, for example hepatitis, cholera and parasitic infections, are endemic to some overseas locations (Mahadevan 2005). It is also useful to ascertain the patient’s family history. It was established that Timothy’s mother had hypertension.

**Physical examination**

To exclude the need for urgent or emergency intervention, it is important to obtain the patient’s vital parameters. When conducting a physical examination, the patient’s privacy needs to be maintained. The procedure should be explained to the patient and his or her consent obtained, where appropriate, to conduct the examination (Hsieh 2006). At the beginning of the examination, the patient should lie flat in a supine position (lying on the back with face upwards), with his or her arms to the side and head on a pillow. The patient might be asked to keep his or her knees slightly bent to relax the abdominal muscles. However, the clinician should ensure that the patient’s bladder is empty before starting the physical examination to minimise any bladder distension that could interfere with the examination. The clinician’s hand should be warm and he or she should avoid any unexpected movement.

Timothy’s vital parameters were stable. However, he had pointed to his right iliac fossa as the source of the pain; this area had to be assessed gently to avoid causing any additional discomfort. Abdominal examination included inspection, auscultation, percussion and palpation.

**Inspection**

Generally, physical examination begins with observation of the patient’s overall appearance. The clinician should stand at the foot of bed and inspect the shape of the abdomen, comparing it with the lower half of the chest. The clinician should be observing for obvious enlargement of the liver or spleen. The patient should be assessed for nail abnormalities such as leuconychia (white patches or spots under the nails) or koilonychia (nails that are thin and concave from side to side) as this may be a sign of chronic iron deficiency anaemia (Long and Cooper 2002). The clinician should look specifically for finger clubbing as this may be caused by gastrointestinal disorders such as inflammatory bowel disease, liver cirrhosis or malabsorption (Ford et al 2009).

It is essential to assess abdominal symmetry, including observing for visible pulsations and masses. The clinician should then move to the side of the bed to obtain an eye-level view of the abdomen. In this position, the clinician can note any changes in contour of the abdomen. Abdominal distension may indicate a tumour, ascites, or accumulation of air (Cox and Steggall 2009). A midline epigastric area pulsation of the aorta can usually be seen in thin patients. However, if aortic pulsations are pronounced it might indicate increased inter-abdominal pressure, which may reflect the presence of a tumour or ascites. Visible peristaltic waves indicate intestinal obstruction (Ford et al 2009).

The clinician should inspect the abdominal skin for tenseness, discolouration, striae, rashes, ecchymosis (bluish discolouration of an area of skin or mucous membrane), prominent or dilated veins and surgical scars (Coleman 2005). Surgical scars may indicate a possibility of adhesions. Striae may be caused by loss of weight or stretch marks during pregnancy. If striae are pink/purplish, it may indicate the presence of Cushing’s syndrome (Cox 2004). Cushing’s syndrome is excessive adrenal corticoid secretion. Abdominal veins, if dilated or tortuous, may indicate inferior vena cava obstruction and cutaneous angiomas may be associated with liver disease (Cox and Steggall 2009).

Discolouration of the umbilical area – if faintly bluish (Cullen’s sign) and if either of the flanks are grey (Turner’s sign) – may be an early sign of intra-abdominal bleeding (Alexander 2010). In addition, this can appear after an ectopic pregnancy (Chopra et al 2009). If visible abdominal veins are prominent, the clinician should assess the direction of blood flow. This is done by placing two fingers at the vein with occlusive pressure and pulling the fingers apart. The examiner then removes one finger and sees in which direction the vein refills. In portal hypertension, the blood flows through the umbilicus, which may be engorged and distended (Swartz 2010).
Auscultation

Useful diagnostic information about bowel motion is provided by auscultation. The clinician should gently place the stethoscope on all quadrants of the abdomen (right lower quadrant, right upper quadrant, left lower quadrant, left upper quadrant (Figure 1)). He or she should make sure that the stethoscope is warm to avoid muscular contraction. The clinician then listens for bowel sounds and verifies the frequency and character of these sounds. Normal bowel sounds include clicks and gurgles that occur frequently – approximately five to 35 times per minute (Talley and O’Connor 2010). Borborygmi are loud peristaltic sounds and gurgles, which occur in hyperactive intestinal peristalsis. They may occur in the presence of diarrhoea, obstruction of the small intestine or as a result of hunger (Cox and Steggall 2009).

In the case study involving Timothy, he had been fasting for 48 hours and borborygmi, which could be heard loudly, were the result of hyperperistalsis. Generally, high-pitched or tinkling sounds can be heard in early intestinal obstruction because of the presence of fluid and air under pressure in the bowel loops. If bowel sounds are absent for seven minutes in all four quadrants, this may indicate paralytic ileus or peritonitis (Cox 2004).

By using the bell of the stethoscope, the clinician can listen to the abdominal blowing or swishing sounds in all four quadrants. Bruits (abnormal blowing or swishing sounds) over the renal, aortic, iliac and femoral arteries may indicate stenosis or other vascular anomalies. Bruits originating from the abdominal aorta may indicate dissecting abdominal aneurysm, and in the renal area, may suggest renal artery stenosis (Bickley and Szilaygi 2010). The clinician should listen for friction rubs, denoted by a high-pitched sound, over the liver and spleen since these may indicate a tumour in an organ, infarction or infection (Epstein 2009).

Percussion

Percussion of the abdomen is used to assess the size and location of solid organs, for example the liver, spleen and kidneys, and identify gas and fluid levels. The clinician should approach each of the abdomen’s quadrants systematically to assess the distribution of dull and tympanic sounds. Usually, a dull sound is heard over solid organs such as the liver and the spleen, whereas a tympanic sound can be heard over an air-filled stomach or the intestines (Coleman 2005).

Percussion can be undertaken by keeping one or two fingers of the non-dominant hand firmly on the abdominal wall and using the flexed middle finger of the other hand as a hammer. The quality of sounds generated is assessed for resonance or dullness. Timothy had pain in his umbilical region and right iliac fossa indicative of rebound tenderness – pain after the clinician relaxes his or her hand during palpation (Epstein 2009). In patients with suspected appendicitis, both percussion and palpation need to be done cautiously to avoid distressing the patient (Silen 2000). If the patient has suspected abdominal aneurysm or has had an abdominal organ transplant, then palpation and percussion is contraindicated to avoid rupture (Cox and Steggall 2009).

Palpation

The size of abdominal organs is assessed by palpation, which will also identify any tumours and may reveal any abdominal tenderness and local muscle spasm. The clinician should perform palpation gently and with warm hands. He or she should start with light palpation using the palm and fingertips to depress the abdominal wall by 1cm. The clinician should move smoothly over the four abdominal quadrants to identify skin temperature, masses and tenderness. As previously mentioned, pain occurring after the clinician relaxes his or her hand is termed rebound tenderness and was noted during Timothy’s examination. If the abdominal wall is hard (rigid), this may indicate peritonitis or appendicitis (Cox and Steggall 2009).

Deep palpation is used to assess the organs and identify large masses. The clinician should press the surface of his or her palm and fingers firmly
4-6cm deep over the abdominal wall. If there are abdominal masses, they could be inflammatory (diverticulitis), neoplastic or as a result of intestinal obstruction (Bickley and Szilaygi 2010). The liver and spleen are also palpated. If there is a tumour or cirrhosis, the surface and edge of the liver will feel firm, hard, tender, irregular or have a smooth tender enlargement in congestive cardiac failure. The liver is felt over the right upper quadrant and the spleen is felt over the left upper quadrant of the abdomen. The spleen may feel enlarged in many conditions such as anaemia, malaria or in certain types of leukaemia. Sometimes, the kidneys may be palpated over the flanks. If they are enlarged, it may be due to the presence of disease.

If deep palpation performed over the left lower quadrant results in rebound pain on the right lower quadrant, this may suggest peritoneal irritation otherwise known as Rovsing’s sign, which is an indication of acute appendicitis (Apau 2010). In Timothy’s case, tenderness was determined over the McBurney’s point (a site of extreme sensitivity in acute appendicitis), which is located over a line drawn between the umbilicus and the anterior superior iliac spine on the right lower quadrant (Yale and Musana 2005) (Figure 2).

Digital rectal examination
The final part of the clinical examination should involve digital rectal examination (DRE). The clinician should explain the procedure to the patient and obtain his or her consent. The patient can be placed in the left lateral position, with knees flexed to the chest, or the lithotomy position, where the patient lies on his or her back with hips flexed and knees and thighs abducted and externally rotated. The anus is examined for haemorrhoids, lumps, ulcers and inflammation. The clinician then inserts a gloved and lubricated forefinger gently into the rectum and checks for any mass, and for the size of the prostate in the case of male patients (Cox 2004). However, in Timothy’s case, DRE was not performed because he anticipated pain and discomfort and refused DRE. Although DRE may be useful, Sedlak et al (2008) evaluated the role of DRE in 577 patients presenting with right lower abdominal pain and suspected appendicitis, and concluded that DRE does not aid diagnosis of acute appendicitis.

Diagnostic tests
Laboratory tests can help to differentiate between the many and varied causes of abdominal pain. In a prospective study of 197 cases of appendicitis, Ali et al (2010) found that in approximately 76% of cases of appendicitis the patient had an elevated leucocyte count. Birchley (2006) found that elevated leucocyte and C-reactive protein, as inflammatory markers, were helpful in supporting the diagnosis of appendicitis. However, appendicitis should not be excluded if inflammatory markers are within the patient’s normal range (Vaughan-Shaw et al 2011).

Abdominal ultrasound is a useful diagnostic tool in patients who complain of pain in the right iliac fossa. Timothy’s ultrasound scan revealed appendicitis. Yu et al (2005) reported that the accuracy of ultrasound in patients with appendicitis was around 75-90%. Ultrasound could also be used to exclude other potential causes of abdominal pain such as disease of the ovaries or fallopian tubes in females (Froggatt and Harmston 2011). Several studies revealed that computed tomography was superior to ultrasound in accurately diagnosing conditions related to abdominal pain (Unlü et al 2009, Van Randen et al 2011).

Diagnosis and management
The Alvarado (1986) scoring system can be used to confirm diagnosis of appendicitis. The scoring system takes into account signs, symptoms and laboratory findings in suspected cases of acute appendicitis. Several studies found that the Alvarado scoring system has high sensitivity and accuracy in diagnosing appendicitis (Andersson and Andersson 2008, Jang et al 2008).

The Alvarado scoring system uses the acronym MANTRELS as a guide for diagnosis (Table 2).
The scoring tool was a component of Timothy’s assessment; he experienced pain migrating to the right iliac fossa, nausea and vomiting, tenderness in his right iliac fossa, rebound pain, fever and anorexia, and a high leucocyte count. Timothy’s score using the Alvarado system was 7 out of 10, which indicated possible appendicitis. The diagnosis was supported by findings from the ultrasound.

The severity of appendicitis depends on the degree of inflammation. If not treated, a swollen and gangrenous appendix can progress to perforation. Appendicitis may be related to intraluminal obstruction with a fecalith (hard impacted mass of faecal matter) (Porth 2010). Urgent and essential treatment of Timothy involved appendectomy. It was important not to delay surgery to avoid perforation, which may lead to peritonitis and septicaemia (Udgiri et al 2011).

There are two surgical approaches to appendectomy: open and laparoscopic. Open appendectomy is a traditional surgical approach that involves a small incision about 5cm long, whereas laparoscopic appendectomy requires three very small incisions each about 1cm long to allow a camera and an instrument to be introduced into the abdomen to aid visualisation and removal of the appendix. Evidence suggests that the laparoscopic approach is safer, causes less pain in the post-operative period, and is associated with early recovery and low complication rates (Shaikh et al 2009, Li et al 2010).

### Table 2

<table>
<thead>
<tr>
<th>The Alvarado scoring system</th>
<th>Score</th>
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</thead>
<tbody>
<tr>
<td><strong>MANTRELS mnemonic for diagnosis of acute appendicitis</strong></td>
<td></td>
</tr>
<tr>
<td>Symptoms</td>
<td></td>
</tr>
<tr>
<td>Migration to right iliac fossa</td>
<td>1</td>
</tr>
<tr>
<td>Anorexia</td>
<td>1</td>
</tr>
<tr>
<td>Nausea or vomiting</td>
<td>1</td>
</tr>
<tr>
<td>Signs</td>
<td></td>
</tr>
<tr>
<td>Tenderness of right iliac fossa</td>
<td>2</td>
</tr>
<tr>
<td>Rebound pain</td>
<td>1</td>
</tr>
<tr>
<td>Elevated temperature</td>
<td>1</td>
</tr>
<tr>
<td>Laboratory</td>
<td></td>
</tr>
<tr>
<td>Leucocytosis</td>
<td>2</td>
</tr>
<tr>
<td>Or</td>
<td></td>
</tr>
<tr>
<td>Shift of leucocyte count to the left*</td>
<td>1</td>
</tr>
</tbody>
</table>

*Indicates an increase in the percentage of neutrophils (Alvarado 1986)

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**References**


Pain management with analgesics, for example, and administration of intravenous fluids may be necessary when the patient arrives at the emergency department. Analgesics should be given according to the severity of pain and associated symptoms. Opioid analgesics can be given to patients with acute abdominal pain. In a review of trials evaluating analgesics given to patients with abdominal pain, Manterola et al (2011) suggested that opioids are associated with significant pain reduction without affecting diagnostic accuracy.

Other complications may include wound infection, fistula formation on the abdominal wall, intra-abdominal abscess, and prolonged ileus following appendectomy (Finlayson 2011).

In Timothy’s case, laparoscopic appendectomy was performed one day following his admission to the surgical unit. He was treated successfully and discharged two days later. Timothy was followed up one week later in the outpatient clinic, and he showed good signs of recovery, with no evidence of complications.

### Complications of appendicitis

Appendicitis may be associated with serious complications. Delay in diagnosis may lead to increased risk of complications and deterioration of the patient’s condition. A perforated appendix is associated with a 50% increase in mortality rates (Andersson and Andersson 2011).

Appendicitis progresses from luminal obstruction to mural inflammation and necrosis, and then to perforation with abscess formation and generalised peritonitis. If untreated, peritonitis can lead to toxaemia and shock. In addition, intestinal obstruction can occur as a result of adhesions caused by the perforated appendix.

### Conclusion

The causes of abdominal pain are many and varied. Accurate history taking and physical examination are essential to make a rapid diagnosis, and distinguish between minor and serious, or even life-threatening, conditions. The case study presented in this article demonstrates a systematic approach to the assessment of a patient with abdominal pain to ensure timely diagnosis and treatment, in this case of appendicitis, which is considered a medical emergency. Early diagnosis of appendicitis can help to reduce the patient’s risk of associated complications and ensure an uneventful recovery NS.

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**References**


