



Spiro Tsipouras

MBBS FACEM, is an Emergency Staff Specialist, Ballarat Health Services, Victoria.
spirot@iprimus.com.au



Nonabdominal causes of abdominal pain

Finding your heart in your stomach!

Background

The diagnosis of abdominal pain is difficult and often inaccurate. Nonabdominal disease, in particular cardiac and pulmonary disease, may present with abdominal symptoms.

Objective

This article provides a brief review of the neuro-anatomical basis of abdominal pain in the adult patient population. Differential diagnoses are outlined with a specific focus on time critical conditions, and clinical 'red flags' for the physician in the 'frontline' are highlighted.

Discussion

Physicians need a high clinical index of suspicion when the diagnosis is elusive. They must acknowledge atypical presentations are common, avoid over reliance on 'classic' presentations or the outcome of preliminary investigations, and specifically seek time critical diagnoses. A detailed history and examination remains the key to avoiding diagnostic error. The priority is not 'correct diagnosis' but 'correct patient disposition'. Options include prolonged observation, further sophisticated investigations, and early specialist referral. Physician's gestalt in elusive cases remains important.

■ **Abdominal pain is a common complaint presenting to primary care physicians, and accounts for 4–8% of all adult visits to a hospital emergency department.^{1,2} Traditional history taking and physical examination findings poorly correlate the 'site of abdominal pain' with the 'aetiology' of the pain.³ This fact alone probably accounts for the single most common cause of diagnostic error when assessing patients.^{2,4} In up to 40% of cases, the cause of pain is never determined, even after extensive evaluation (ie. nonspecific abdominal pain).¹ One in three patients who subsequently require surgery for their pain will have manifested at least one atypical clinical feature on initial presentation.^{4,5}**

Because pain may be referred from remote sites to the abdomen, nonabdominal causes should always be considered, especially in high risk populations such as the elderly, diabetics and the immunocompromised.^{1,2,4} In addition, pre-existing morbidity – both known and previously unsuspected – such as dementia, cardiac disease and 'polypharmacy', may complicate and/or contribute to the clinical presentation, further confounding the diagnostic process and potentially delaying definitive management.^{1,2,4} Given these limitations, the clinical priority in the first instance is not diagnostic accuracy, but rather accurate 'patient disposition' – 'the right patient, to the right service(s), within the right time frame'.

Over reliance on 'classic' clinical presentation, laboratory findings, radiographs and other imaging may significantly mislead the physician to misdiagnose the cause of abdominal pain.² The value of a physician's gestalt ('gut feeling') when evaluating abdominal pain of any cause, and maintaining a high clinical index of suspicion, cannot be overstated.



Neurological basis of abdominal pain

Pain in the acute setting is a subjective phenomenon related to inflammation and/or tissue injury. There are three broad categories of abdominal pain:

- parietal (somatic)
- visceral (autonomic), and
- referred pain.^{4,6}

Somatic nerve pathways are anatomically more numerous and better represented within the central nervous system than autonomic pathways. As a result, parietal pain is better characterised within the cerebral cortex than is visceral pain. The changing character of pain seen clinically in intra-abdominal inflammatory conditions, such as appendicitis, reflects the sequential activation of visceral nerves within the diseased organ in the first instance (related predominately to stretch receptor activation)⁷ followed by stimulation of somatic nerves within the adjacent parietal peritoneum, as inflammation extends beyond the diseased part. The character of the pain changes from nonspecific and diffuse to increasingly intense and more focally localised, as somatic innervation dominates the clinical picture.

During embryological development, visceral cell precursors migrate from their midline origin either side the neural tube (embryonic spinal cord) and come to lie eventually within their respective body cavities. Neural tissue precursors from the neural tube adjacent to these segments 'follow' the visceral precursors on their journey to innervate the mature organ. As a result, visceral organ innervation reflects the embryological origin of the visceral precursor cells and accounts for the transmission of visceral pain to spinal segments remote to the adjacent somatotomes. This concept of 'viscerotomes' explains why, for instance, testicular torsion may present early as ipsilateral flank pain, similar to renal colic or pyelonephritis, before localising to the scrotum, as the ipsilateral testis and kidney share a common embryological origin.

Although the exact mechanism of referred pain is not fully understood, it is believed in part to reflect a misinterpretation of the origin of pain impulses by the cerebral cortex at the level of the spinal cord. Both visceral and parietal pain pathways synapse with second order neurones in close proximity to each other within the spinal cord. The cerebral cortex 'mistakenly' interprets stimuli from visceral pathways as having originated from the more anatomically dominant parietal pathway. As a result, cardiac pain (which recruits C4-T5 spinal segments) may manifest as referred pain to the shoulder and arm (C4-6), as well as the upper abdomen (T3-5).

Differential diagnosis

There are many extra-abdominal causes of abdominal pain (*Table 1*). Although many conditions are infrequently encountered in clinical practice, the cardiac, pulmonary and diabetic/metabolic conditions are time critical, necessitating rapid patient evaluation, resuscitation and definitive management in a concurrent manner. This article will focus on these conditions, with particular attention on excluding

Table 1. Nonabdominal causes of abdominal pain^{6,7}

Cardiac	Haematologic
<ul style="list-style-type: none"> • myocardial ischaemia and infarction • myocarditis • endocarditis • congestive heart failure 	<ul style="list-style-type: none"> • sickle cell anaemia • haemolytic anaemia • Henoch-Schönlein purpura • acute leukaemia
Thoracic	Toxins
<ul style="list-style-type: none"> • pneumonia, pneumonitis • pulmonary embolism and infarction • pneumothorax • oesophageal rupture (Boerhaave syndrome) • pleurodynia (Bornholm disease) • emphysema • oesophagitis • oesophageal spasm 	<ul style="list-style-type: none"> • hypersensitivity reactions • envenomation (ie. snake, spider bite) • lead/heavy metal poisoning
Neurologic	Infections
<ul style="list-style-type: none"> • radiculitis: spinal cord or peripheral nerve tumours • abdominal epilepsy • tabes dorsalis 	<ul style="list-style-type: none"> • herpes zoster • osteomyelitis
Metabolic	Miscellaneous
<ul style="list-style-type: none"> • ketoacidosis (diabetic and alcoholic) • acute adrenal insufficiency • uraemia • hyperthyroidism • porphyria • hyperparathyroidism/hypercalcaemia 	<ul style="list-style-type: none"> • narcotic withdrawal • familial Mediterranean fever • heat stroke • psychiatric disorders • abdominal wall spasm/haematoma

acute coronary syndrome (ACS) as a cause of abdominal pain, and issues related to the patient who presents clinically 'unwell' with abdominal pain in whom the cause is unclear.

Clinical considerations and 'red flags'

The imprecise character of abdominal pain, and referred pain in particular, make a comprehensive review of all possible scenarios of extra-abdominal causes of abdominal pain difficult and beyond the scope of this review. The following provides practical issues for primary care physicians to help avoid common pitfalls, with specific focus on 'red flag' clinical and diagnostic features.

The ABCs

The immediate priority of any physician examining a patient with abdominal pain is to assess the patient's cardiopulmonary stability and need for urgent resuscitation. Determining the integrity of the patient's ABCs precedes (or occurs concurrently with) the more traditional approach of history taking and physical examination. In most cases, the assessment is quick and completed within the first few moments of 'eye balling' the patient as they walk into your room. It should follow, that any patient with haemodynamic instability or respiratory compromise requires urgent management, irrespective of the cause.



Demographic issues

Not all patients presenting with upper abdominal pain require extensive cardiac work-up or search for extra-abdominal causes of their symptoms, but caution should be exercised when dealing with specific patient populations. The elderly, diabetics, and female patients are known to be over represented in studies of patients with atypical features of ACS.⁸ Immunocompromised patients, especially those with HIV, are also at high risk of atypical presentations as a result of changes to their immune system, the presence of comorbidities and/or their treatment regimens.^{1,7}

In addition, the elderly present several diagnostic difficulties for the physician. They frequently have atypical manifestations of many disease entities, including intra-abdominal disease; are less likely to manifest specific signs and symptoms compared to younger patients; and may not be in a position to inform the clinician of their symptoms because of pre-existing cognitive impairment, physical frailty, or the effects of prescribed medications.⁴

History

A comprehensive history of the patient's symptoms remains the key in most cases to uncovering the aetiology of abdominal pain.¹ Deficiencies in obtaining and accurately documenting the patient's symptoms are more often cited as the cause of misdiagnosis in malpractice cases than are misinterpretation of the available data.¹ Unfortunately, the process is plagued with difficulties, including language and cultural differences, which may influence the accuracy of the communication and mutual understanding between the patient and the clinician.⁶

All patients with a past history of coronary artery disease (CAD) or significant cardiac risk factors must be evaluated further for a cardiac cause of their symptoms.⁷ The clinician must assume that patients with exertional features to their abdominal pain have ACS until proven otherwise.⁹ It is unwise to attribute the aetiology of anorexia, nausea or vomiting to a primary gastrointestinal cause. These symptoms are among the least useful in identifying a specific cause of abdominal pain.⁴ Nausea and vomiting occur commonly in ACS.¹⁰ Epigastric pain associated with food intake has been described in patients with severe CAD (in particular triple vessel and critical left main artery disease); and clinical response to antacids has been reported, falsely reassuring the clinician (and the patient) that symptoms are not cardiac in origin.¹¹

Physical examination

The physical examination begins with recording the vital signs (blood pressure, pulse rate, respiratory rate, and temperature). Pulse oximetry (the 'fifth' vital sign) should also be recorded where available. Patients with abnormal vital signs – in particular with features of inadequate perfusion (eg. hypotension, tachycardia or bradycardia), hypoxia and/or respiratory distress – require further evaluation irrespective of the cause. Unfortunately, individual abnormalities in the vital signs are neither sensitive nor specific enough to make a diagnosis,¹ but they do indicate that the patient has abnormal physiological parameters

that require further evaluation, explanation and treatment, which should include a search for extra-abdominal causes.

Patients in whom the abdominal pain is not reproducible on examination of the abdomen, and who appear distressed or remain clinically 'unwell', or in whom the physician is unable to make a reasonable intra-abdominal diagnosis, should undergo further assessment. This aims to exclude both extra-abdominal pathology such as cardiac or pulmonary disease,⁹ and more insidious intra-abdominal pathologies such as mesenteric ischaemia, which have equally catastrophic potential.²

Random blood glucose (sugar) level (BSL), like urinalysis, has essentially become an extension of the physical examination in modern practice. This accurate and simple test should be performed routinely on all diabetic patients presenting with abdominal pain, and should be considered in patients in whom diabetic ketoacidosis is suspected or to be excluded.

Cardiac investigations

Despite its limitations, the electrocardiogram (ECG) remains the first line investigation in the assessment of patients with suspected CAD.^{1,8} They are readily available, inexpensive, and can be interpreted by the primary care physician or faxed to specialists for urgent analysis if desired, making them a useful 'bedside' adjunct to the physical examination. A normal ECG in a patient with epigastric pain is reassuring, but given the sensitivity of the initial ECG is at best only 50% for detection of acute myocardial infarction,¹⁰ further evaluation should be undertaken if clinical suspicion remains high (ie. past history, significant risk factors, physiological compromise). This may involve transfer of the patient to an appropriate facility.

Continuous ECG monitoring and recording of vital signs is recommended in patients undergoing further cardiac evaluation of their abdominal pain. Serum markers of cardiac injury should be obtained. Troponin I or T are currently the assays of choice, and should be used instead of CK-MB.^{8,12} An elevated troponin assay is highly suspicious of ACS, but a negative assay taken within 4–6 hours of the onset of symptoms is not specific enough to exclude myocardial damage (ie. false negative rate high), and should be followed up by a repeat assay of at least 8 hours from onset of symptoms to be interpreted correctly.⁸ The patient should remain under medical supervision during this time, preferably with continuous monitoring, until active cardiac disease can be excluded. Management by an appropriate cardiac service will be necessary if abnormalities in the ECG or serum cardiac markers are detected or clinical concern remains high.

Respiratory examination

Examination of the chest, with particular attention to auscultation of the basal lung fields, should form part of the routine physical examination of patients with abdominal pain. Tachypnoea is a nonspecific finding that may be caused by both intra- and extra-abdominal aetiologies.¹ Nonabdominal causes of tachypnoea include



hypoxia (due to primary respiratory pathology), metabolic acidosis, sepsis, anaemia, hyperventilation and diaphragmatic pathologies. Hypoxia, irrespective of cause, requires urgent attention and treatment. Auscultation of the chest is neither sensitive nor specific enough to diagnose underlying pulmonary disease, and is subject to significant inter-observer variability. In such circumstances, plain film chest X-rays should be obtained – preferably in the erect posture – in order to visualise the lung parenchyma and identify areas of consolidation, effusion or pneumothorax. Further investigations may include urgent computerised tomography (CT), and less frequently chest ultrasound, as individual circumstances dictate.

Pneumonia involving the lower lobes of the lung may present with upper abdominal pain, and can on occasion be the primary symptom of the patient. Pain associated with pneumothorax or pulmonary embolism less frequently present as isolated upper abdominal pain.

Laboratory investigations

Unfortunately there are no specific laboratory investigations that will categorically rule in or rule out extra-abdominal causes of abdominal pain, especially in the elderly.² Laboratory investigations are helpful if they confirm the physician's clinical impressions, but results that counter the physician's impression should not be used to influence clinical decision making. A normal leukocyte count (WCC) or C-reactive protein (CRP) should never be used as the decision trigger to discharge a patient from care who continues to remain clinically 'unwell'. Both tests are neither sensitive nor specific enough to be used in such a manner.¹ Between 30–40% of elderly patients with acute cholecystitis and 20% with acute appendicitis will have normal WCC,¹³ and 28% of all patients with nonspecific abdominal pain will have an elevated WCC of no clinical consequence.^{2,4}

For patients who appear critically unwell, and in whom the diagnosis remains elusive, the physician should consider arterial blood gas analysis to help identify patients at risk of physiological dysfunction. The arterial gas analysis gives the physician a 'physiological' snapshot in time of the patient, and although a normal results does not preclude early onset pathology, normal pH and oxygen levels are reassuring that the patient is maintaining physiological homeostasis. The detection of hypoxia and/or acidosis is an indication of significant physiological dysfunction, necessitating urgent attention irrespective of the cause.²

Conclusion

The diagnostic accuracy of physicians assessing abdominal pain using clinical signs and symptoms and preliminary investigations is very poor.^{4,14} When preliminary and final diagnoses are compared, clinical accuracy has been reported to be 50–65% overall, and as low as 30% in the elderly.⁴ All patients presenting with abdominal pain who appear 'unwell', and in whom the diagnosis is unclear, require more extensive evaluation, looking for intra- and extra-abdominal pathology as a cause. As part of the latter group of diseases, all patients should at least have their vital signs noted, an ECG taken and BSL recorded.

The need to perform further investigations, such as plain film chest X-ray; laboratory investigations, including cardiac markers; or more sophisticated imaging such as CT or ultrasound, will depend on individual patient circumstances, but should be seriously considered for high risk patient populations and those who remain 'unwell' without an adequate explanation.

Observation of the patient over 8–10 hours has been demonstrated to improve diagnostic accuracy in borderline cases of appendicitis,¹⁴ and should be considered a viable patient disposition option in those whom either an extra-abdominal cause is being considered, or who remain unwell without a cause. The most appropriate method of observation or early review will depend on both patient factors and practical factors such as location, time and facilities. The discharge of patients from medical care with incorrect diagnosis has been associated with increased complication rates and mortality in all age groups, especially in the elderly where mortality doubles.¹³ In the absence of a clear working diagnosis and a patient who appears clinically 'unwell', the physician should maintain a high index of suspicion and be prepared to seek assistance from specialist care.

Conflict of interest: none declared.

References

- Colucciello SA, Lukens TW, Morgan DL. Assessing abdominal pain in adults: a rational, cost-effective, and evidence-based strategy. *Emergency Medicine Practice* 1999;1:1–20.
- Kamin R, Nowicki TA, Courtney DS, Powers RD. Pearls and pitfalls in the emergency department evaluation of abdominal pain. *Emerg Med Clin North Am* 2003;21:61–72.
- Yamamoto W, Kono H, Maekawa H, Fukui T. The relationship between abdominal pain regions and specific diseases: an epidemiologic approach to clinical practice. *J Epidemiol* 1997;7:27–32.
- Gallagher EJ. Acute abdominal pain. In: Tintinalli JE, Kelen GD, Stapczynski JS, editors. *Emergency medicine: a comprehensive study guide*. 6th edn. New York: McGraw-Hill Companies, 2004;487–501.
- Staniland JR, Ditchburn J, de Dombal FT. Clinical presentation of acute abdomen: study of 600 patients. *BMJ* 1972;3:393–8.
- King KE, Wightman JM. Abdominal pain. In: Marx JA, editor. *Rosen's emergency medicine: concepts and clinical practice*. 6th edn. Philadelphia: Mosby Elsevier, 2006;209–18.
- Fishman M, Aronson M. Differential diagnosis of abdominal pain in adults. *UpToDate* 2008;16.1. Available at www.uptodate.com/patients/content/topic.do?topicKey=-9FTC32rdzms/x9.
- Acute Coronary Syndrome Guidelines Working Group. Guidelines for the management of acute coronary syndromes 2006. *Med J Aust* 2006;184:S9–29.
- Roy S, Weimersheimer P. Nonoperative causes of abdominal pain. *Surg Clin North Am* 1997;77:1433–54.
- Ghaemmaghami C, Brady W. Pitfalls in the emergency department diagnosis of acute myocardial infarction. *Emerg Med Clin North Am* 2001;19:351–69.
- Winters M, Katzen S. Identifying chest pain emergencies in the primary care setting. *Prim Care* 2006;33:625–42.
- Reeder GS, Kennedy HL. Diagnosis of an acute myocardial infarction. *UpToDate* 2008;16.1 Available at www.uptodate.com/patients/content/topic.do?topicKey=-CDGA3ovp_U&selectedTitle=18-150&source=search_result.
- McNamara R. Abdominal pain in the elderly. In: Tintinalli JE, Kelen GD, Stapczynski JS, editors. *Emergency medicine: a comprehensive study guide*. 6th edn. New York: McGraw-Hill Companies, 2004;501–5.
- Graff LG, Robinson D. Abdominal pain and emergency department evaluation. *Emerg Med Clin North Am* 2001;19:123–36.