Clinical Cases Uncovered series

Get the most from clinical practice, with Clinical Cases Uncovered

No other series is quite like Clinical Cases Uncovered, where you can rehearse for life in clinical practice with easy-to-use and well-instructed walk-through scenarios. Each case is presented as you would see it and the use of real-life experiences means the decisions and outcomes are factually based. Along the way to determining a diagnosis and identifying treatments, you learn about variable symptoms, danger signs and get overviews of all the common, classical and atypical presentations.

Background to the subject and how to approach the patient are covered in an introductory section and once you have worked through the range of cases you can test yourself with a selection of MCQs, EMQs and SAQs. This distinct blend of learning means you will improve time and again, greatly enhancing your decision-making skills. With such a wide range of subjects covered you will soon see the benefit of the CCU approach.
Clinical Cases

Case 1  
A 19-year-old with abdominal pain and vomiting
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Kathryn, a 19-year-old student, who is usually fit and well, is admitted to accident and emergency (A&E) with a 2-day history of abdominal pain, vomiting and feeling generally unwell. She has lost 5 kg in weight over the past 3 weeks for no clear reason. There is no significant past medical history of note except for three episodes of urinary tract infection (UTI) over the past 6 months.

What are the differential diagnoses of abdominal pain and vomiting?

**Intra-abdominal pathology**
- Peptic ulcer disease
- Pancreatitis
- Cholecystitis and gall stones
- Appendicitis
- Ectopic pregnancy
- Intestinal obstruction
- Renal calculi and pyelonephritis

**Other conditions associated with abdominal pain but less likely to cause vomiting**
- Dysmenorrhea
- Pelvic inflammatory disease
- Inflammatory bowel disease
- Intra-abdominal arterial and venous thrombosis
- Ruptured saccular aneurysm (in older individuals)

**Endocrine causes of abdominal pain and vomiting**
- Diabetes mellitus complicated by diabetic ketoacidosis
- Hypoadrenalism
- Hypercalcaemia

What clinical features are associated with weight loss?
- Chronic infections and infestations: particularly in individuals with a deranged immune system, such as patients with AIDS
- Malignancy
- Diabetes mellitus
- Hyperthyroidism
- Malnutrition: uncommon in Western countries
- Degenerative neurological and muscular diseases

It is impossible to give an accurate diagnosis at this stage and a more detailed history and careful physical examination is of paramount importance in order to establish the correct diagnosis.

What questions will you ask?
- Has the pain and vomiting started recently or has it been occurring for weeks, months or years?
- Was the onset of pain sudden or gradual?
- What is the pain like and how severe is it?
- Where is the pain localized?
- Does anything relieve the pain?
- Has a new treatment been introduced recently?
- Are there any associated symptoms (review of systems)?

On further questioning, Kathryn tells you that the abdominal pain was gradual in onset over 4-6 h, generalized and cramp-like, with severity varying between 2/10 and 4/10. Nausea and vomiting preceded the abdominal pain by 6 h or so. Kathryn has been on oral contraceptive pills (OCP) for 18 months and her last withdrawal bleed was 1 week ago.

Does this help with the diagnosis?
- The gradual onset of pain and low severity (although this is subjective) make a surgical cause for the pain less likely, but do not fully rule it out. For example, appendi-
citis may initially present with gradual and cramp-like abdominal pain. Also, it should be noted that in some cases of acute abdomen, the symptoms may be relatively mild and this can be seen in older patients or in individuals who are on steroid treatment
• The combination of OCP use and a recent normal withdrawal bleeding rules out dysmenorrhea and ectopic pregnancy as causes for Kathryn’s pain

During review of systems and on further questioning, Kathryn tells you that she had polyuria up to 15 times/day and nocturia 6 times/night for 2 weeks prior to her current presentation. She is a non-smoker and drinks up to 20 units of alcohol per week. Family history includes pernicious anaemia in her uncle and hypothyroidism in her mother.

Does this help with the diagnosis?
Polyuria can be secondary to a number of causes. In this case, a urinary tract infection may have caused the abdominal pain and polyuria, which is usually associated with dysuria, and only small amounts of urine are passed on each occasion.

Box 16 Other causes of polyuria

- Electrolyte abnormalities such as hypercalcaemia
- Chronic renal disease
- Endocrine disease such as diabetes insipidus (lack of, or ineffective, antidiuretic hormone)
- Osmotic diuresis due to high plasma glucose levels (diabetes mellitus)
- The use of drugs such as lithium and demeclocycline

In this patient:
• Hypercalcaemia can indeed cause abdominal pain and polyuria but this condition is infrequently seen in a young person. Nevertheless, it should be checked out
• There is no indication that this patient has chronic renal disease but this should certainly be excluded. The fact that she had three UTIs in 6 months may indicate a pathology in the urinary tract. However, urinary infections are common in female individuals, particularly if they are sexually active
• Diabetes insipidus is a recognized cause of polyuria but is not associated with abdominal pain or vomiting and therefore this diagnosis is unlikely
• Type 1 diabetes mellitus (T1DM) is a strong possibility. Diabetic ketoacidosis (DKA), a complication of T1DM, classically presents with:
  - Nausea
  - Vomiting
  - Abdominal pain
  - Associated symptoms: a few days/weeks history of polyuria and polydipsia (known as osmotic symptoms), and weight loss

The family history of autoimmunity further supports this diagnosis, as it suggests a genetic predisposition to autoimmune disease in Kathryn

Kathryn deteriorates and becomes slightly confused, with a drop in her Glasgow Coma Scale (GCS) from 15/15 to 13/15 (E3, V5, M5). On examination, she is tired, dehydrated, tachycardic at 112 beats/min, has a temperature of 36.6°C, blood pressure of 115/70 mmHg, with a postural drop of 20/10 mmHg, and respiratory rate of 32/min, with otherwise normal chest examination. Cardiac auscultation is normal, and abdominal palpation reveals minimal generalized tenderness with no rigidity, guarding or rebound tenderness.

How do her clinical findings help with the diagnosis?
• Kathryn is clinically dehydrated with tachycardia and a postural drop in blood pressure indicating significant fluid loss
• The tachypnea is a matter of concern and could be due to a primary lung pathology or secondary causes. A primary lung pathology in this patient may be:
  - Chest infection may result in tachypnea and pneumonia is a recognized cause of abdominal pain. However, she is apyrexial and chest auscultation is unremarkable, making this an unlikely diagnosis
  - Pulmonary embolus causes tachypnea and hypotension, and OCP use is a known risk factor for thromboembolism. However, Kathryn has no chest pain, whereas abdominal pain and vomiting are not usually features of pulmonary embolism
  - Metabolic acidosis: the respiratory system compensates for metabolic acidosis by increasing the respiratory rate to blow off CO₂ resulting in respiratory alkalosis, which may fully or partially compensate for the metabolic acidosis. Causes of metabolic acidosis are summarized in Table 27 and DKA is one cause, which seems to fit the diagnosis. A distinctive ketotic-smelling breath can further aid the diagnosis of DKA.
• Abdominal examination revealed only minimal generalized tenderness with no signs of acute abdomen (rigidity, guarding or rebound tenderness), which is reassuring
Table 27 Causes of metabolic acidosis.

<table>
<thead>
<tr>
<th>Metabolic acidosis with increased anion gap (Increased acid production/Ingestion)</th>
<th>Metabolic acidosis with normal anion gap (Imbalance between HCO₃⁻ and H⁺ Ions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lactic acidosis: increased production of lactate due to infection, shock or hypoxia</td>
<td>Renal tubular acidosis: loss of HCO₃⁻ or excessive absorption of H⁺ ions</td>
</tr>
<tr>
<td>Uraemic acidosis: renal failure</td>
<td>Diarrhoea: loss of HCO₃⁻</td>
</tr>
<tr>
<td>Ketotic acidosis: diabetes or alcohol</td>
<td>Pancreatic fistula: loss of HCO₃⁻</td>
</tr>
<tr>
<td>Toxins and drugs: salicylate overdose, ethylene glycol and methanol ingestion</td>
<td>Addison's disease: excessive absorption of H⁺ ions</td>
</tr>
<tr>
<td>Drugs: acetozolamide: excessive absorption of H⁺ ions</td>
<td></td>
</tr>
</tbody>
</table>

and makes a surgical cause for Kathryn's abdominal pain less likely.

**What test(s) would you request to confirm the diagnosis?**

Taken together, the most likely diagnosis here is DKA, which is characterized by:

- Metabolic acidosis
- Raised plasma glucose
- Dehydration
- Increased ketone production

Therefore, the following tests should be requested:

- Venous bicarbonate and pH: bicarbonate falls in DKA to <15 mmol/L and can be as low as 1 mmol/L, resulting in a variable degree of acidosis. In early DKA, pH can be normal due to compensated respiratory alkalosis. A common hospital practice is to take an arterial blood sample for bicarbonate and pH measurement (arterial blood gas analysis), which is unnecessary unless a primary lung pathology precipitating DKA is suspected.
- Plasma glucose: this is elevated in DKA. Capillary glucose (finger-prick glucose) can be initially done to give a quick result but it should always be followed by plasma glucose measurement.
- U&Es: in DKA these show:
  - High or high-normal urea (due to dehydration)
  - High or high-normal potassium (due to acidosis)
  - In advanced or more severe cases, creatinine can be elevated (due to pre-renal renal failure)
- Urine dipstick: detection of large amounts of ketone bodies in the urine aids the diagnosis of DKA

In addition to DKA-specific tests, other blood tests should be requested, including:

- Full blood count: usually requested in ill individuals attending A&E, and can aid in the diagnosis of anaemia (low haemoglobin) and infection (raised white cells). It is worth bearing in mind that infection may precipitate DKA
  - Cultures: DKA can be precipitated by an infection and, therefore, blood and urine cultures (as well as culture of sputum if respiratory symptoms are present) are usually requested on presentation, unless the cause of DKA is clear (non-compliance with insulin injections for example)
  - Chest X-ray: to rule chest infection as the precipitating cause. This is perhaps not necessary in newly diagnosed patients with no reason to suspect a respiratory pathology
- Electrocardiogram: this should be requested in patients with diabetes particularly in the older age group as silent myocardial infarction (myocardial infarction with no chest pain) is common in these patients and may precipitate DKA. A myocardial infarction is unlikely here due to Kathryn's young age but an ECG may show abnormalities and arrhythmias consistent with electrolyte disturbances (hyperkalaemia for example), which may require urgent attention
- Abdominal X-ray (AXR): this is usually requested in patients attending A&E with severe abdominal pain and vomiting to rule out intestinal obstruction and/or perforation. Opinions will differ, but an AXR is probably not necessary here as Kathryn has no signs to suggest an acute abdomen

**Blood, urine and radiological tests show the following:**

<table>
<thead>
<tr>
<th>Test</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>FBC</td>
<td>Hb 14.1 g/dL</td>
</tr>
<tr>
<td>WBC</td>
<td>23.3 × 10⁹/L (neutrophils 18.2 × 10⁹/L)</td>
</tr>
<tr>
<td>Platelets</td>
<td>380 × 10⁹/L</td>
</tr>
</tbody>
</table>
U&Es:  
- Na 131 mmol/l.
- K 5.4 mmol/l.
- Urea 10.1 mmol/l.
- Creatinine 124 μmol/l.
- Bicarbonate 9 mmol/l.
- pH 7.16
- Glucose 22 mmol/l.
- Amylase normal.
- CXR clear.
- AXR normal.
- Urine dipstick: ketones +++, glucose ++, RBC −, WBC −, nitrates −.

**Box 17 Precipitants of DKA**

- New diagnosis of T1DM in 20% of cases
- In a known diabetic patient, DKA can be due to:
  - Infection in 35% cases
  - Non-compliance with insulin injection in 30%
  - Errors in insulin administration and dose calculation in 15%
  - In a minority of patients, DKA may be precipitated by an ischaemic event such as myocardial infarction.

**How do you interpret these results?**

- Kathryn has high WBC with elevated neutrophil counts suggesting an underlying infection. However, DKA patients may have very high WBC count without associated infection, which normalizes once DKA is adequately treated. In some cases, infection is difficult to rule out, and this is why a septic screen is requested (blood and urine cultures, sputum culture if any, CXR), followed by antibiotic cover if the suspicion of infection is high.

- The diagnosis of metabolic acidosis is evident from the combination of low pH and low bicarbonate.

- The metabolic acidosis together with high plasma glucose and strongly positive urinary ketones confirm the diagnosis of DKA.
  - Patients with DKA excrete large amounts of ketones in their urine due to deranged glucose metabolism and the production of abnormally high levels of ketone bodies: acetone, acetoacetate, β-hydroxybuturate.
  - Urine dip testing methods check only for acetone and acetoacetate.

- Other abnormalities include:
  - High urea consistent with dehydration.
  - High potassium secondary to acidosis, which shifts the potassium from the intracellular compartment to the extracellular space. Potassium falls with successful treatment of DKA and this should be monitored carefully as detailed below.
  - Marginally low sodium is commonly seen in patients with DKA due to high plasma glucose and this normalizes with treatment of the condition and the fall in blood sugar.

- Urine dipstick is positive for ketones and glucose consistent with the diagnosis of DKA. Of note is the absence of pyuria and nitrates on urine dipstick, making the diagnosis of a urinary tract infection unlikely.

**How would you manage this patient?**

The management should be directed to:

- Correct the metabolic abnormality by replacing:
  - Fluid
  - Insulin
  - Potassium

- Treat the precipitating cause (if any)

- Monitor the patient carefully during treatment of DKA.

  Local hospital guidelines should be followed for the management of patients with DKA.

**Fluid**

- Fluid replacement usually starts with normal saline (0.9%): 1 L over the first h, 1 L over 2 h then 1 L every 4–6 h, with careful monitoring of the patient clinical status and urine output.

- Fluid replacement should be modified according to the clinical status of the patient. For example, if the patient has a very low blood pressure at presentation with signs of shock, initial fluid replacement should be more aggressive.

- Normal saline should continue until the blood glucose drops below 12–15 mmol/l (different protocols use different cut-offs), when saline should be substituted with 5% glucose. This helps to restore normal energy metabolism and clears the blood of ketone bodies, thereby normalizing the pH.

**Potassium**

- Monitoring of potassium status is very important as failure to replace potassium can result in severe hypokalaemia, which may cause cardiac arrhythmias, potentially resulting in death.

- Serum potassium is usually elevated on initial presentation due to the presence of acidosis, but it quickly drops after the initiation of treatment (both insulin replace-
Table 28: An example of sliding scale insulin. This is only a guide and different sliding scales can be used as some individuals require higher doses of insulin whereas others need less.

<table>
<thead>
<tr>
<th>Capillary glucose (mmol/L)</th>
<th>Insulin dose (units/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;4.0</td>
<td>0.5 (with i.v. dextrose)</td>
</tr>
<tr>
<td>4.1–10.0</td>
<td>2</td>
</tr>
<tr>
<td>10.0–16.0</td>
<td>4</td>
</tr>
<tr>
<td>&gt;16.0</td>
<td>6</td>
</tr>
</tbody>
</table>

- In around one-third, DKA is due to other causes such as infection or myocardial infarction and these conditions should be treated appropriately.

Other measures
- Low-dose heparin to prevent thromboembolism is recommended by some, but there is no clear evidence to support this practice, which is unnecessary unless other risk factors exist (prolonged immobility).
- A nasogastric tube should be inserted into patients with protracted vomiting.

Monitoring
- Capillary glucose should be checked hourly.
- Potassium levels should be regularly assessed and this can be done using the following time points as a guide: presentation (time 0 h), 2 h, 4 h, 8 h, 16 h and 24 h.
- Both venous bicarbonate and glucose can also be checked at the same time points as above to assess response to treatment.
- The above time points can be modified according to the severity of the DKA and the response to treatment.

The management of DKA is summarized in Fig. 37 (Part 1, p. 57).

What is the prognosis in this case?
Prognosis is very good in uncomplicated DKA and the mortality rate is less than 3%.

Kathryn improves after initial treatment, her BP normalizes and her confusion clears. However, she starts feeling very weak 12 h after admission and complains of palpitations. An ECG is shown (Fig. 39).

What complication has occurred? How should this be treated?
- ECG shows changes consistent with hypokalaemia:
  - ST depression
  - Presence of U wave after T wave
- Plasma potassium should be checked and corrected urgently:
  - Supplementation of potassium to i.v. fluid
  - A cardiac monitor should be attached to the patient

Twenty hours after admission, Kathryn’s blood glucose levels fall to 6.8 mmol/L and the acidosis clears. However, Kathryn becomes suddenly confused and agitated and subsequently GCS drops to 6.
What urgent test would you request at this stage?
- A drop of GCS and neurological signs in a treated DKA patient should raise the suspicion of cerebral oedema, which may be secondary to over-enthusiastic fluid replacement
- This complication is rarely seen in adults but it is not uncommon in children
- If cerebral oedema is suspected, urgent CT/MRI of the head should be requested, and if the diagnosis is confirmed:
  - The patient should be immediately transferred to an intensive care unit
  - Should be treated with mannitol and dexamethasone, which may help to reduce the cerebral oedema
  - Unfortunately, prognosis is poor once this complication occurs, with mortality approaching 90% in adults

What does long-term management of a type 1 diabetes patient involve?
- Ensure strict glucose control
  - Monitored by home sugar readings and glycosylated haemoglobin levels (HbA1c). The input of the diabetes nurse specialist is important to provide support to patients and help with adjustments of insulin doses
  - Most commonly used insulin injection regimens in type 1 diabetes include four daily injections (one long acting and three short acting insulin with meals) or two daily injections with a mixture of short and long acting insulin preparations. An insulin pump can be used for those with erratic glucose control
  - Good diabetes control is important to avoid long-term microvascular complications (retinopathy, nephropathy and neuropathy) as well as macrovascular complications (coronary artery disease, cerebrovascular and peripheral vascular disease)
  - Tight glucose control should not be achieved at the expense of increasing hypoglycaemia, which can be dangerous and sometimes fatal
- Screen for the development of microvascular complications
  - Yearly retinal screening
  - Yearly check of urinary microalbumin: usually done on an early morning urine sample with results expressed as albumin/creatinine ratio (ACR)
  - Yearly foot examination to rule out neuropathy: usually done using monofilament test
- Watch for/prevent the development of macrovascular complications
  - Have a role threshold for investigating individuals with suspected vascular pathology
  - Add statin treatment to patients above the age of 40 or earlier in those at high risk
  - Adding aspirin treatment to high-risk individuals is of debatable benefit
  - Aggressively treat hypertension

CASE REVIEW
Kathryn is a young woman admitted to hospital with short history of abdominal pain, vomiting and feeling unwell. Also, there is a history of significant weight loss over a 3-week period. The differential diagnosis of abdominal pain is wide and a detailed history together with a full examination usually help to rule out a surgical cause, which should be diagnosed early as delays can have serious consequences. There is nothing in the history or examination to suggest an acute abdomen, and, therefore, a surgical cause for this patient's symptoms is less likely.

Continued
Kathryn's clinical condition subsequently deteriorates and her Glasgow Coma Scale (GCS) drops from 15/15 to 13/15. She is found to be clinically dehydrated, tachycardic and tachypnoeic. Taken together, diabetic ketoacidosis is suspected, which is subsequently confirmed by demonstrating low plasma pH and bicarbonate levels, raised glucose and significant ketonuria. Appropriate tests are arranged to rule out an underlying infection (CXR, blood cultures) and she is treated with intravenous fluid and insulin with initial improvement in her symptoms. However, 12 h after her admission, she starts complaining of palpitations; an ECG shows an abnormal U wave and a depressed ST segment. This was due to hypokalaemia and inadequate monitoring of her potassium levels, which can fall very rapidly during DKA treatment. She is treated with intravenous fluid containing potassium, which stabilizes her condition, but she deteriorates again 24 h after admission and her GCS drops to 6. This raises the possibility of cerebral oedema and an urgent CT or MRI of the head should be requested. If confirmed this complication should be aggressively treated in intensive care settings.

DKA is a common condition and frequently the first presentation of diabetes. Monitoring is a vital part in the management, in order to avoid the development of serious complications, which may have tragic consequences.

**KEY POINTS**

- Diabetic ketoacidosis (DKA) is a relatively common condition, which can be life-threatening
- Abdominal pain, vomiting and tachypnoea (air hunger) are typical manifestations of this diabetic complication
- DKA should be suspected in any type 1 diabetes patient with gastrointestinal symptoms. In those with no history of diabetes, DKA should be suspected in individuals, particularly the young, who are acutely unwell and have the above symptoms
- Around one-third of patients with DKA present as a new diagnosis of diabetes, one-third are due to errors or non-compliance with insulin administration in a known diabetes patient, and in the final third the DKA arises secondary to infections or an ischaemic event
- A history of osmotic symptoms, with or without weight loss, should prompt appropriate investigations to rule out diabetes as a cause
- Biochemical abnormalities in DKA include:
  - Raised blood glucose
  - Low bicarbonate with or without low pH
  - Low pCO2 on arterial blood gas analysis (not necessary to make the diagnosis)
  - Heavy ketonuria
- Treatments for DKA include:
  - Intravenous fluid (with adequate potassium replacement)
  - Intravenous insulin
  - Treat the precipitating cause
  - Monitoring of glucose, bicarbonate and potassium is paramount to assess response to treatment
  - Intravenous fluid and insulin should be continued until bicarbonate normalizes and the urine is ketone-free
- Serious complications of DKA include:
  - Hypokalaemia (common)
  - Cerebral oedema (rare)
- Long-term management of type 1 diabetes patients should include:
  - Good glucose control
  - Screen for the development of complications: for microvascular disease use retinal screening, urinary microalbumin and regular foot examination; for macrovascular disease, promptly investigate potential vascular pathology, initiate statin treatment for individuals at high risk or those above the age of 40 and aggressively treat hypertension and microalbuminuria